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S. V. HORECKY

3,072,386

AUTOMATIC SPEED ADJUSTMENT FOR CLOTHES DRYERS

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FIG. 1

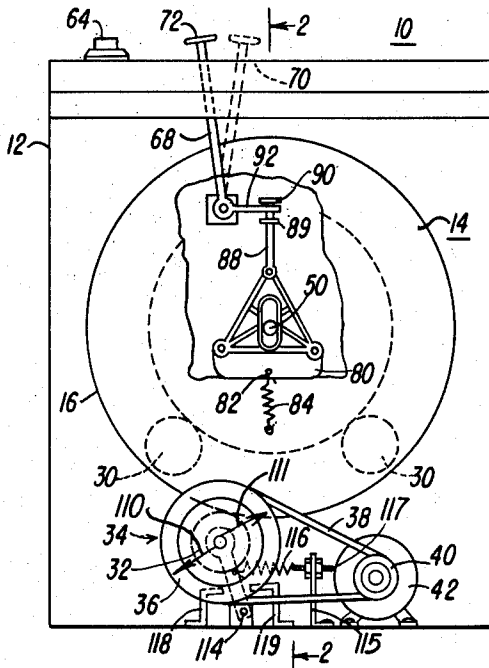


FIG. 2

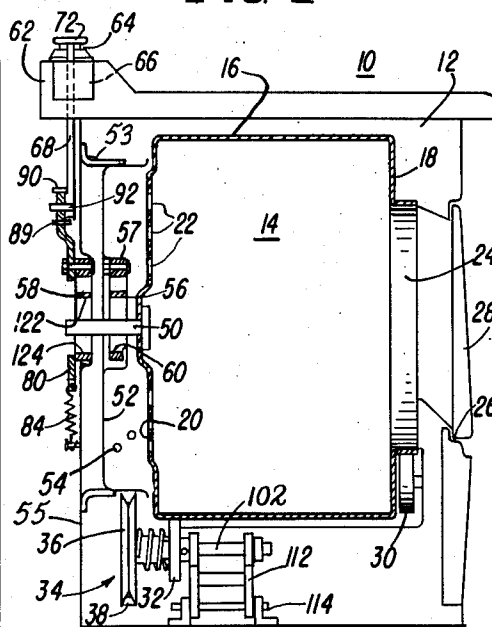


FIG. 3

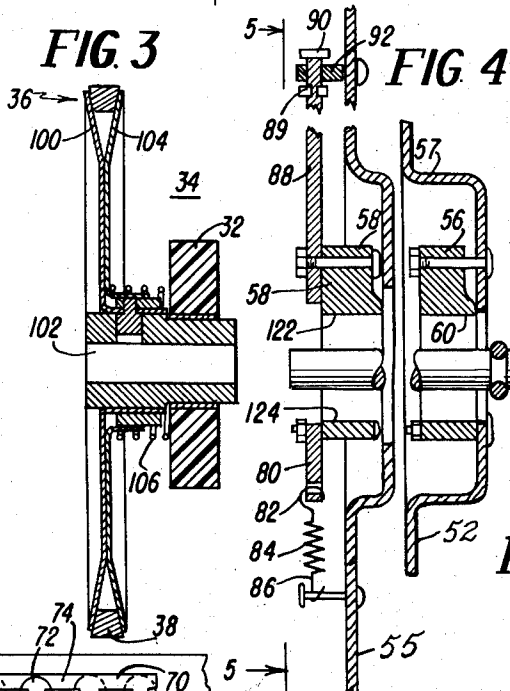


FIG. 4

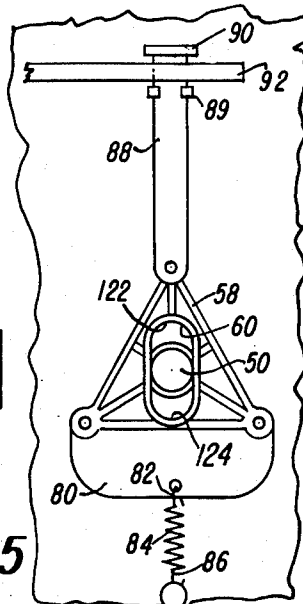


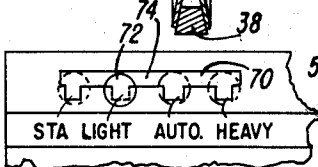
FIG. 5

INVENTOR.
STANLEY V. HORECKY

BY
Andrew P. Hubbard

ATTY.

