

Nov. 22, 1960

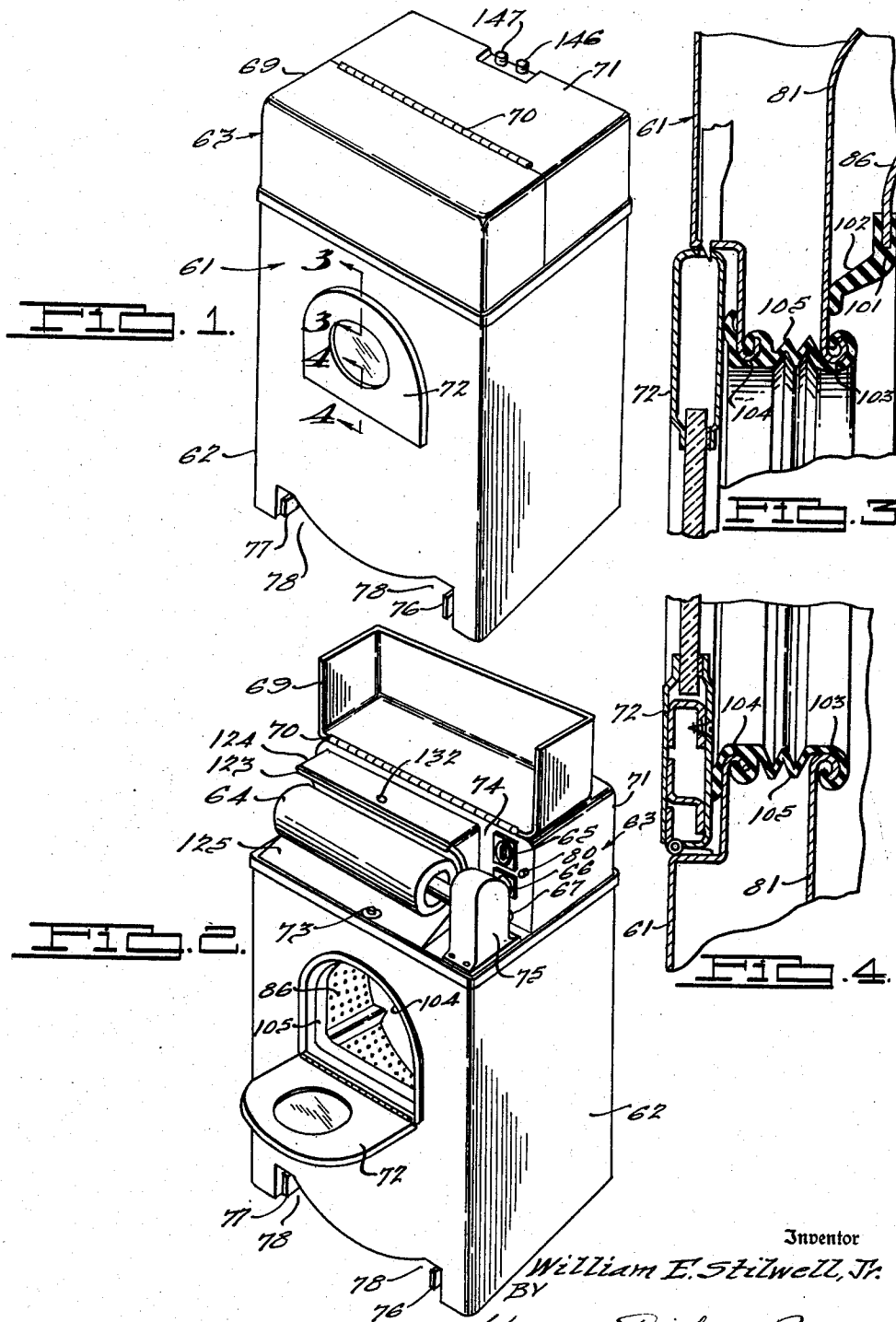
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2,960,780

