Aug. 28, 1956 J. J. HAVERSTOCK 2,760,639

METHOD OF WASHING AND DRYING TEXTILES

Filed June 14, 1951 4 Sheets-Sheet 1

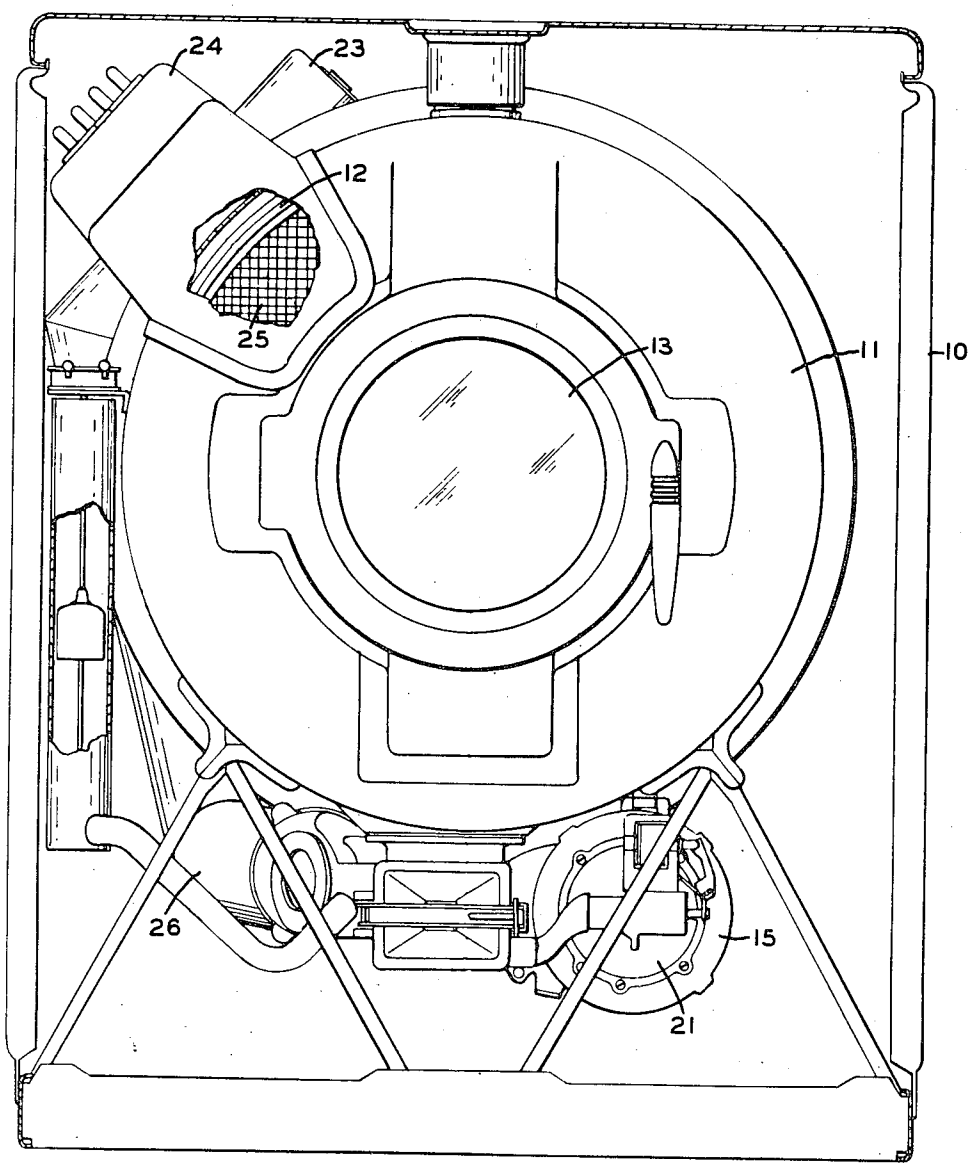


Fig. 1.

