

Jan. 13, 1948.

N. B. WALES

2,434,476

COMBINED DRYER AND AUTOMATIC WASHER

Filed April 19, 1946

4 Sheets—Sheet 1

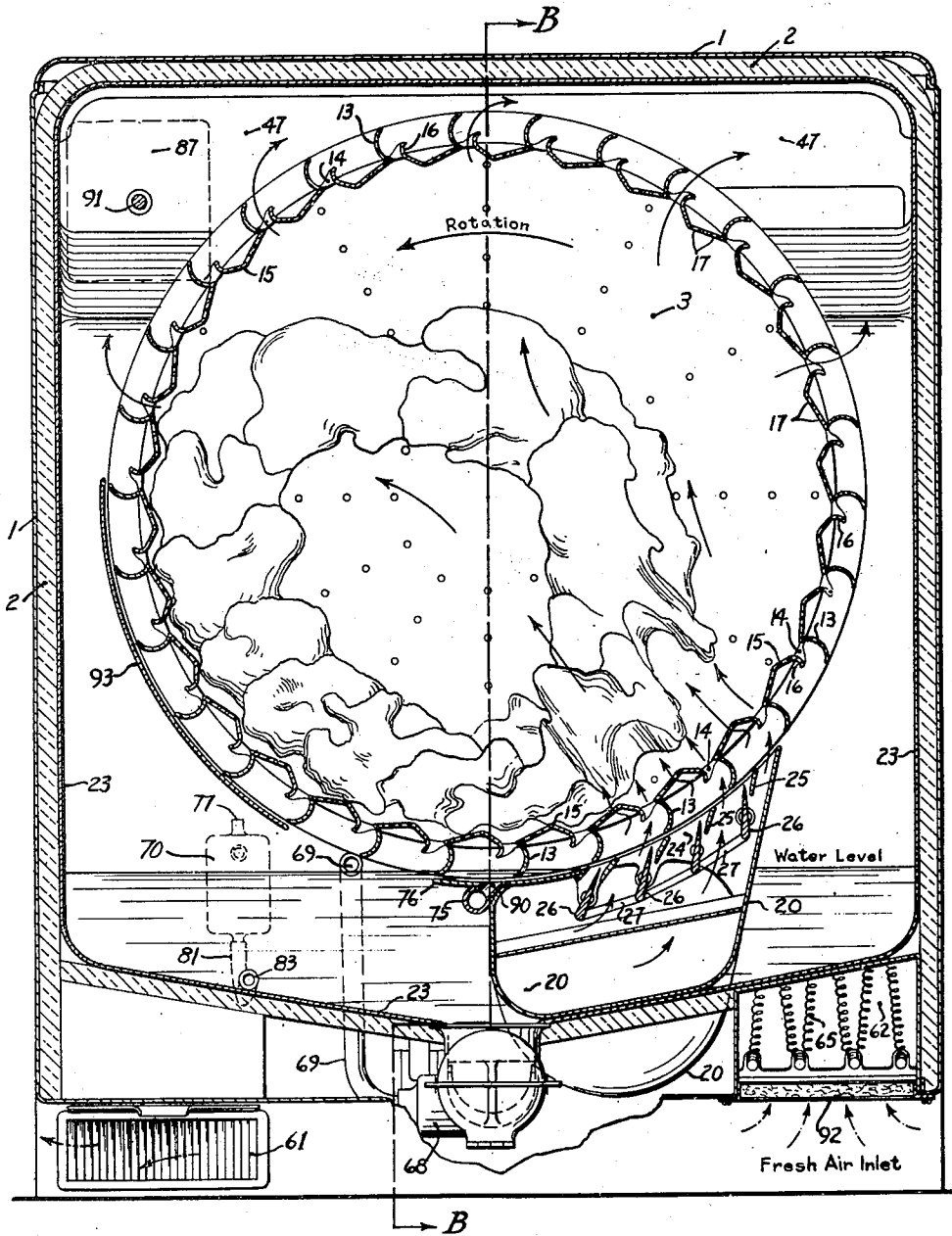


Fig. 1