FIG. 6



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AUTOMATIC SPEED ADJUSTMENT FOR CLOTHES DRYERS

Stanley V. Horecky, Villa Park, Ill., assignor to General Electric Company, a corporation of New York
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12 Claims. (259—81)

The present invention relates to clothes drying machines and more particularly to arrangements for supporting and driving the clothes bearing receptacle during drying.

An object of my invention is to provide an improved clothes dryer which will adjust its speed of drum rotation commensurate with the weight of clothes borne therein.

A further object of the invention is to provide an improved clothes dryer which has controls allowing the selection of speed to be determined either by the user or automatically.

It is a further object of the invention to provide a simplified multiple speed drive mechanism for use in conjunction with cylindrical containers rotatable on a nonvertical axis.

A still further object of the invention is to provide an improved automatically adjusting, multiple-speed drive mechanism driven by a constant speed drive motor.

It is generally known that in drying clothes, optimum results can be obtained if the speed of rotation of the drying drum can be varied depending on the weight of the clothes load being dried. In the usual situation, where only a single rotative speed is used for all clothes loads, the single speed chosen for use must of necessity be a compromise speed. The speed chosen nominally will be about midway between the optimum speed for smaller loads and that for larger loads. For example, where a 26-inch diameter drum is used, a compromise speed of 51 r.p.m. is employed. However, with this size drum, it has been found that light loads are dried most efficiently with a minimum of clothes balling or tangling at a dryer drum rotative speed of approximately 46 r.p.m. For heavier loads, a more efficient tumbling pattern and resultant faster drying has been found to occur with drum speeds of approximately 54 r.p.m. Although speed differences of this order may appear inconsequential, this difference at the low speeds employed has been found to have considerable effect on drying time and efficiency.

The speed-adjustment mechanism embodying the present invention is applied to an otherwise conventional clothes dryer having a clothes drying drum rotatable on a non-vertical axis during its drying operation. The drum is cradled at the front on a pair of rollers beneath the drum periphery. At the rear, the drum carries an axial stub shaft extending rearwardly. The stub shaft is journaled within a vertically elongate bearing which allows vertical movement of the stub shaft without interference with rotation of the drum. The drum is driven by contact between the drum periphery and a drive roller which in turn is directly driven by a variable speed pulley of conventional design. The pulley is belt driven from a single speed motor equipped with a fixed-center drive pulley. Means are provided whereby the tension on the belt between the pulleys is responsive to changes in the weight of the drum. As the weight of the drum and clothes therein increases, for example, the center-to-center distance between the drive pulley and the variable speed pulley increases, thereby automatically changing the pulley ratio and consequently the speed of the drive roller and the drum.

Further means have been provided to allow manual setting of the drum operating speeds. These means in-

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clude a bell crank actuatable from the machine exterior which positions the shaft for manually set speeds or for automatic weight sensing selection. This manual setting also allows the machine to be raised off the drive roller if stationary or non-tumbling drying is preferred.

The invention both as to its organization and principle of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings in which:

FIG. 1 is a rear elevational, partially sectioned view of a dryer embodying my invention with the back cover of the machine removed;

FIG. 2 is a cross-sectional view of the dryer taken along the lines 2—2 of FIG. 1;

FIG. 3 is a side sectional elevation of the construction of the driven pulley of FIGS. 1 and 2;

FIG. 4 is a side sectional elevation of the rear axial bearing structure of the drum as enlarged from the showing of FIG. 2 to enumerate further detail;

FIG. 5 is a rear elevational view of the drum bearing structure as enlarged from the showing of FIG. 1;

FIG. 6 is a partial top view of the speed control panel of FIGS. 1 and 2.