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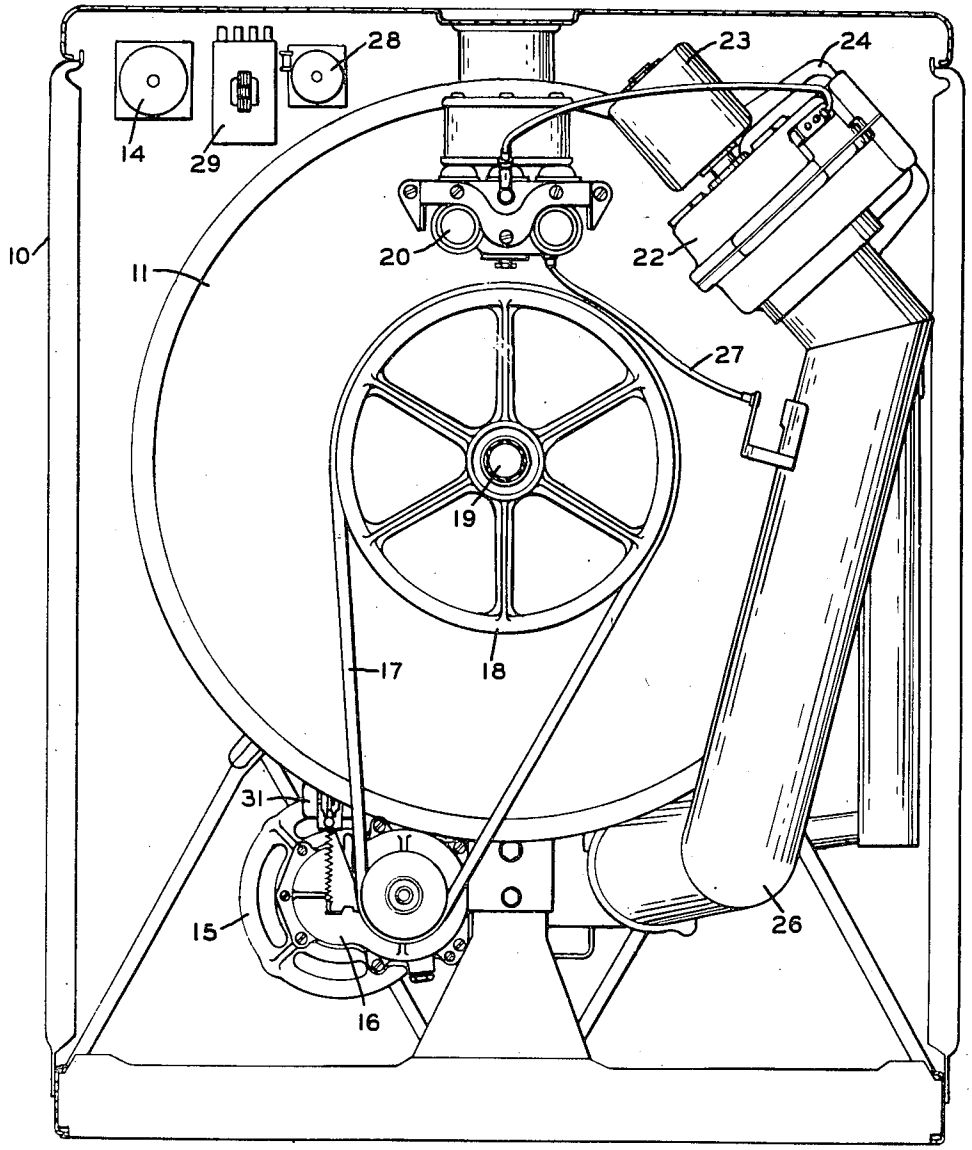


Fig. 2.