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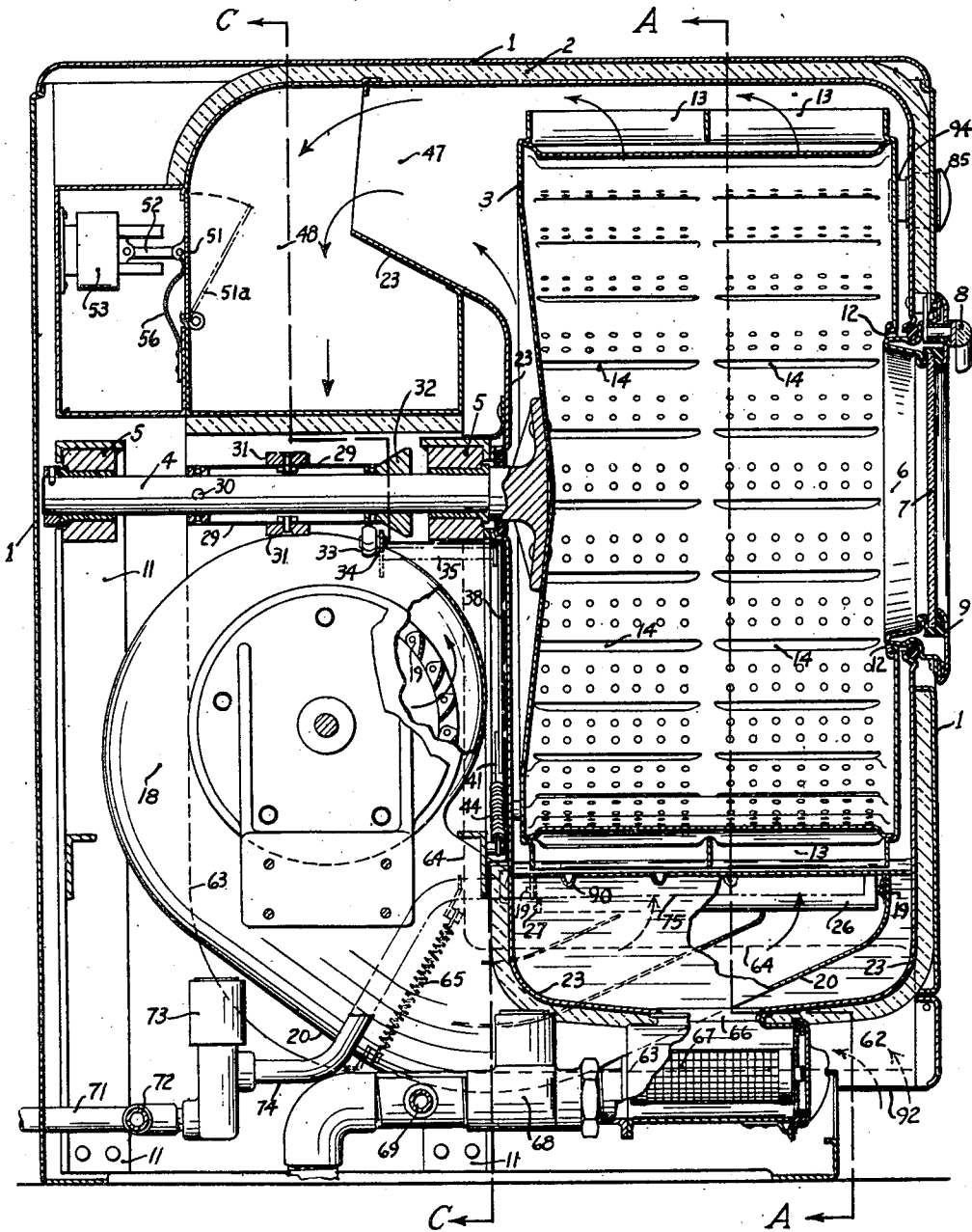


Fig. 2

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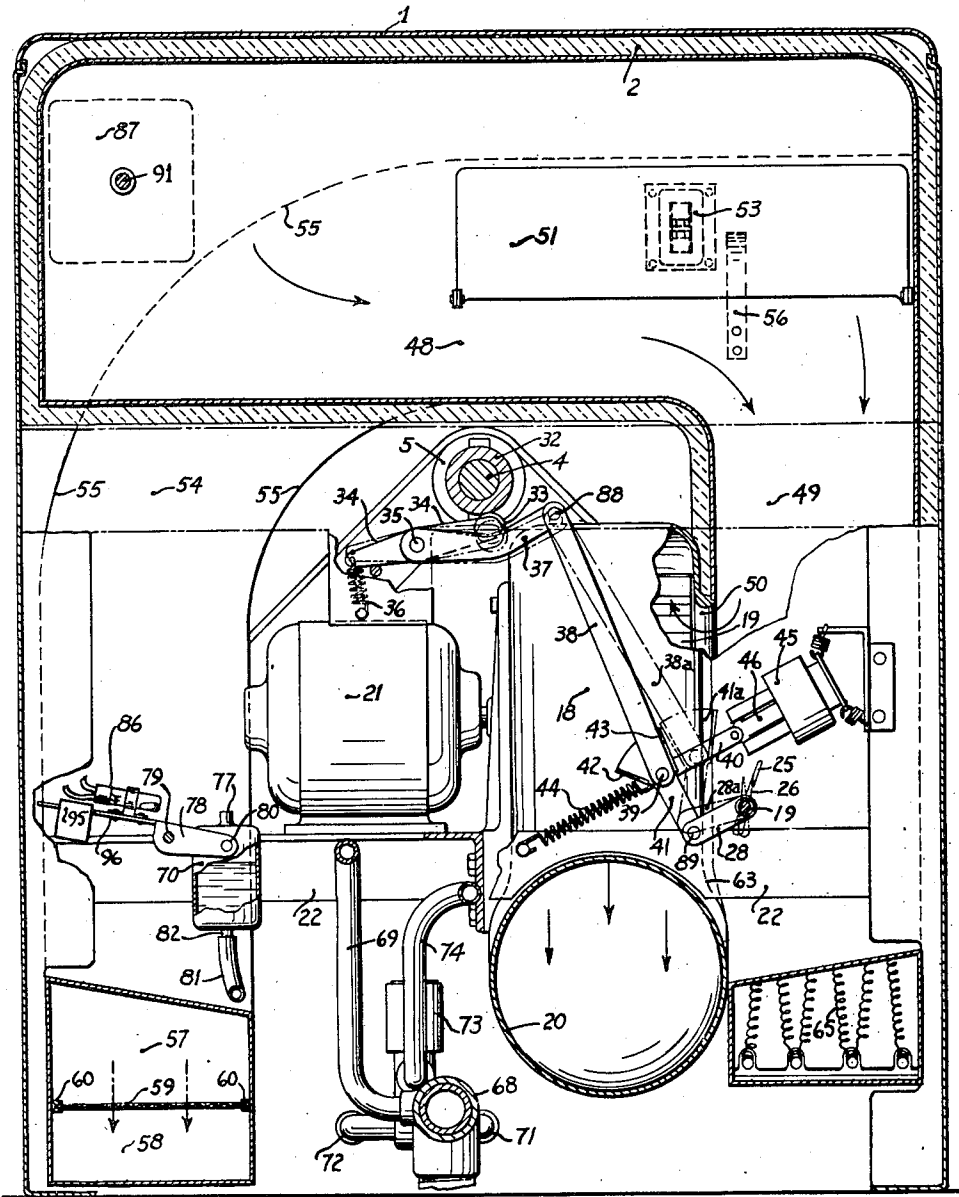