APPARATUS FOR THE COMPLETE LAUNDERING OF FABRICS

Filed Sept. 7, 1951

12 Sheets-Sheet 1



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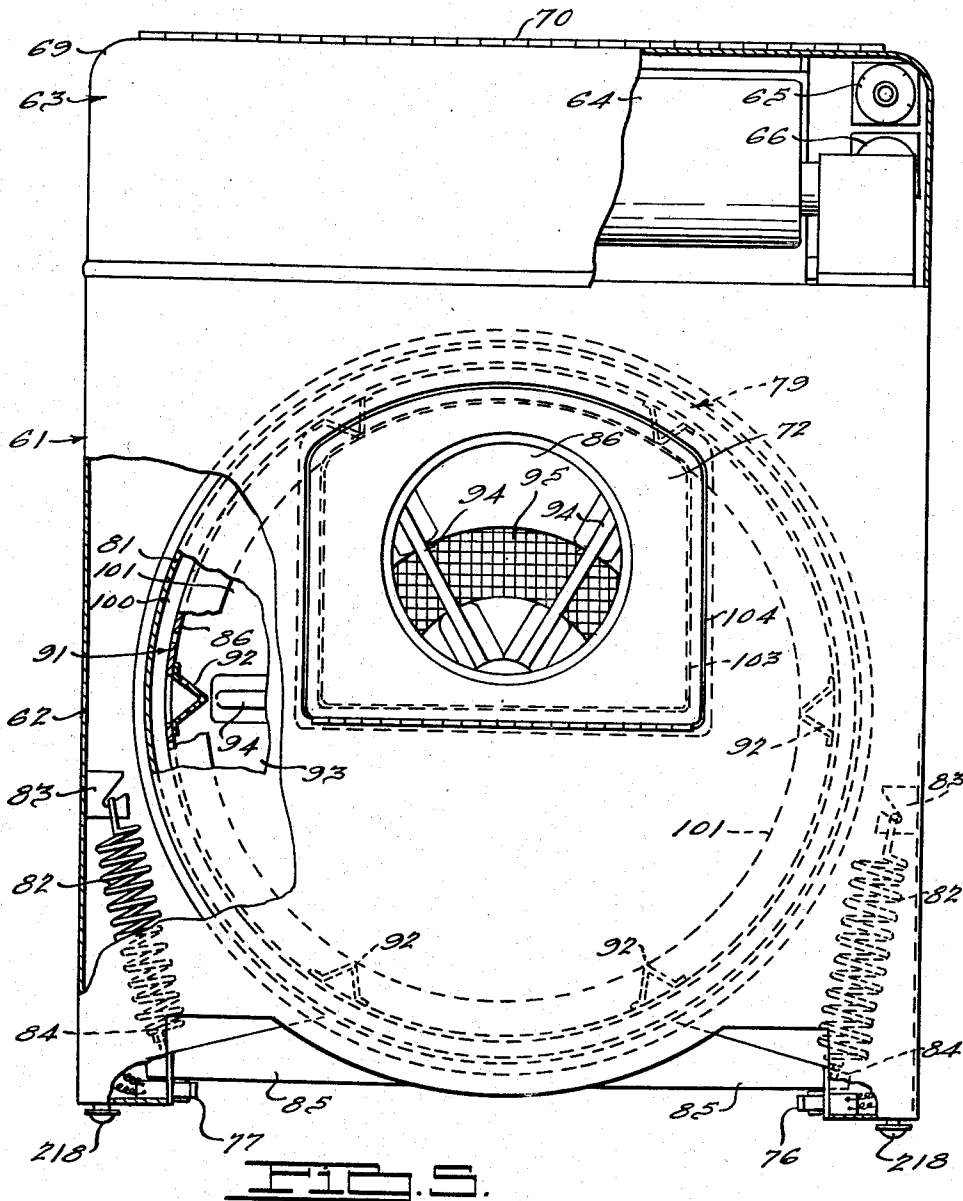
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12 Sheets-Sheet 2