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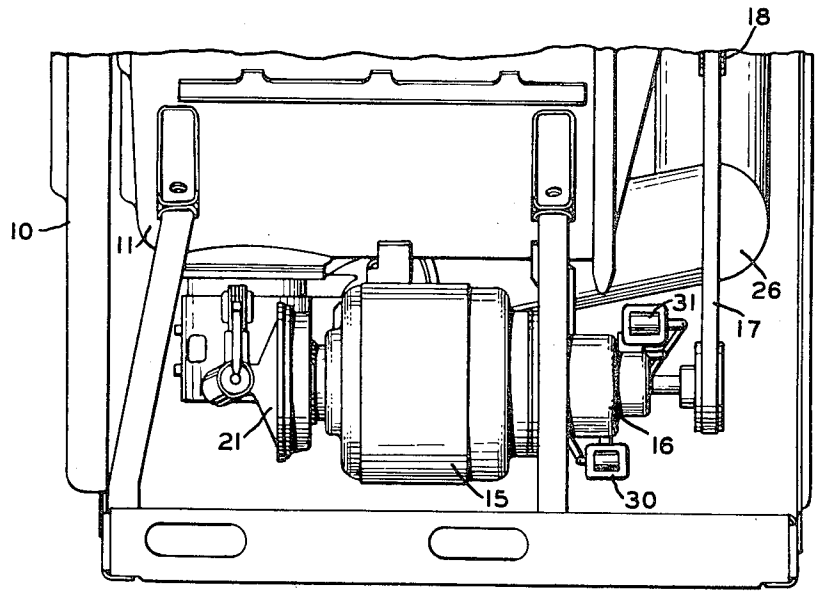
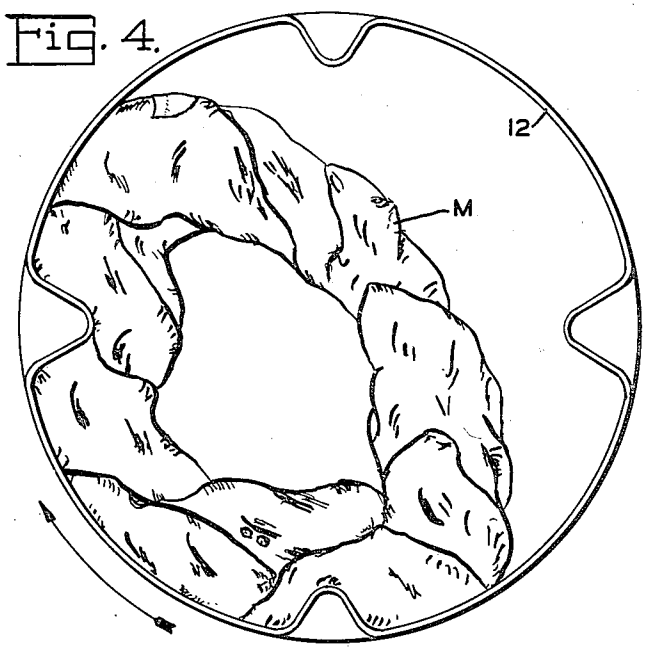


Fig. 3.

Fig. 4.



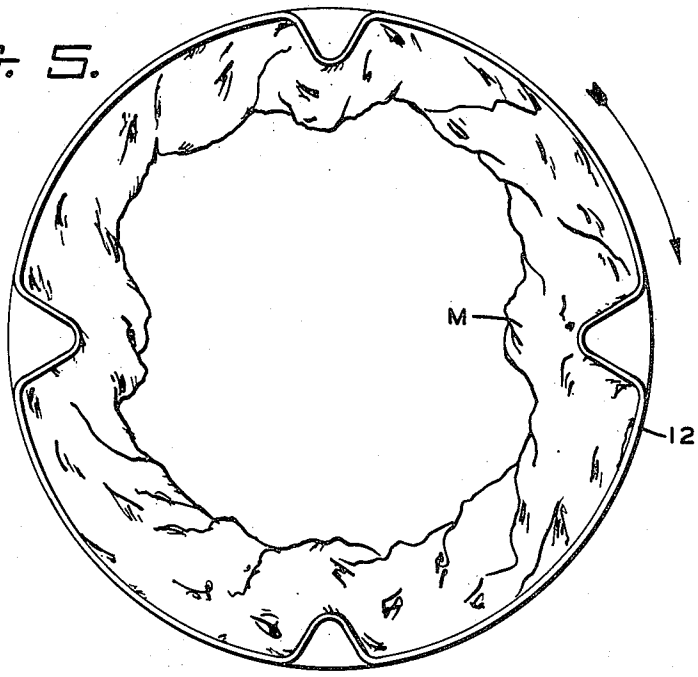
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Fig. 5.