Fig. 3

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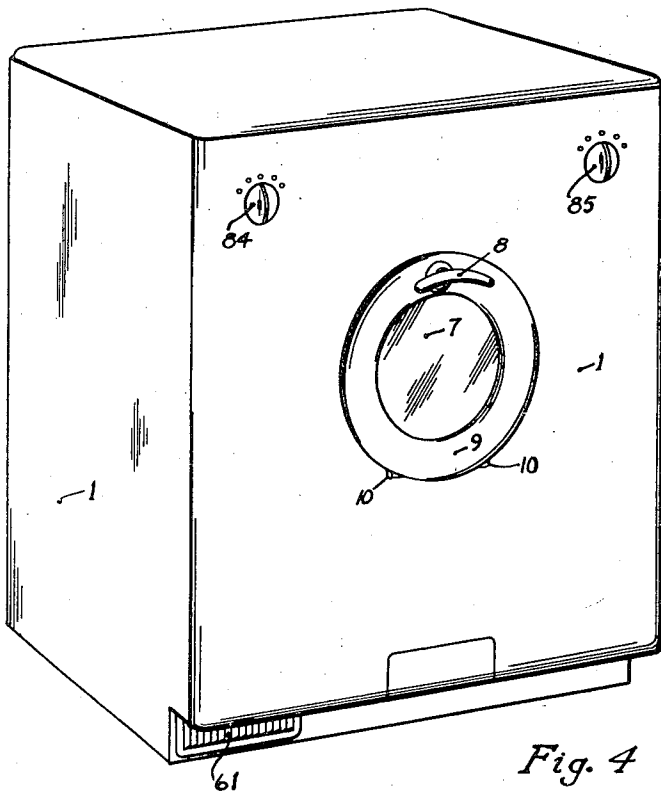


Fig. 4

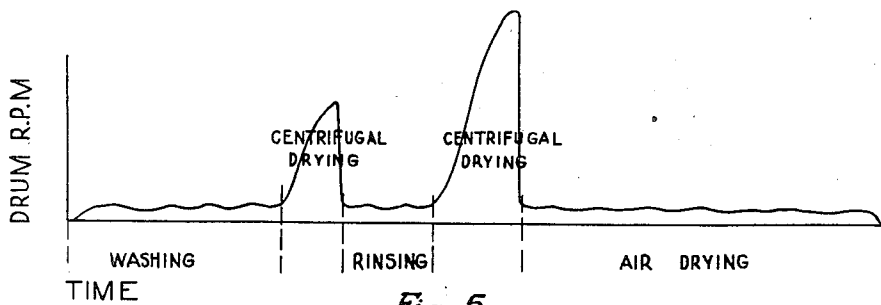


Fig. 5

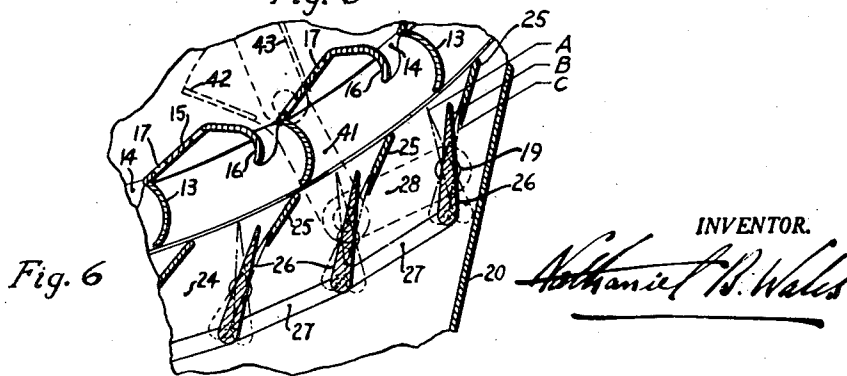


Fig. 6

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2,434,476

COMBINED DRYER AND AUTOMATIC WASHER

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Application April 19, 1946, Serial No. 663,501