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12 Sheets-Sheet 3

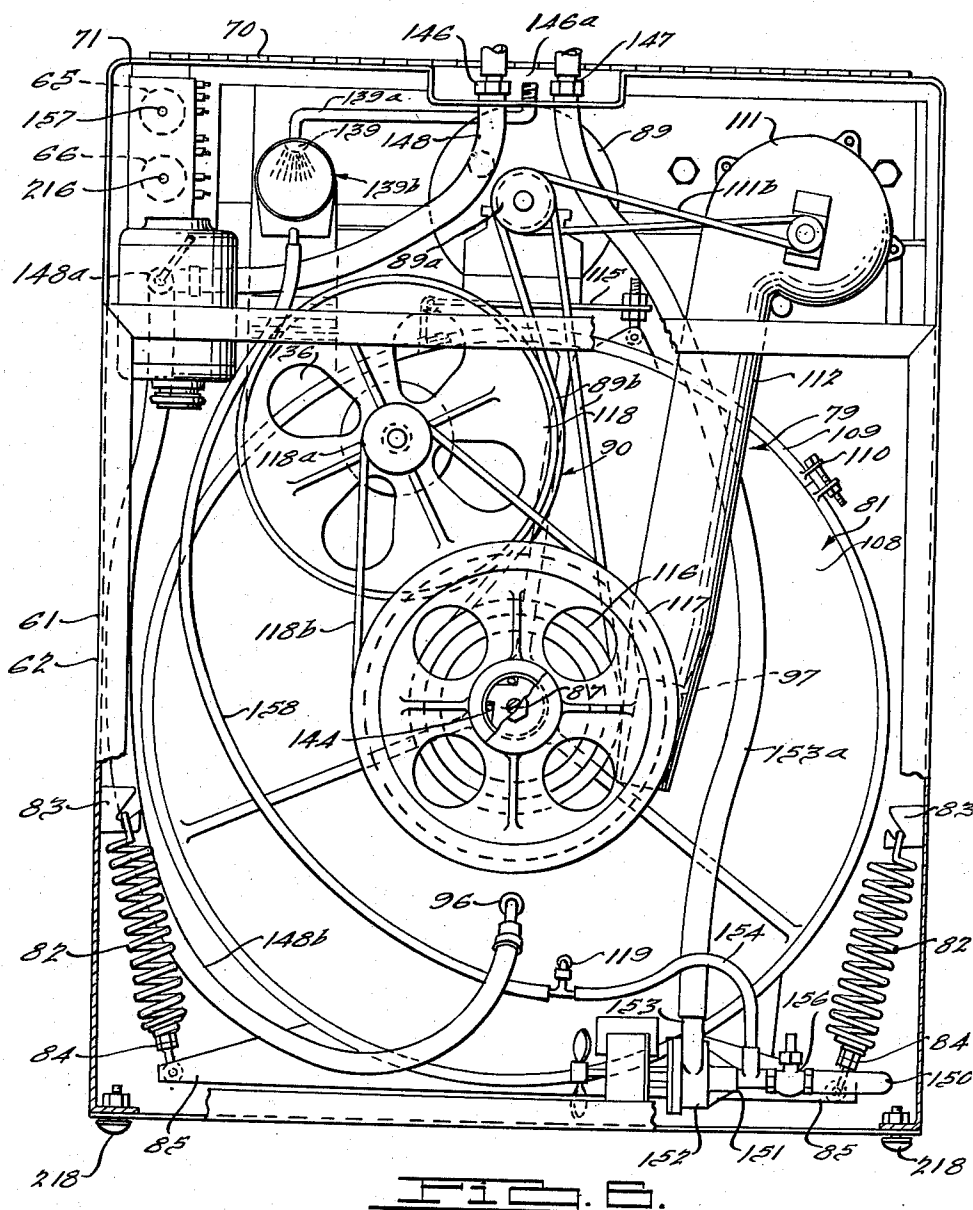


FIG. 6.