Referring now to FIGS. 1 and 2, there is shown the dryer structure 10 including an outer appearance cabinet 12. Within the appearance cabinet there is provided a clothes tumbling drum 14 mounted for rotation within the cabinet on a substantially horizontal axis. The drum comprises a cylinder with imperforate sidewall 16, and annular front and rear walls 18 and 20 respectively. Rear wall 20 includes a plurality of annular spaced openings 22 to allow inlet air to be introduced into the drum. Front wall 18 includes a circular access opening 24 coincident in lateral area with an access opening 26 in the outer cabinet. The cabinet opening is closed by a hinged door 28 movable from a closed position covering cabinet access opening 26 to an open position allowing access to the interior of the drum for loading and unloading.

The front of the drum is rotatably supported within the outer cabinet by a pair of spaced idler wheels 30 which are rotatably supported by the cabinet and are positioned to cradle the front end of drum sidewall 16. At the rear of the drum there is provided a single roller 32 which is positioned to contact sidewall 16 near the rear thereof. This roller wheel is mounted eccentrically relative to the drum axis, but coaxially and concentrically to a variable speed pulley assembly 34. The pulley assembly includes a variable pitch pulley wheel 36 about which is fitted in driving relation an endless drive belt 38. The drive belt is further fitted about a pulley 40 which is mounted on the drive shaft of a drive motor 42. As utilized herein, motor 42 is a conventional uni-directional motor, of the single speed type. Of the motors which will function properly in this invention, a 4-pole appliance motor which has an unloaded speed of approximately 1750 r.p.m. is used herein. It is obvious that a two-speed motor, or a single speed motor with additional speed changing transmission, could be employed to effect a greater multiplicity of output drum speeds, although the range of speeds provided by the illustrated embodiment is fully satisfactory. A blower (not shown), driven by the motor will ordinarily be provided to circulate drying air through the drum. The construction and application of the air flow system is not germane to the subject matter of my invention and has therefore been omitted to simplify the disclosure.

The rear of the drum is allowed limited vertical displacement while secured against sideward movement, by an axial stub shaft 50 journaled in a vertically elongated bearing presently described. Shaft 50 may be secured

to rear wall 20 in any generally known manner. The shaft extends rearwardly of the rear drum wall through shroud 52 which in turn encloses an air heater 54 and suitable air intake and dispersing means (not shown). This shroud is secured by suitable brackets 53 to the stationary rear wall 55 of cabinet 12. In this way both the shroud and heaters are fixed in position adjacent the rear wall 20 of the rotating drum 14. The shaft further extends through the dual rear bearings. These bearings include an inner stationary bearing 56 secured by suitable means to an inwardly directed emboss 57 of the rear wall of shroud 52 and a second bearing 58. Bearing 58 is mounted about stub shaft 50 and is constrained to slide motion in a vertical direction along the outside of rear wall 55 of cabinet 12, as will be explained more fully. Both bearings are virtually identical in shape and each includes a vertically upright oblong opening 60 (see FIG. 5) through which the stub shaft 50 fits rotatably. The shaft may be maintained against forward and rear movement by suitable snap rings and the like. These bearings may be fabricated from material which is inherently lubricous to remove the necessity of external lubrication.

Continuing in the general description of the machine, there is provided at the top of the cabinet a control section 62 which includes a knob 64 manually manipulatable from the exterior of the machine. The knob 64 may actuate conventional timing mechanisms 66 for providing a controlled drying cycle of any known type. Adjacent control knob 64, there is provided an operation selection lever 68 extending vertically from the control section through stepped slot 70 and terminating in a handle section 72. The slot 70 as shown in FIG. 6 includes a transverse continuous section 74 with stepped extensions leading forwardly of section 74. These extensions are labeled Stationary, Light, Auto and Heavy respectively and each is shaped to retain lever 68 as the operator moves the lever thereto.