5 Claims. (Cl. 68-19)

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This invention relates to a combined automatic dryer and revolving drum type washing machine.

A major object of the invention is to minimize the mechanism necessary to effectively wash, rinse, centrifugally extract the water content, and air-dry the clothes, or the like, in a predetermined sequence in one machine.

To accomplish this I not only utilize the blast of air from a motor driven blower as basically necessary for rapid air-drying, but also utilize this air blast to rotate the drum during the washing, rinsing, and centrifugal water extraction periods of the cycle.

This procedure results in new and desirable characteristics during the washing and rinsing of the clothes in the drum, as the blast of air together with the wash or rinse water entrained therewith impinges on turbine buckets, or vanes, incorporated in the outer circumference of the drum, and enters the drum at its circumference through proper slots formed therein, thus producing an effective washing and rinsing action.

Moreover, the air-blast and entrained water, by its angle of entry through the slots or orifices in the revolving drum, prevents tangling of the wash, due to the spreading and flotation action of the air-blast on the underside of the clothes, as they are permitted to fall by gravity due to the controlled air flow within the drum, into that segment of the drum's inner circumference under which the air blast nozzles are located. Thus in my invention an entirely different relationship of active forces is produced on the clothes within the drum than that which obtains when the drum is revolved by conventional mechanical means, wherein only the gravity-centrifugal component acts on the clothes.

Furthermore, the drum need not have as high a peripheral velocity during the washing and rinsing period as the conventional mechanically driven drum, which depends largely on the centrifugal component to circulate the clothes through a "working circuit" in the drum. The air blast utilized in this invention introduces an uplifting force which in penetrating the circumference of the drum and by its diffusion therein largely determines the circuit and placement of the clothes, and tends to elevate the clothes from the inner and lowermost periphery of the drum, and consequently the textiles are not lifted in the drum by the baffles or centrifugal force component alone as the drum revolves.

It is also to be noted that the predetermined water-level in the tub in this invention is below the circumference of the drum, and the wash-

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water entrained by the air-blast is the only water which contacts the clothes while being washed or rinsed. To insure a positive and large entrainment of the wash, or rinse water into the air-blast which impinges against the vanes, or buckets, on the drum and which in turn after deflection by the vanes enters the interior of the drum, and then impinges on the wash therein, I employ a scoop-like inclined platform, which at its lower portion is slightly below the predetermined water level in the wash tub, and over which the vanes travel as the drum revolves, whereby the water body thereon is scooped therefrom on to and over the open orifices of the air nozzles and entrained into the air-blast issuing from the nozzles.

I utilize one or more air vanes or guides which are positioned in the throat of the air-blast nozzle to control the angle of flow of the air as it leaves the nozzle. Other or equivalent construction, such as actually tipping the nozzle itself may be employed. By this means, I substantially change the angle of incidence of the air as it impinges on the vanes on the drum and by this deflection I am able to control its rotatable speed.

The relative movement of the air vanes or guides is controlled by a governor reflecting the revolutions per minute of the drum at all times during a complete automatic cycle of the machine. Furthermore, I superimpose on this automatic speed control a basic change of position of the air vanes or guides during the centrifugal extraction period in order to produce a maximum of torque on the drum. Thus I control the speed of the drum within broadly defined limits irrespective of the varying amount or weight of the wash being processed. I have found that it is preferable to vary both the angle of incidence, in respect to the vanes on the drum, and to a minor extent the effective area of the air nozzle to govern the change of drum speed for centrifugal extraction and particularly for the control during the wash and rinse periods. In this manner the volume of the wash or rinse water entrained into the air-stream issuing from the nozzles is not materially reduced by the deflection of the nozzles in relation to the entry angle of the vanes, as compared with its reduction if blower speed or an air-control or throttling damper was employed to govern the revolutions of the drum.

There occurs a relatively slow transition of revolutions per minute of the drum from its low speed during the washing and rinsing periods, to its greatly increased speed during the centrifugal extraction period. During centrifugal extraction air alone without any water entrainment is used

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to rotate the drum. This slow transition has been found to assist in a uniform and geometrical arrangement of the wash within the drum, so as to prevent vibration of the drum to an unbalanced load.