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12 Sheets-Sheet 4

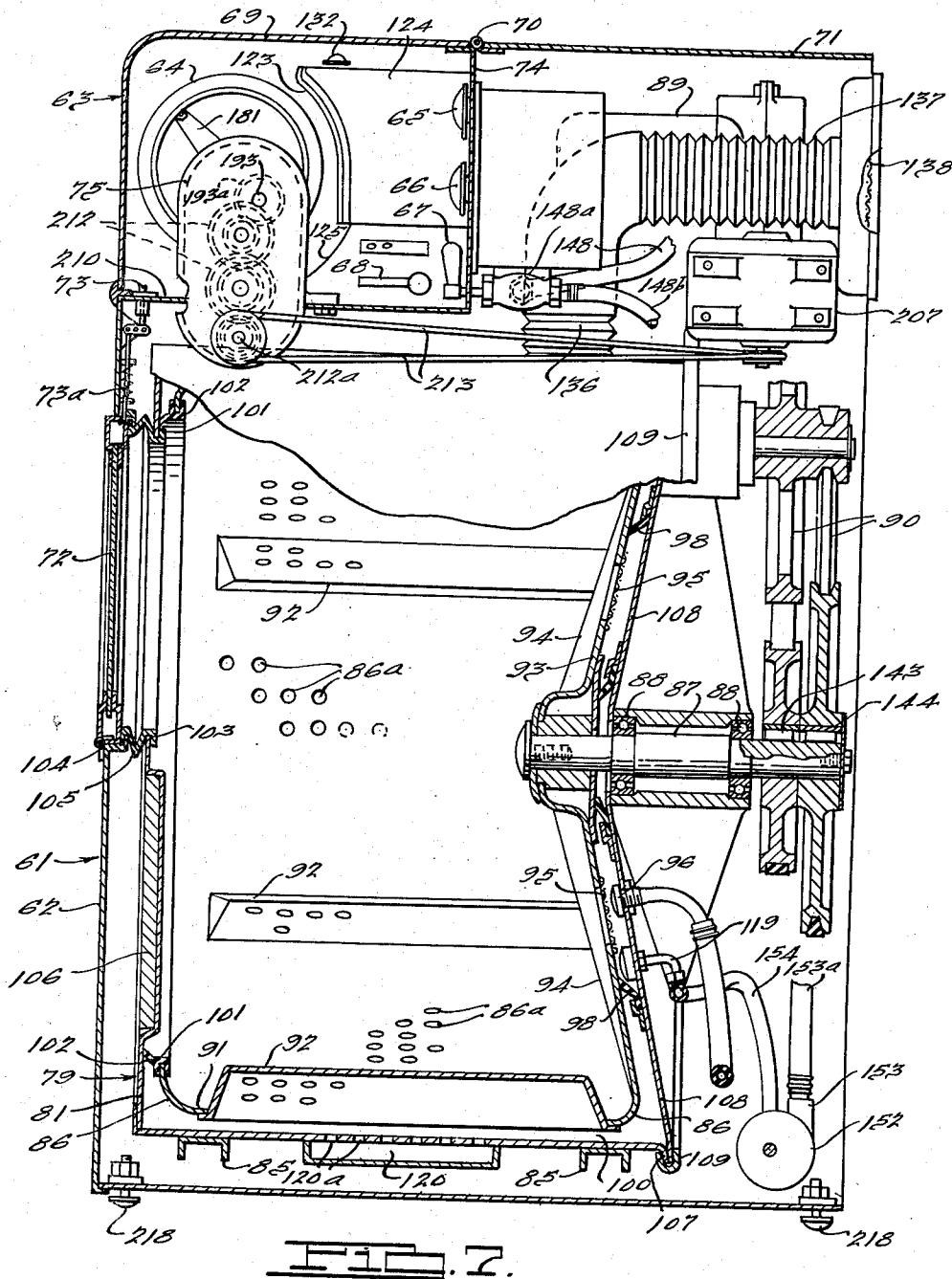


FIG. 7.