Referring now to the slideable linkage of outer bearing 58 (FIGS. 4 and 5), this bearing has fixedly secured to its lower surface a spacer plate 80. The plate near its lower edge includes a hole through which one end 82 of a coiled tension spring 84 is hooked. The opposite end 86 of tension spring 84 is hooked through a suitable opening in rear wall 55. In this way bearing 58 is vertically movable and biased downwardly. At its upper end, bearing 58 has permanently secured to it, a slide bar 88 which includes near its upper end a shoulder 89 or fitted snap ring and terminates at its upper end in an expanded section 90. Between the shoulder and expanded section, the slide bar extends through a suitable bearing opening in the horizontal arm of a bell crank 92, the vertical arm of which is the previously mentioned selection lever 68. The bell crank is pivotally secured to the rear wall of the cabinet at the point of juncture of the bell crank arms. By this linkage, movement of the handle to the Stationary, left-most position in FIGS. 1 and 6 raises crank arm 92 and consequently will raise bearing 58. The relationship between the shaft 50 and bearing 58 is such that the shaft will be raised consequent to the raising of bearing 58. Conversely movement to the Heavy or right-most position will tend to depress shaft 50. The effect of these movements will be explained in greater detail subsequently.

Turning now to FIG. 3, the speed changing pulley 36 of the variable pitch type includes a stationary disk 100 which may be press-fitted or otherwise firmly secured to pulley shaft 102. The sliding disk 104 is splined or otherwise mounted on shaft 102 in a manner allowing axial movement along the shaft. These disks at their abutting surfaces form an annular groove in which endless V belt 38 is fitted. Disk 104 is biased toward the stationary disk by a compression spring 106 compressed between disk 104 and roller 32. Roller 32 is also pressed or otherwise secured onto shaft 102 to be driven at the rotational speed of pulley 36.

Pulley assembly 34 is mounted for motion toward and

away from the fixed pulley 40, indicated by arrows 110 and 111 of FIG. 1. A convenient mounting, which makes the pulley assembly immediately responsive to changes in drum weight, includes pivot arms 112 which are secured for joint pivotal motion about pivot shaft 114. A tension spring 116 anchored at the cabinet base and fixed to one of the arms 112, nominally biases the pulley assembly 34 toward drum 14 so that the roller 32 is in good driving engagement with the sidewall 16 of the drum. Travel limiting arms 118 and 119 are poised on either side of said one pivot arm 112 to limit the arc through which pivot arm 112 may rotate.

Obviously, the tension of spring 116 influences the response of the speed change pulley assembly to drum load changes. It is therefore desirable to secure the fixed end of the spring to a suitable tension adjustment means, such as the pin 117 adjustably secured to the anchor 115.

As previously noted, the invention allows the operator manually to select a high speed drying operation, low speed drying operation, stationary drum drying, or provides for automatic speed selection governed solely by the weight of the drum and contents. The operator first sets the timer to initiate the drive motor for the timed period required. Considering manual speed selection as the first example, the operator then sets the output speed desired.

First, it will be assumed that the operator has a heavy load which may be considered as a load which would weigh 8 or more pounds dry and when removed from a conventional extraction-type washing machine would contain approximately 100% moisture or 8 pounds of moisture. To dry this load most efficiently, a speed of approximately 54 r.p.m. is desirable where as in the exemplified case, a drum of 26 inch diameter is used. This speed is consistent with parameters taught in U.S. Patent 2,165,884, issued to J. W. Chamberlin et al. on July 11, 1939. The lever 68 should then be set to the Heavy or right-most position. Movement of the handle to this position rotates bell crank arm 92 downwardly, driving slide bar 88 and bearing 58 downwardly. This action forces the upper annular edge 122 of slot 60 downwardly against the stub shaft 50 which in turn forces the rear end of the drum 14 to travel downwardly. Because of the geometry of the drive roller and variable speed pulley mounting relation to the drum axis, the pulley assembly 34 is pivoted in the direction indicated by arrow 110. As the assembly moves to the left away from motor 42, belt 38 tends to tighten and moves inwardly toward pulley shaft 102, spreading the respective pulley disks 100 and 104 against the bias of compression spring 106. The movement of belt 38 inwardly toward the pulley shaft decreases the pitch diameter of pulley 36 and increases the center distance between pulleys 36 and 40. This change varies the ratio between pulleys to one at which the variable speed pulley is driven at a higher speed. The amount of displacement of the variable speed pulley assembly for a specific movement of the lever 68 will be substantially uniform, making it possible to establish the higher tumbling speed with reasonable accuracy.