Another object of this invention is to provide a simple air circulation duct system wherein during the washing, rinsing and centrifugal water extraction periods a full charge of air is circulated within the case of the machine, passing in its circuit through the blower, air nozzle and drum, while during the air-drying period a saturated portion of the air circulating through this same circuit is expelled from the duct system and machine, and air of relatively low humidity content is automatically admitted to the duct system of the machine and heated to provide the necessary absorption vehicle for drying the wash.

A further object is to automatically clean the air, expelled during the air drying period of all lint which may be held in suspension therein so that it will not be deposited in the room in which the machine is located, or be re-circulated and catch on fire as it passes the electric heaters used to heat that portion of fresh air admitted into the machine.

It is to be noted that the water entry into the tub to supply the wash and rinse water is positioned so that it falls directly on the water-scoop platform so that washing action of the clothes may start by the rotation of the drum while the clothes are still comparatively dry and the starting torque is low, and without waiting for the tub to fill to its normal level.

Further objects and pertinent details will be more specifically described and illustrated in the following specifications and drawings, in which:

Figure 1 is a front elevation of the machine taken in section on line A—A in Figure 2, showing the "working circuit" of the clothes in the drum during the washing and rinsing periods.

Figure 2 is a side elevation taken in section on line B—B in Figure 1 to show the motor driven blower and its air discharge through a duct in the base of the wash tub leading to the nozzles so directed as to permit the air discharge therefrom to impinge on the vanes positioned on the outer circumference of the drum.

Figure 3 is a section in elevation taken on line C—C in Figure 2. This view clearly shows both the automatic centrifugal and cycle controls for adjusting the air nozzles.

Figure 4 is a perspective view of the combined dryer and washer showing the cyclic and air drying temperature manual control knobs as well as the saturated air-discharge grille.

Figure 5 is a plotted graph of the speed of the processing drum during the complete washing and drying cycle illustrating the gradual increase of R. P. M. of the drum during the centrifugal drying periods.

Figure 6 is an enlarged fragment of that portion of Figure 1 showing the air control vanes, or guides, which are incorporated in the mouth of the air discharge nozzle to vary the angle of the air discharge against the buckets on the circumference of the drum.

Referring more specifically to the several drawings, similar numerals refer to similar parts as shown therein.

In Figure 1, numeral 1 is the case of the machine; 2 indicates insulation to prevent radiation of heat, especially required during the air drying periods; 3 is the rotating processing chamber or drum. A shaft 4 suitably secured to drum 3 is

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journalled in bearings 5 which are supported by angle iron pedestals 11. An aperture 6 in case 1 forms the entry into the drum 3 through a registering orifice 12. A door 7 formed of a rim 9 with a glass plate secured thereto is mounted on case 1 by hinges 10, see Figure 4. A locking handle 8 in rim 9 locks the door closed when the machine is in operation.

On the outside circumference of drum 3 are buckets or vanes 13, so positioned that the inner edge of each vane 13 is adjacent to orifice 14 formed in the circumference of the drum 3 to permit free entry of the air and entrained water after deflection by impinging on vanes 13. In forming orifices 14, the metal on the circumference of drum 3 is forced inwardly to form the baffles 15 and the edge of the metal forming the following edge of orifice 14, in terms of the rotation of drum 3, see arrow in Figure 1, is curved outwardly to form a secondary smaller vane 16 and small orifices 17 are pierced in the metal forming the baffles 15 to permit additional entry of air and water.

Referring to Figure 3, the air blower 18 suitably supported by frame member 22, is directly connected to electric motor 21. The air discharge duct 20, see Figures 1 and 2, enters the tub 23 and terminates in the nozzle orifice 24. Fixed partitions or air guides 25, virtually subdivide the nozzle orifice 24 into several orifices in which the adjustable air deflector vanes 26 are positioned. The deflector vanes 26 are suitably positioned in swivel bearings 19 and are connected one to the other by members 27, so that all move in unison. The deflector vane 26 to the extreme right in Figure 6 is connected at its swivel bearing 19 to lever 28, shown in phantom as it is positioned on the outer side of tub 23, see also Figure 3, which is a section taken on line C—C wherein the particular deflector vane 26 referred to, is shown in phantom.

In order to govern the speed of the drum at all times during a complete processing cycle to compensate for varying amounts of wash inserted in the drum, the conventional centrifugal governor 29, see Figure 2, is employed. Governor 29 is secured to drum shaft 4 by pin 30. When the weights 31 move outward from shaft 4 in varying degree in accordance with the R. P. M. of drum 3, the floating cam sleeve 32, shown in that position which it assumes when motionless, is moved towards the contacting roller 33.