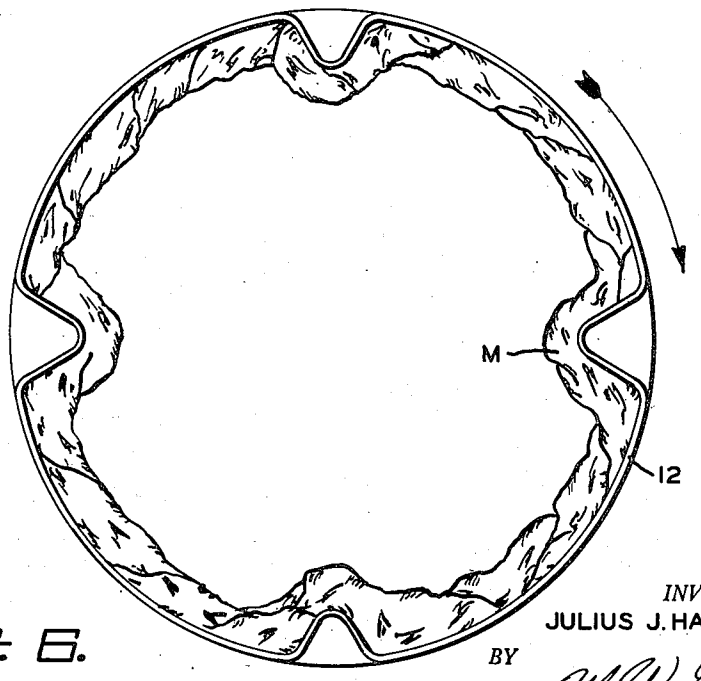


Fig. 6.

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2,760,639

METHOD OF WASHING AND DRYING TEXTILES

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Application June 14, 1951, Serial No. 231,574

9 Claims. (Cl. 210—66)

This invention relates to improvements in the washing and drying of textile materials in a machine of the horizontal or inclined axis tumble action type adapted to operate automatically according to a predetermined and definite cycle of operations; and particularly to a method of preventing objectionable adherence of the materials to the wall of the cylinder in this type of machine.

I have chosen to illustrate and describe below in detail, the improvement effected by the present invention as applied to a machine of the general type disclosed in copending application Serial No. 54,278 now Patent No. 2,656,695, filed October 13, 1948, in the name of Lewis L. Miller and assigned to the same assignee as the present invention. It is sufficient to say here, that the machine described in said copending application is of the horizontal axis tumble action type well known in the art but having additional means for effecting a complete drying of textile materials in addition to the washing, rinsing and spin drying operations of machines in domestic use today. The complete drying of the materials is effected by a tumbling of the clothes in the presence of drying air currents circulated through the cylinder by means of a centrifugal blower.

Briefly the cycle of operations of this machine consists of a prewash or so-called "soak," a wash, three rinse periods, and a final drying period wherein the materials are tumbled in the cylinder by rotation thereof at a speed such that the centrifugal force created thereby is sufficient to cause a lifting of the materials to a point near the top of the cylinder, yet slow enough that the materials may fall away at that point and drop across the central portion of the cylinder as taught by U. S. Patent Re. 22,375. At the end of each of the aforementioned periods with the exception of the final drying period, there is a draining of liquid from the cylinder at which time the materials are distributed in an annulus substantially uniformly about and spaced from the axis of rotation of the cylinder by rotating the cylinder at the same speed but without the liquid; and a subsequent high speed centrifugal extraction of the major portion of remaining liquid from the materials.

In experiments with the type of machine aforementioned, it has been found that due to the flushing action of large quantities of liquid through the materials during the centrifugal extraction periods of the cycle of operations, the many fibres present on the surface of most textiles become matted down by contact with the cylinder inner surface from the centrifugal force exerted thereon due to the extremely high speed rotation of the cylinder. This matting down of the fibres creates a marked tendency for the material to firmly adhere to the inner surface periphery of the cylinder and to remain in that position even after rotation of the cylinder is stopped. The adherence of the material to the inner wall surface of the cylinder is due to the increased surface pressed against the wall when the centrifugal force of high speed rotation of the cylinder for extraction acts on the relatively heavier load of material produced by increased density in the presence of large quantities of liquid in the wet clothes.

Obviously, the above mentioned condition would prove to be most undesirable in a machine of the type described in the aforementioned copending application since during the final drying process, which immediately follows the final damp dry or centrifugal extraction portion of the cycle of operation, it is desirable to have the greatest possible amount of the material surface exposed to the drying air currents passing through the cylinder. This is best accomplished by rotating the cylinder slowly and thereby tumbling the material therein so that all surfaces are periodically exposed to the drying air currents as they fall across the central portion of the cylinder, and therefore it is a primary requirement that the clothes fall away from the periphery to produce a tumbling action during the final drying process instead of adhering to the inner surface of the cylinder and failing to tumble.