If the operator sets the machine to low speed for light loads (6 pounds or less of dry clothes preferably) the lever 68 is set to the Light position whereby crank arm 92 is physically moved upwardly. This upward motion causes slide bar 88 to move upwardly elevating bearing 58. Lower edge 124 of slot 63 exerts upward pressure on shaft 50 raising the shaft and consequently the rear end of the drum moves upwardly decreasing pressure on roller 32. The tension spring 116 draws pulley pivot arm 112 in the direction indicated by arrow 111 which in turn increases the pitch diameter of pulley 36 and thereby decreases the pulley center distance. Tension on belt 38 is partially released and the belt will ride outwardly on pulley 36, which decreases the center distance between

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pulleys effecting a lower output speed. The lever movement and resulting action of the speed change assembly 34 are such that the drum rotational speed is of the order of 46 r.p.m.

When it is desired that drying occur with no rotation of the drum, the drying action taking place only due to the forced circulation of heated air, lever 68 is moved to the Stationary or left-most position. This movement raises crank arm 92, slide bar 88, bearing 58 and consequently stub shaft 50. In this position, shaft 50 is raised to a greater degree than in the Light position and the drum is disengaged from roller 32. Pivot arm 112 strikes right limit stop 119 and can move no further. Driving contact between the roller 32 and sidewall 16 is disengaged by this upward movement of the drum off the drive roller and the drum will remain stationary until reset.

If it is desired that the drum speed be set automatically, lever 68 is moved to the Automatic position which through the previously described linkage sets bearing 58 in a neutral position. The position of shaft 50 within bearing 58 is determined essentially by the tension of spring 116 as determined by the weight of the drum and its contents. As previously indicated, this will determine the drum speed. Now, with a heavy weight of clothes in the drum, drum 14 and its shaft 50 will by gravity, and in opposition to the spring 116, move downwardly within the bearings to assume a position adjacent the lower edge 124 of slot 60. In this lowered position, pressure is exerted on roller 32 to move pivot arm 112 in the direction indicated by arrow 110. This action tends to increase the tension on belt 38 as described above, and accordingly the pulley ratio is changed to a value at which the drum speed will approximate 54 r.p.m. This automatic response to the weight of the drum and its contents approximates the action of the pulley mechanism for the Heavy setting.

If with a setting on Automatic, the load is in the intermediate range of 6 to 8 pounds of clothes dry (12 to 16 pounds wet) the shaft will assume the intermediate position of FIGS. 4 and 5 and the spring 116 will draw the arms 112 to the right, whereby the resulting intermediate pulley ratio will set the drum speed at roughly 51 r.p.m.

If the load within the drum is less than 6 pounds of dry clothes (12 pounds wet) and the lever 68 is set to Automatic, shaft 50 will rise within the slot 60 toward upper edge 122. The resulting retraction of the spring will rotate arms 112 additionally to the right, whereupon the belt 38 will decrease its tension allowing plates 104 and 100 to contact (position of FIG. 3) setting the pulley ratio so that a drum speed of approximately 46 r.p.m. will be effected.

The structure shown embodying the invention has been found to be a most practical and efficient one although it is conceded that other configurations could be employed. For example, the expandable pulley could be coupled directly to the motor and the fixed distance pulley set on drive roller.

It will be recalled that a typical "heavy" load may comprise 8 pounds of clothes, containing 8 pounds of water. Under "Automatic" operation, this load initially establishes the tumbling operation at 54 r.p.m. As the drying operation proceeds and the drum load diminishes due to evaporation of the water, the drum speed, also, will diminish, until at a bone dry condition of the clothes, the dryer will be rotating at approximately 51 r.p.m., the optimum speed for tumbling that weight of clothes. Thus, the automatic setting provides for a substantially continuous speed adjustment to maintain the optimum relationship between drum speed and clothes load.