It must be understood that the contour of the cam sleeve 32 is so formed in respect to contacting roller 33 that during the washing, rinsing and air-drying periods assuming the drum speed is 30 R. P. M., this desired drum speed is attained by the deflection of the air vane elements 26 which is accomplished by the following mechanism:

Cam 32 contacts roller 33. Roller 33 is mounted on one end of lever arm 34, see Figure 3, which is secured to and pivoted on shaft 35, suitably journalled. Spring 36, one end of which is secured to the frame of the machine, maintains roller 33 in the position as shown in Figure 2 by its connection with arm 34. As roller 33 is displaced by its contact with cam 32, shaft 35 is rotated. On the opposite end of shaft 35 is secured lever 37 which in turn is connected by a bearing pin 38 to link 38, link 38 is connected to pin 39, which moveably connects link 40 with limiting movement link 41. Link 41 is fan-shaped on its upper end with the raised limiting stop edges 42 and 43, which contact in either one

of its two positions, as shown in Figure 3, with link 38.

Spring 44 one end of which is connected to a frame member in the machine, and the other end secured to pin 39, exerts a pull in one direction on this toggle linkage and the movement of the pull of spring 44 is limited by edge 43 contacting link 38. Solenoid 45 suitably mounted on the frame of the machine is connected through link 40 to pin 39 and when energized exerts a pull on pin 39 in the opposite direction which overcomes spring 44 and causes links 38 and 41 to assume that position shown in dotted lines when link 38 contacts edge 42.

Lever 38 linked to member 41 by pin 39 then moves into position 28a, and as lever 28 is secured to deflector 26 through its pivoted bearing 19, and referring to Figure 6 air-deflector vane 26 is moved away from position B toward position A, and due to connecting links 27 all the air-deflector vanes 26 move likewise. This movement of deflector 26 causes the air-blast and entrained water to be deflected on to the buckets 13 at an angle which is less efficient in generating torque on the drum 3, thus tending with a given load of wash to reduce the speed of drum 3.

However, during the centrifugal extraction period when air alone is utilized to rotate the drum 3 and a maximum of torque is required to spin the drum 3, electric solenoid 45 is energized by the cyclic electric control circuit, which will be described further on, and as the armature 46 is drawn within the solenoid 45 by such energization, link 40 connecting armature 46 with the limiting stop link 41, overcomes the tension on spring 44 and links 38 and 41 move into the dotted positions 38a and 41a respectively, causing lever 28 to move to the dotted position 28a and the air deflection vane 26 to move from position A to position C, which position of the deflector vane 26 produces the most efficient angle for the air leaving nozzle 24 to impinge on the buckets or vanes 13 and thus generates maximum torque on drum 3. However, if the speed of drum 3 becomes excessive, the governor 29 will cause, through mechanism which has already been described, a movement of air deflector vane 26 from position C towards position B and thus reduce the speed of the drum during centrifugal extraction.

It is to be noted that the air escapes from the washing tub 23, see Figures 1 and 2, after it has passed through drum 3, and through duct passage 47 during the washing, rinsing, and centrifugal extraction periods and flows downward via 48 and passage 49, see Figure 3, into the suction orifice 50 of blower 18 and is thus rapidly recirculated.

During the air-drying period, see Figure 2, the cyclic electric control system de-energizes solenoid 53 allowing link 52 to open damper 51 under activation of spring 56 to the position shown in dotted lines 51a. As damper 51 moves into position 51a it restricts the air passage 48 formed between the opened damper and the upper flaring portion of tub 23 and saturated air enters open damper 51 and passes through duct 54 defined by lines 55 in Figure 3.

Duct 54 terminates in horizontal duct 57 which leads to the front of the machine. A lint screen 59 is slideably retained by supports 60 and the expelled saturated air is forced through screen 59 and enters the lower duct 58 which registers at its front end with grille 61 seen in Figure 4.

Conversely when damper 51 is open during the air-drying period as has just been described and

referring to Figure 3, the suction from blower 18 through orifice 50 due to the slight restriction formed in passage 48 causes fresh air to be induced through grille 92, see Figure 2, and the air flows up through duct 62 as defined by dotted lines 63 and 64 to blower suction inlet 50, comingling with that portion of the circulating air that is not expelled through damper 51.

The electric air heater 65 is positioned in air inlet duct 62 and during the air drying period is suitably energized. In the bottom of washing tub 23 is drain opening 66 which communicates with a conventional strainer fixture 67 to free the drain water from any substance which would interfere with the normal operation of solenoid actuated drain valve 68. An overflow drain pipe 69 enters the tub 23, see Figure 1, at a point registering with the water level therein, controlled by water level control 70 which will be presently described.

A cold water supply pipe 71 and a hot water supply pipe 72 connect into the solenoid operated water supply valve 73. A pipe 74 conveys the water from valve 73 to a supply water distributor 75, see Figure 1. A curved platform 76 which is submerged except at that end which is adjacent to nozzle 24 and which may be one-quarter of an inch above the normal water level in tub 23 so that water will not enter duct 20 if the blower is not in operation serves, when the vanes 13 are moving across its extent as a water scoop to positively deliver a substantial volume of water across the air nozzle orifices to be entrained therein. Supply water distributor 75 is connected through the floor of platform 76 at orifices 90 so that as soon as solenoid water supply valve 73 is opened after the motor operated blower 18 is started, water entering on platform 76 is at once transferred on to the textiles in drum 3.