An important discovery related to the method comprising the present invention was the finding, after extensive tests, that by first flushing out a major portion of the rinsing liquid from the material at an intermediate speed (between the low speed for washing and the high speed for extraction); allowing the materials to break away from the cylinder by slowing or stopping the rotation thereof; and then spinning out the remaining excess liquid at high speed; the material will then fall by gravity away from the periphery of the cylinder as the speed thereof and resultant centrifugal force exerted on said materials falls to a point below that which is equal and opposite to the force of gravity. Breaking away of the materials from the surface of the cylinder at all times is thereby assured since at no time are they subjected to the flushing action of large quantities of liquid at high rotative speeds.

Based upon the above-mentioned discovery; it is therefore a primary object of the method comprising the present invention to assure that the materials will at all times break away from the surface of the cylinder after the centrifugal extraction of liquid therefrom at high rotative speeds.

A further object of the present invention is to provide an aid in reducing the instantaneous power requirements of the drive motor in accelerating from tumbling speed to high speed extraction.

It is a still further object of the present invention to provide the above and other objects with a minimum of additional parts and at a minimum additional cost.

The above and other objects and advantages will become apparent from the following more detailed description and by reference to the one illustrative embodiment shown in the accompanying drawings forming a part hereof and wherein:

Fig. 1 is a front view of a combined washing and drying machine (front panel removed) of a type more particularly adapted to carrying out the method of the present invention.

Fig. 2 is a rear view of the machine shown in Fig. 1 and shows the relationship and general arrangement of the various component parts thereof.

Fig. 3 is a partial side view of the lower portion of the machine taken substantially along the lines 3—3 of Fig. 2 and shows the general arrangement of the power unit and a three-speed transmission used for carrying out the present invention.

Fig. 4 is a diagrammatic showing of the general arrangement and path followed by the material when the cylinder is rotated at low or tumbling speed for washing and final drying.

Fig. 5 is a view similar to Fig. 4; but showing the position assumed by the material when the cylinder is rotated at intermediate or primary extraction speed.

Fig. 6 is a view similar to Figs. 4 and 5; but showing a photomicrograph of a single typical cotton thread portion and illustrates the many fibres which are present on the surface thereof.

The illustrated machine, except for the three-speed feature and method, is more particularly shown and described in the aforementioned copending application Serial No. 54,278 filed October 13, 1948 and will not be described in great detail here. This basic machine and its operation will be briefly described as follows, the added mechanism to carry out my new method being described later:

As will obviously appear this machine is built around a standard horizontal axis tumble action automatic washing machine, of known type to those skilled in the art, and which comprises a suitable casing **10** within which is located a suitable washing liquid container or tub **11**. Within the tub **11** is rotatably mounted a generally perforate cylinder **12** (shown diagrammatically in Figs. 4, 5 and 6) within which the materials to be processed are placed.

The materials M to be processed are placed within the cylinder **12** through an opening **13** in the front of the tub **11**. Operation of suitable automatic clock switch means, shown by reference numeral **14** (Fig. 2), is then initiated by the operator to cause the machine to perform the operations of soaking, washing, draining, rinsing and damp drying, all in sequence according to a predetermined cycle of operations. A suitable drive motor **15**, is provided for driving the cylinder **12** by means of a suitable transmission **16**, belt **17** and pulley **18** keyed to the cylinder shaft **19**. A suitable thermostatically controlled solenoid operated mixing valve **20** of known type is provided for supplying hot or warm water to the interior of the cylinder **12** during the washing cycle; warm water during the rinsing cycle; and cold water for a condensing medium during the final drying cycle to be described below. A suitable pump **21** is also provided for discharging used water at predetermined points in the cycle of operations as determined by the clock switch **14**. In the operation of the machine during the final drying portion of the cycle of operations, a suitable centrifugal blower (not shown) mounted within a blower housing **22** and driven by a small fractional horsepower motor **23** circulates air through the circulating system, which air passes over suitable electric heating elements (not shown) mounted within a duct **24** and into the cylinder **12** through a screened wall **25** thereof, and thence through a conduit **26** communicating with the interior of the cylinder **12** adjacent the bottom thereof and with the blower housing **22**. Cold water is supplied to the inner wall of the conduit **26** through a spray tube **27** from the mixing valve **20**, which water serves as a condensing medium to condense the moisture from the vapor laden air carried in the conduit **26** and also to collect flying lint particles on the surface of the conduit **26** where the stream of water may carry them through the pump **21** by means of a suitable connection therewith. A suitable automatic timing switch **28** is provided for controlling the duration of the drying cycle in accordance with the wishes of the operator; and a suitable temperature regulating thermostat **29** is provided for controlling the maximum temperature to which the materials M will be subjected according to the characteristics thereof and the judgment of the operator. It should be stated that all of the electrical components are so coordinated and arranged in a suitable circuit that completely automatic operation of the machine through all of the cycles will take place as preselected by the operator without requiring further attention; or the controls can be pre-set to have the machine perform either the washing or drying operation only, if desired.