What is claimed is:

1. In a clothes drying machine of the type including a cylindrical clothes receptacle rotatable on a non-vertical axis and adapted to contain wet clothes to be dried, means for rotating said receptacle by frictional contact

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with the surface of said cylinder, drive means comprising a motor rotatable at a constant speed, means driven by said motor for transmitting power at a given speed ratio to said contact means for rotating said contact means at a first speed thereby driving said receptacle at a first speed, means responsive to the downward motion of said receptacle resulting from a greater weight of said receptacle and its contents for increasing the speed transmission ratio from said constant speed motor for rotating said contact means at a speed faster than said first speed to thereby drive said receptacle at a speed faster than said first speed.

2. In a clothes drying machine of the type which includes a cylindrical clothes bearing drum rotatable on a non-vertical axis, a drive roller driveably contacting the periphery of the drum cylinder, said roller pivotally mounted responsive to the downward force of said drum, a driven pulley wheel secured coaxially with said roller, a single speed motor, a drive pulley rotated by said motor, a drive belt driveably connecting said driven and drive pulleys, a first stationary sheave on said driven pulley, and a second sheave biased normally toward said first sheave and movable against said bias on downward movement of said drum to move away from said first sheave whereby to change the pulley ratio between said drive and driven pulleys, said roller and driven pulley pivotal on said drum downward movement away from said drive pulley to maintain tension on said connecting belt.

3. In a clothes drying machine of the type which includes a cylindrical clothes bearing drum rotatable on a non-vertical axis, a drive roller driveably contacting the periphery of the drum cylinder, means for pivotally mounting said roller whereby said roller is responsive to the gravitational force of said drum to move downwardly, a driven pulley wheel secured coaxially with said roller for motion therewith, a drive motor, a drive pulley rotated by said motor, a drive belt driveably connecting said driven and drive pulleys, a first sheave on said driven pulley, and a second sheave biased normally toward said first sheave to maintain a first pulley ratio between said pulleys, said second sheave movable against said bias on further downward movement of said drum to move away from said first sheave whereby to change the pulley ratio between said drive and driven pulleys, said roller and driven pulley pivotal on said drum further downward movement away from said drive pulley to maintain tension on said connecting belt at said changed pulley ratio.

4. In a clothes drying machine of the type which includes a cylindrical clothes bearing drum rotatable on a non-vertical axis, a drive roller driveably contacting the periphery of the drum cylinder on one side of the drum center line, said roller pivotally mounted responsive to the downward force of said drum to move away from said center line, a driven pulley wheel secured coaxially and co-rotatively with said roller, a single speed motor, a drive pulley rotated by said motor, said drive pulley positioned on the opposite side of the center line of drum from that of said drive roller, a drive belt driveably connecting said driven and drive pulleys, a first stationary sheave on said driven pulley, and a second sheave biased normally toward said first sheave and movable against said bias on downward movement of said drum to move away from said first sheave whereby to change the pulley ratio between said drive and driven pulleys which in turn is responsive to downward movement of said drum for pivoting said roller and driven pulley in a direction away from the center line of said drum and also away from said drive pulley to maintain tension on said connecting belt.

5. In a clothes drying machine of the type including a cylindrical clothes bearing drum rotatable on a non-vertical axis; a mechanism for driving said drum at one of a multiplicity of speeds comprising a drive motor having at least one constant speed, a drive pulley directly coupled to said motor to be driven at the rotative speed of said

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motor, a belt driven by said pulley, a driven pulley encircled by said belt, means for mounting said driven pulley pivotally for movement away from the axis of said drum on downward movement of said drum, a roller mounted co-rotatively to said driven pulley and adapted to contact said drum for rotating said drum thereby, means for normally maintaining a first pulley ratio between said first and second pulleys thereby driving said drum at a first speed, said maintaining means responsive to said movement of said driven pulley for changing said pulley ratio and thereby driving said drum at a second speed.