A stationary air deflector 93, see Figure 1, is so positioned as to direct upwardly the air currents and particularly their discharge from within the drum to allow the wash to contact the inner periphery of drum 3 and lodge on the baffles in that section of the rotating drum wherein gravity exerts a downward component in order to utilize the weight of the wash to assist in the rotation of the drum.

I prefer to use a water weighing device in order to maintain the normal water level in tub 23. To this end I employ a chamber 70 vented to the atmosphere at 77. A member 78 fulcrumed on pin 79 engages chamber 70 through pin 80. A flexible hose 81 is secured to a nipple 82 in the bottom of chamber 70 and the other end of the hose 81 is secured to a nipple 83 secured into the wall of tub 23, see Figure 1. On an arm 96 extending from member 78 is an adjustable weight 95.

As the tub 23 fills with water by the opening of solenoid valve 73, water enters the hose 81 and rises in chamber 70 to a corresponding height because the chamber 70 is vented at 77. When that amount of water has entered chamber 70 so that its weight exceeds the weight of the member 95 on the other side of fulcrum pin 79 the apparatus falls to the position as shown in Figure 3. The weight 95 is adjusted on arm 96 to unbalance chamber 70 at the proper level desired in tub 23.

A conventional mercury switch 86 mounted on arm 96 is therefore tilted by the above mentioned fall of chamber 70 and the electric contact is broken thereby de-energizing solenoid valve 73 and closing same. Conversely when tub 23 drains,

chamber 70 also drains into tub 23 and the switch 86 is tilted in the converse "on" plane but the master cyclic control keeps the circuit that governs solenoid valve 73 open until the cyclic control dictates its next opening.

The master linear switch cyclic control system used in this invention (not shown) is similar to that described in my two co-pending applications, Serial No. 559,553 filed October 20, 1944, now abandoned, and Serial No. 570,059, filed December 28, 1944, now Patent No. 2,417,998, dated March 25, 1947, and controls in proper timed sequence in accord with cycle diagram as shown in Figure 5, the motor 18, the solenoid drain valve 68, the solenoid water supply valve 73, the solenoids 45 and 53 and the electric air heater 65.

The operation of my combined dryer and washer of textiles is as follows:

After the operator has placed the wash in drum 3 through orifice 6 and closed and locked the glass door 7, the manual cyclic control knob 84 is turned to its "on" position and the main cyclic control switch (not shown) is turned to its operative position by the connecting shaft 91. The motor switch in box 87 is then closed energizing the motor 21 and the blower 18 starts. The solenoid operated drain valve 68 is also energized by the main cyclic control switch and the drain connection from tub 23 is thereby closed. Solenoid 53 is likewise energized closing damper 51 and compelling the air passing through blower 18 to be re-circulated.

The air blast therefrom passing into duct 20 enters the nozzle opening 24 and the deflectors 26, at this moment when the drum 3 is starting, are at position B as shown in Figure 6. The solenoid water supply valve 73 is also energized and water enters on to platform 76 and as the drum is already in motion the vanes 13 displace the water on platform 76 on to and over the openings in nozzle 24 and the water is entrained by the air blast and enters drum 3 as already described and the washing period starts.

In the meantime water in tub 23 has reached its normal level and at this level the weight of water in water control chamber 70 has caused the arm 96 sustaining mercury switch 86 to open said switch and solenoid valve 73 is deenergized and closed. During the washing period the deflectors 26 control the speed of the drum 3 as previously described.

At the end of the predetermined washing period drain valve 68 is deenergized, drawing off the wash water from the tub 23 and the clothes therein while the drum is continued in motion by the air blast from blower 18, and solenoid 45 is energized, causing levers 38 and 41 to assume position 33a and 41a respectively, thereby moving deflectors 26 into position C and the drum gradually increases its rotative speed to expel the wash water from the wash in drum 3.

After a predetermined interval determined by the main cyclic control the rinsing period starts. Solenoid 45 is de-energized restoring deflectors 26 to position A and the drain valve 68 is energized and closed and solenoid operated water valve 73 is energized and opened and the same action takes place as during the washing period.

When the rinsing period ends and the main centrifugal drying period starts, which period is identical to the first period of centrifugal action above described but is of a greater duration so that the R. P. M. of the drum 3 may finally attain full centrifugal-extraction. After this centrifugal-extraction period has elapsed the air-

drying period is initiated by the main cyclic control which returns the air deflectors 26 to position A and the air duct damper 51 is opened to position 51a by the de-energization of solenoid 53. This opening of damper 51 causes a portion of the air to be expelled through air grille 61 and suction to be exerted in duct 62 and to fresh air inlet 92 and the suction inlet 50 of blower 18 is partially supplied with fresh air. The fresh air admitted into the circulation of the machine is heated by electric heater 65 located in duct 62 and the temperature of the circulating air is controlled by a conventional manually-set thermostat 94, see Figure 2. (Wiring connection not shown.)