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12 Sheets-Sheet 5

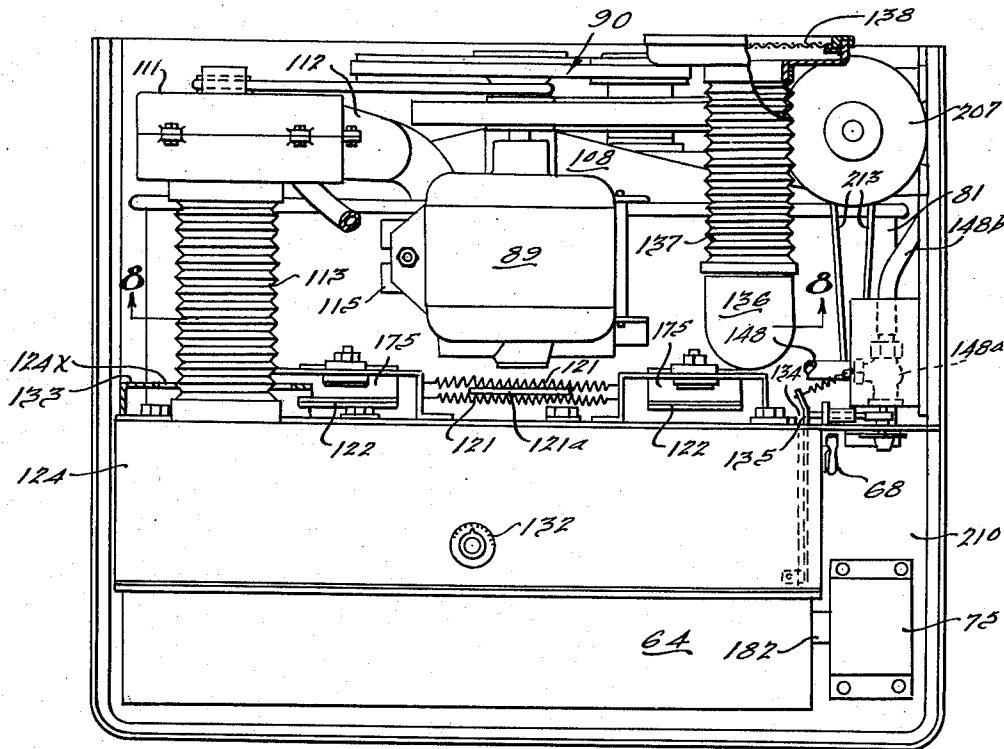


FIG. 8.

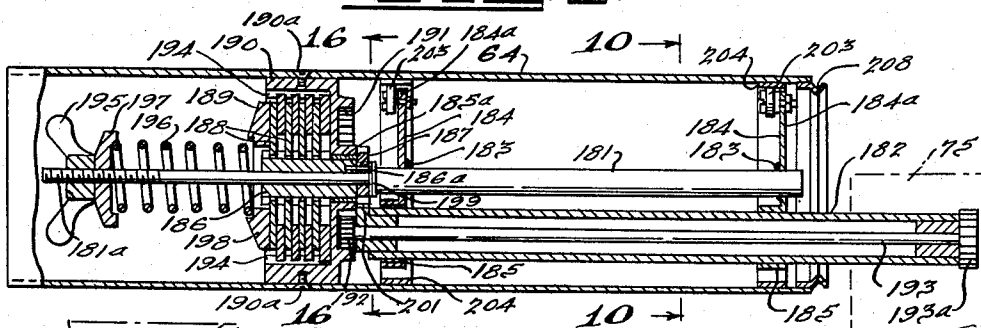
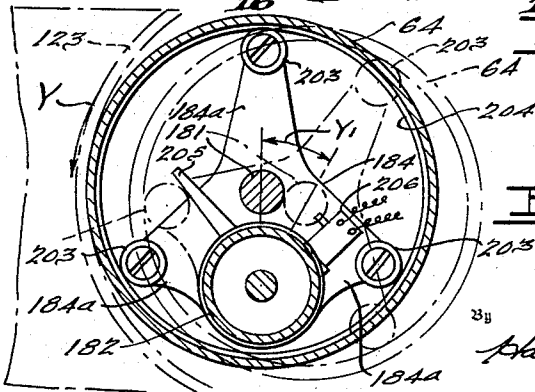