6. In a clothes drying apparatus comprising a rotatable cylindrical drum for containing clothes to be dried, means for rotating said drum at a plurality of speeds, selectively operable control means for providing manual and automatic selection of the rotative speed of said drum, said control means comprising a bell crank movable between a plurality of positions, a stub shaft axially secured to said drum, speed changing means responsive to the downward movement of said drum and its contents for changing the rotative speed of said drum responsive thereto, means responsive to movement of said bell crank to a first selective position of said control means for exerting pressure on said stub shaft to move said drum downwardly, said speed changer responsive to said downward drum movement for rotating said drum at a high speed, means responsive to movement of said bell crank to a second selective position for raising said stub shaft thereby lessening the downward force movement of said drum, said speed changer responsive to said lessened downward movement of said drum for rotating said drum at a second speed lower than said high speed, both said responsive means cooperatively responsive to movement of said bell crank to a third selective position for allowing automatic selection of drum speed.

7. In a clothes drying apparatus comprising a rotatable cylindrical drum for containing clothes to be dried, selectively operable control means for providing manual or automatic selection of the rotative speed of said drum, said control means comprising a bell crank movable between a plurality of positions, a stub shaft axially secured to said drum, speed changing means responsive to downward pressure exerted by said drum and its contents for changing the rotative speed of said drum responsive thereto, means responsive to movement of said bell crank to a first selective position of said control means for exerting pressure on said stub shaft to exert a great downward pressure on said drum, said speed changer responsive to said exerted great pressure for rotating said drum at a high speed, means responsive to movement of said bell crank to a second selective position for raising said stub shaft thereby lessening the downward force exerted by said drum to a lesser pressure, said speed changer responsive to said movement of said bell crank to said second position for rotating said drum at a second speed lower than said high speed, both said responsive means cooperatively responsive to movement of said bell crank to a third selective position for allowing selection of drum speed to be determined by the gravitational pressure exerted by the drum and its contents.

8. A clothes drying machine comprising in combination, a drum to contain a load of clothes to be dried, means for mounting said drum for rotation about a substantially horizontal axis, said mounting means constraining said drum to rotative motion and restricted vertical motion, a

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drive motor of the fixed speed type, a variable speed transmission between the motor and the drum for driving the drum, means for increasing or decreasing the output speed of said transmission according to the spacing between the axis of rotation of said motor and the axis of rotation of said transmission, and means responsive to the vertical deflection of said drum within said mounting means due to weight of the drum and its contents to effect such spacing variation.

9. A clothes drying machine as claimed in claim 8 in which said weight responsive means comprises a lever arm, means for mounting said lever arm for pivotal motion with respect to said motor on vertical deflection of said drum and its contacts for effecting said space variation.

10. A clothes drying machine comprising a drum to contain a load of clothes to be dried therein, means for mounting said drum for rotation about a substantially horizontal axis, said mounting means including means permitting vertical displacement of said rotation axis relative to a fixed datum plane while permitting continued rotation of said drum, means for resiliently biasing said drum to assume a maximum elevation of said axis of rotation under a minimum condition of loading of said drum and yielding to establish a minimum axis elevation under a maximum condition of loading, a fixed-speed motor disposed in a fixed location relative to said datum plane, a variable speed transmission interposed between said motor and said drum for rotating the drum thereby, and means responsive to the elevational position of the axis of rotation to adjust the transmission to rotate the drum at a greater or a lesser speed according to the axis position relative to said datum.

11. A clothes drying machine comprising, in combination, a clothes receiving drum, means for mounting said drum for rotation about an axis inclined from the vertical, said mounting means affording limited vertical displacement of said axis, driving means for rotating said drum, means including said driving means for resiliently supporting said drum whereby the vertical displacement of the axis of rotation thereof is a function of the weight of said drum and its contents, a motor fixed relative to said drum, and driving mechanism operatively associating said motor and said drum driving means, said driving mechanism including means effecting a change in the rotational speed of said driving means according to the direction and extent of displacement of said rotational axis.

12. A clothes drying machine, comprising, in combination, a clothes receiving drum, means for mounting said drum for rotation about a substantially horizontal axis, means for resiliently supporting said drum to effect an angular displacement of said axis of rotation according to the weight of said drum and contents, a drive motor fixed relative to said drum, means for rotating said drum, means for displacing said drum-rotating means relative to said motor according to the extent and direction of said angular displacement, and mechanism including a driving belt and sheaves respectively on said motor and said drum rotating means for changing the rotational speed of the latter pursuant to the displacement of said rotating means relative to said motor.

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