As aforementioned it is possible to encounter difficulties in the proper performance of this type of machine in the final drying portion of the cycle of operations

when sufficient rotative speed is maintained to complete centrifugal extraction in one step; especially when processing materials having a long nap such as Turkish towels, chenille spreads, etc. This difficulty is due, as aforementioned, to the tendency of the material M to adhere to the inner surface of the cylinder **12** when rotated at high speeds as illustrated by Fig. 6. Consequently, when the cylinder **12** is stopped at the end of the damp drying portion of the cycle the material M remains in the compacted position shown, thus when the cylinder **12** is again started in rotation at the slow or tumbling speed for final drying, only the innermost surfaces of the materials would come into contact with the drying air currents thereby resulting in unsatisfactory performance of the machine during the final drying portion of the cycle of operations. In order to render the operation of the dryer more satisfactory under these conditions, it becomes necessary for the operator to first stop the machine and then disengage the materials M from the surface of the cylinder **12** before initiating the final drying period so that the materials may be free to tumble in the prescribed manner as illustrated by Fig. 4.

Suitable photomicrographs which I have taken during the course of extensive experiments with a machine of this type demonstrate that there are innumerable minute fibers which protrude from the surfaces of most textiles. Naturally the number of these fibres is dependent on the type and quality of the material since threads are graded by the number and length of the fibres from which they are made; however, it is safe to say that there are many thousands of these minute fibres protruding from every square inch of surface of most textile materials. The major conclusion drawn as a result of my experiments with a machine of the aforementioned type is that the force and flushing action of large quantities of water through the materials and out of the perforations in the cylinder **12** at high rotative speeds has a tendency to straighten out these tiny fibres and cause them to be flattened and interlaced against the surface of the cylinder **12** thereby presenting an increased surface area thereto which is more smooth and free from the pockets formed by the normal unstressed intermingling of the fibres. This action of the centrifugal force exerted on the materials M can be likened to compressing a suction cup on a smooth surface; or a more approximate action can be seen by examining the surface of a fibrous material such as an ordinary paper blotter. If the blotter is soaked with water and then placed on a smooth surface such as a piece of plate glass and slightly compressed, it will remain in that position even if the glass is turned over and over in the hands which is a good example of the adhesive action with which we are concerned in the present application.

I have found through my extensive experiments and tests that the cylinder **12** can be rotated at an optimum intermediate speed as illustrated by Fig. 5, such that a major portion of the excess liquid will be removed from the materials M yet, as shown, they will not become so compacted nor will they adhere to the surface of the cylinder **12** when the rotation thereof is discontinued; but will fall away therefrom due to the force of gravity. If subsequently the cylinder **12** is then rotated at the high centrifugal extraction speed, the flushing action of the remaining liquid is not so strenuous and therefore the fibres on the material surfaces do not become matted down but, alternatively, act as a sort of buffer between the material surfaces and the inner peripheral surface of the cylinder **12**; consequently, when the rotation is again stopped the force of gravity is again sufficient to cause the material M to fall away from the surface of the cylinder **12**. Thus, the desired amount of excess liquid can be removed from the material M and the satisfactory operation of the machine during the drying operation is assured without requiring the attention of the operator other then pre-selecting the duration of the

washing and drying periods as taught by the aforementioned copending application.