FIG. 9.



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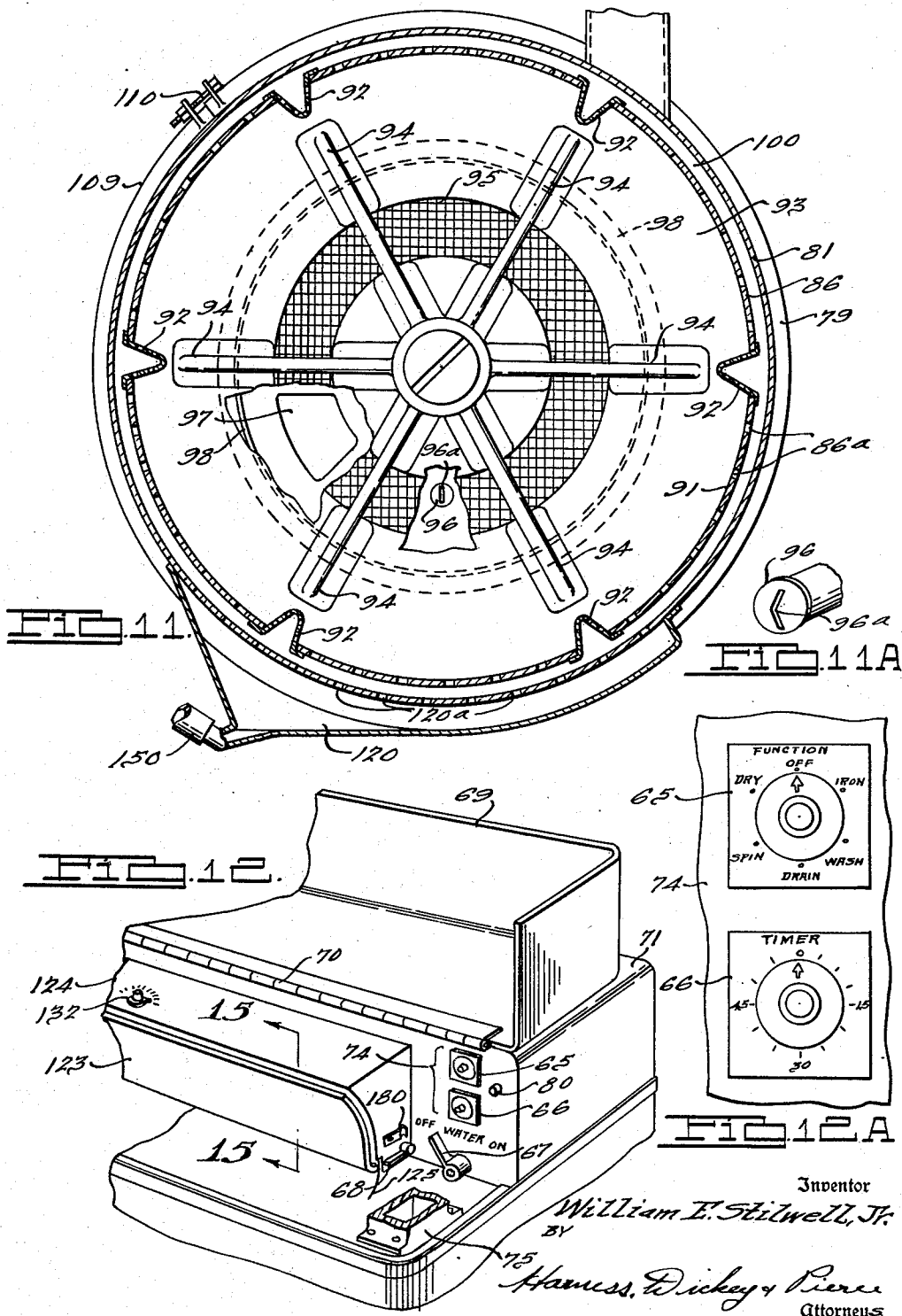
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