At the predetermined end of the air-drying period, the main cyclic control de-energizes solenoids 45 and 53 and opens the switch controlling motor 21 and turns off air heater 65 and the textiles, or wash, are ready to be removed from the machine.

Without prejudice, or restricting the scope of this invention, a one-third horsepower motor is used to operate the blower in order to process a nine pound load of dry clothes. It is to be noted that the force-vector of the air blast entering the drum over a considerable segment of the drum's circumference tends to throw the wash during the washing and rinsing periods, inwardly from that segment of the drum which would normally lift the wash to the top of the drum and as would occur in the conventional washing drum's rotation. This air force vector combined with the proper R. P. M. of the drum results in a circuit of movement of the clothes in the drum necessary to obtain an effective washing and rinsing action.

What I desire to protect by United States Letters Patent is encompassed in the following claims:

1. A combined textile dryer and washer adapted to wash, rinse, centrifugally extract moisture and air-dry said textile, comprising a rotatable washing and drying chamber, means to rotate said chamber by an air-jet generated by a motor-driven blower, means to permit said air-jet to issue from a nozzle and to impinge on vanes positioned on the outer circumference of said chamber, means to entrain wash and rinse water into said air-jet, orifices formed in the circumference of said chamber adjacent to the inner edge of said vanes to permit said air and entrained water to penetrate into said chamber after said air and water is deflected by said vanes, duct means for re-circulating said air during said washing, rinsing and centrifugal-extraction periods through said blower, nozzle and drum, and duct control means to expel a portion of said re-circulated air and to admit an equivalent portion of heated fresh air during said air-drying period.

2. A combined textile dryer and washer, adapted to wash, rinse, centrifugally extract moisture and air-dry said textile, comprising a rotatable washing and drying drum, said drum positioned in a tub, means to supply water to said tub and water control means to maintain the level of said water below the circumference of said drum, means to rotate said drum by an air-jet generated by a motor-driven blower, said air impinging on vanes positioned on the circumference of said drum, means to entrain wash or rinse water into said air-jet, orifices formed in the circumference of said drum adjacent to said vanes to permit said air and entrained water to penetrate into said drum after said air and water is de-

9 deflected by said vanes, means to control the peripheral speed of said rotatable drum by adjusting the angle of said air-jet in respect to said vanes, duct means for recirculating said air during said washing, rinsing and centrifugal-extraction periods, and duct control means to expel a portion of said circulating air from said air-circulating duct and to admit heated fresh air during said air-drying period.

10 3. A combined textile dryer and washer, adapted to wash, rinse, centrifugally extract moisture and air-dry said textile comprising a rotatable washing and drying drum, means to rotate said drum by an air-jet generated by a motor-driven blower, said air impinging on vanes formed on the exterior of said drum, means to entrain wash or rinse water into said air-jet, orifices formed in said drum, adjacent to said vanes to permit said air and entrained water to penetrate into said drum after said air and water is deflected by said vanes, automatic means to control the peripheral speed of said rotatable drum by adjusting the angle of incidence of said air-jet in respect to said vanes, air circulation duct means for recirculating said air during said washing, rinsing and centrifugal-extraction periods, through said blower, duct control means to expel a portion of said circulating air, and to admit fresh air during said air-drying period.

4. A combined textile dryer and washer, adapted to wash, rinse, centrifugally extract moisture and air-dry said textile comprising a rotatable washing and drying drum, said drum positioned in a tub and means to supply said tub with wash and rinse water and control means to maintain the level of said water below the circumference of said drum, means to rotate said drum by an air-jet generated by a motor-driven blower, said air impinging on vanes positioned on the exterior of said drum, means to entrain wash or rinse water into said air-jet, orifices formed in said drum, adjacent to said vanes to permit said air and entrained water to penetrate into said drum, after said air and water is deflected by said vanes, automatic means to control the peripheral speed of said rotatable drum by adjusting the angle of

5 incidence of said air-jet in respect to said vanes, a heating element for heating air, duct means for re-circulating said air through said blower, air-jet and drum during said washing, rinsing and centrifugal-extraction periods, and duct control means to expel a portion of said circulating air, and to admit heated fresh air during said air-drying period, and means incorporated in said air-expulsion duct to separate the lint derived from said textile during said washing, rinsing and drying periods from said air.

15 5. A combined textile dryer and washer adapted to wash, rinse, centrifugally extract moisture and air-dry said textile, comprising a rotatable washing and drying chamber, means to rotate said chamber by an air-jet generated by a motor-driven blower, means to permit said air-jet to issue from a nozzle and to impinge on vanes positioned on the exterior of said chamber, means to entrain wash and rinse water into said air-jet, orifices formed in the exterior of said chamber adjacent to the inner edge of said vanes to permit said air and entrained water to penetrate into said chamber after said air and water is deflected by said vanes, duct means for re-circulating said air during said washing, rinsing and centrifugal-extraction periods through said blower, nozzle, and drum and duct means to expel a portion of said re-circulated air and to admit heated fresh air during said air-drying period.

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