In order to adapt this machine to include the use of the steps involved in my new and novel method, a few additional parts or changes in construction are necessary. The transmission **16** must be provided with suitable means such as an additional set of gears in order to drive the cylinder **12** at the intermediate or primary extraction speed, and an additional solenoid shifter **30** to engage this set of gears. A solenoid shifter **31** adapted to shift the speed from washing speed to high speed extraction is normally existent in machines of this type. In addition to the set of gears and shifter **30** a minor change would need to be effected in one of the switch actuating cams in the timing switch **14** to provide for automatic operation of the shifter **30** to engage the intermediate speed gears at the proper point or points in the cycle of operations, or a separate switch and actuating cam therefor may be provided at very little additional cost.

In operation the steps of my new method from the final rinse period to the finish drying period are as follows:

The material M is slowly tumbled for a period of approximately four minutes in the rinsing liquid as illustrated by Fig. 4 at the end of which time the free liquid is drained from the tub **11** and discharged by the pump **21**. The solenoid shifter **30** is then energized to engage the aforementioned set of intermediate speed gears in the transmission **16** to rotate the cylinder **12** at the primary extraction speed (see Fig. 5) for a period of approximately a minute to a minute and a half such as to remove a major portion of the retained liquid; after which time the rotation of the cylinder **12** is either stopped completely or sufficiently slowed down to allow the materials to fall away from the inner periphery thereof. The cylinder **12** is then started in rotation again at the slow or tumbling speed (Fig. 4) for a short period in order to effect a redistribution of the load, after which time the solenoid shifter **31** is energized to engage the set of high speed gears in the transmission **16** thereby to rotate the cylinder **12** at the high centrifugal extraction speed (Fig. 6) for a period of approximately 4 minutes in order to effect a satisfactory damp drying of the materials. At the end of the damp dry period the rotation of the cylinder **12** is again either stopped completely or sufficiently slowed down to allow the materials M to fall away from the inner periphery thereof so that they may be properly tumbled thereafter at the slow speed (Fig. 4) in the presence of drying air currents in order to effect a complete drying thereof.

Another useful purpose is served by the addition of the intermediate speed mechanism and that is to reduce the power requirements of the motor **15** in acceleration to high speed rotation of the cylinder **12**. For this purpose it may be desirable to effect an intermediate speed rotation prior to each high speed centrifugal extraction period in order to lessen the load on the motor **15** as much as possible and therefore prolong the life thereof. For the purpose of preventing adherence of the material M to the surface of the cylinder **12**, however, it is only necessary to effect a primary extraction after the final rinse period since after the other extraction periods the presence of rinse water in the tub **11** causes the material to be loosened and properly tumbled therein.

In the foregoing description, where reference is made to slow, intermediate and high speeds, the following approximate speeds have been found to be satisfactory for a cylinder having an internal diameter of approximately 25-inches and processing an average 9-pound load of materials with a suitable amount of liquid; slow speed 50 R. P. M.; intermediate speed 225–275 R. P. M. depending upon the characteristics of the material; and high speed 500 R. P. M. It should be stated, however, that the speeds will vary with the diameter of the cylinder as taught by the aforementioned Patent No. Re. 22,375 and also with the size of the load and the level of liquid within the cylinder.

While the present invention has been illustrated and described, in the foregoing, with reference to one particular embodiment, it is not intended that it be limited to that particular embodiment, nor otherwise than by the terms of the appended claims.

I claim:

1. That method of centrifugally extracting liquid from fabric materials which have been washed by low speed tumbling within a drum the lower portion of which dips into a cleaning liquid, which comprises a primary extraction of the major proportion of retained liquid from the materials by rotating said drum at a first, centrifuging speed higher than said tumbling speed but lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall of said drum is obviated, reducing the rotative speed below said first, centrifuging speed to a point sufficient to permit said materials to fall by gravity away from the wall of said drum, and then increasing the speed of said drum to a speed in excess of said first, centrifuging speed.

2. That method of conditioning fabric materials for drying which materials have been washed by low speed tumbling within a drum in the presence of a cleaning liquid which comprises the steps of; a primary centrifugal extraction of the major proportion of retained liquid from the materials by rotating said drum at a first, centrifuging speed higher than said tumbling speed but lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall of said drum is obviated, reducing the rotative speed of said drum below said first, centrifuging speed to permit said materials to fall by gravity away from the wall of said drum, distributing said materials around the periphery of said drum, and then increasing the speed of said drum to a speed in excess of said first, centrifuging speed.