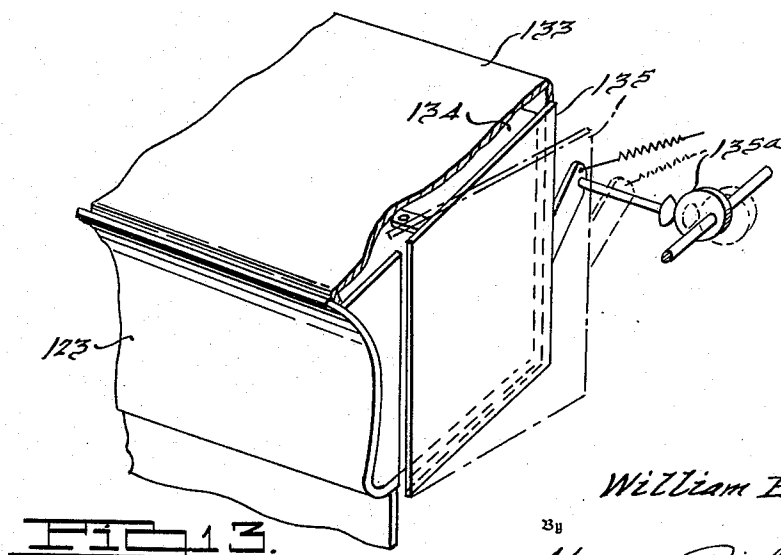
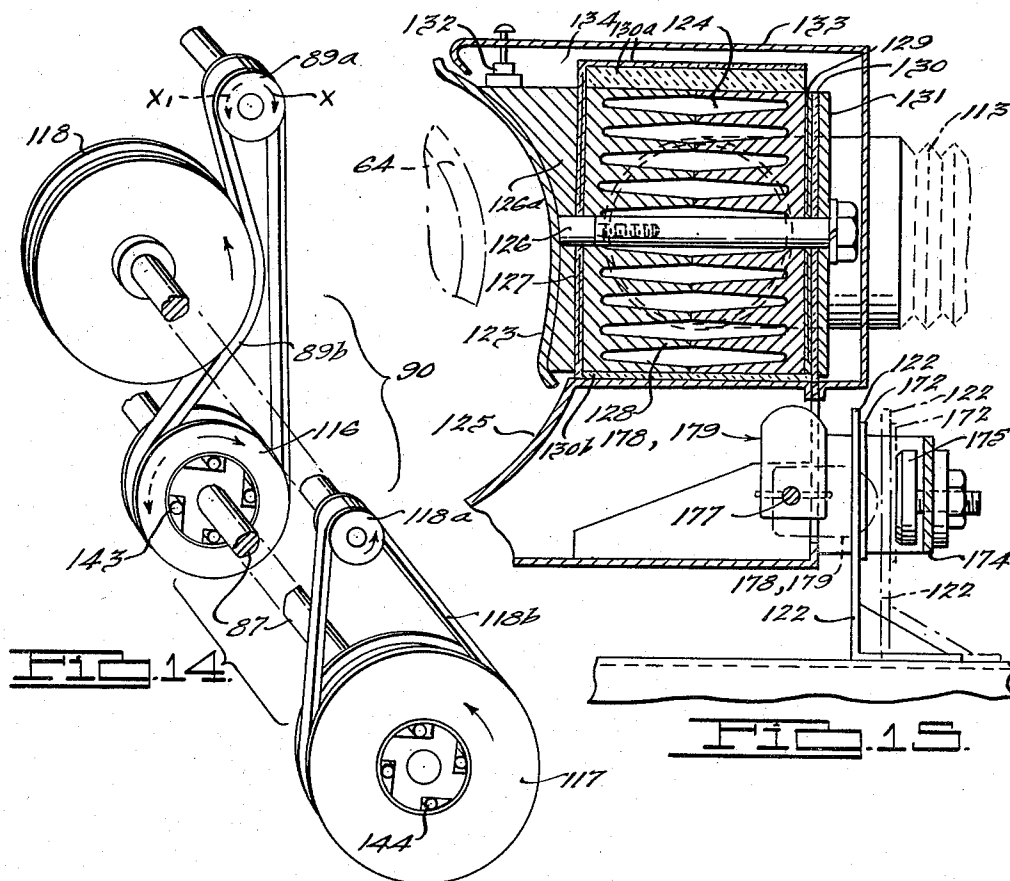
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12 Sheets-Sheet 7