3. That method of centrifugally extracting liquid from fabric materials which have been washed by slow speed tumbling within a drum in the presence of a cleaning liquid which comprises, a primary extraction of the major proportion of retained liquid from said materials by rotating said drum at a first, centrifuging speed higher than said tumbling speed but lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall of said drum is obviated, reducing the rotative speed of said drum to a point sufficient to enable said materials to fall by gravity away from the wall thereof, distributing said materials substantially uniformly around the periphery of said drum by slow speed rotation thereof, again rotating said drum at said first, centrifuging speed, and then increasing the speed of said drum to a speed in excess of said first, centrifuging speed.

4. That method of centrifugally extracting liquid from fabric materials thereby to condition same for drying, which materials have been washed by slow speed tumbling within a drum in the presence of a cleaning liquid, which comprises a primary extraction of the major proportion of retained liquid from said materials by rotating said drum at a first, centrifuging speed higher than said tumbling speed but lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall thereof is obviated, reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof, distributing said materials substantially uniformly about the periphery of said drum by slow speed rotation thereof, again rotating said drum at said first, centrifuging speed followed by a secondary extraction of an additional amount of remaining liquid by rotating said drum at a speed substantially higher than said first, centrifuging speed, and again reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof.

5. That method of centrifugally extracting liquid from and of air drying fabric materials which have been washed by slow speed tumbling within a drum in the presence of a cleaning liquid, which comprises a primary extraction of the major proportion of retained liquid from said materials by rotating said drum at a first, centrifuging speed higher than said tumbling speed but lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall thereof is obviated, reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof, distributing said materials substantially uniformly about the periphery of said drum by slow speed rotation thereof, again rotating said drum at said first, centrifuging speed followed by a secondary extraction of an additional amount of remaining liquid from said materials by rotating said drum at a speed substantially higher than said first, centrifuging speed, again reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof, and finally drying said materials by tumbling same within said drum in the presence of drying air currents at a slow rotative speed.

6. That method of centrifugally extracting liquid from fabric materials which have been washed by agitation in the presence of a cleaning liquid, which comprises a primary extraction of the major proportion of retained liquid by rotating a drum containing said materials at a first centrifuging speed lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall thereof is obviated, reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof, a secondary extraction of an additional amount of remaining excess liquid by rotating said drum at a speed substantially higher than said first, centrifuging speed, and again reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof.

7. That method of centrifugally extracting liquid from and of air drying fabric materials which have been washed in a cleaning liquid, which comprises a primary extraction of the major proportion of retained liquid by rotating a drum containing said materials at a first centrifuging speed lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall thereof is obviated, reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof, a secondary extraction of an additional amount of remaining excess liquid by rotating said drum at a speed substantially higher than said first, centrifuging speed, again reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof, and finally drying said materials by tumbling same within said drum at a slow speed in the presence of drying air currents.

8. That method of centrifugally extracting liquid from and of air drying fabric materials which have been washed by slow speed tumbling within a drum in the presence of a cleaning liquid, which comprises a primary extraction of the major proportion of retained liquid from said materials by rotating said drum at a first, centrifuging speed higher than said tumbling speed but lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall of said drum is obviated, stopping rotation of said drum to permit said materials to fall by gravity away from the wall thereof, distributing said materials substantially uniformly about the periphery of said drum by said slow speed tumbling, again rotating said drum at said first, centrifuging speed, performing a secondary extraction of an additional amount of remaining liquid from said materials by rotating said drum at a sped substantially higher than said first, centrifuging speed, again stopping the rotation of said drum to permit said materials to fall by gravity away from the wall thereof, and finally drying said materials by tumbling same within said drum in the presence of drying air currents at said slow tumbling speed.

9. That method of centrifugally extracting liquid from and of air drying fabric materials which have been washed in a cleaning liquid, which comprises a primary extraction of the major proportion of retained liquid by rotating a drum containing said materials at a first, centrifuging speed lower than the final centrifuging speed whereby objectionable adherence of said materials to the inner wall of said drum is obviated, stopping rotation of said drum to permit said materials to fall by gravity away from the wall thereof, a secondary extraction of an additional amount of remaining excess liquid by rotating said drum at a speed substantially higher than said first, centrifuging speed, reducing the rotative speed of said drum to a point sufficient to permit said materials to fall by gravity away from the wall thereof, and finally drying said materials by tumbling same within said drum at a slow speed in the presence of drying air currents.

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