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12 Sheets-Sheet 8

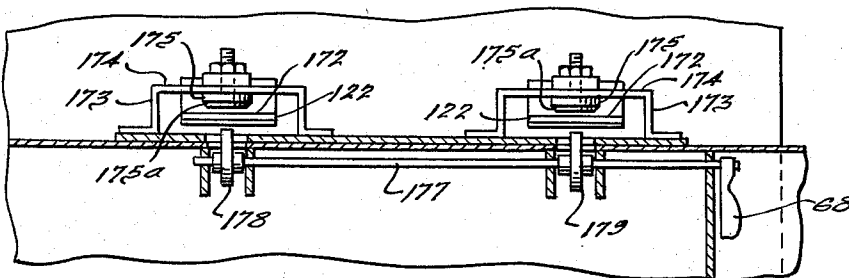
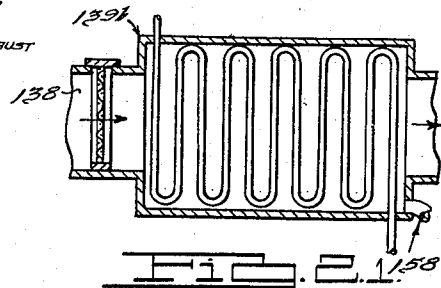
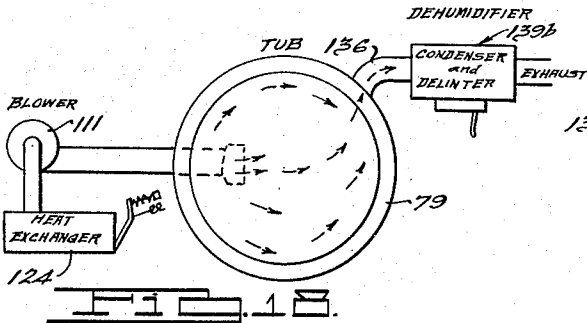
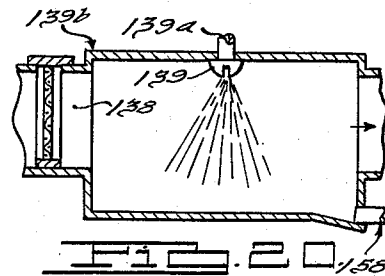
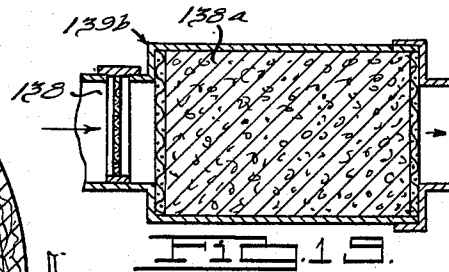
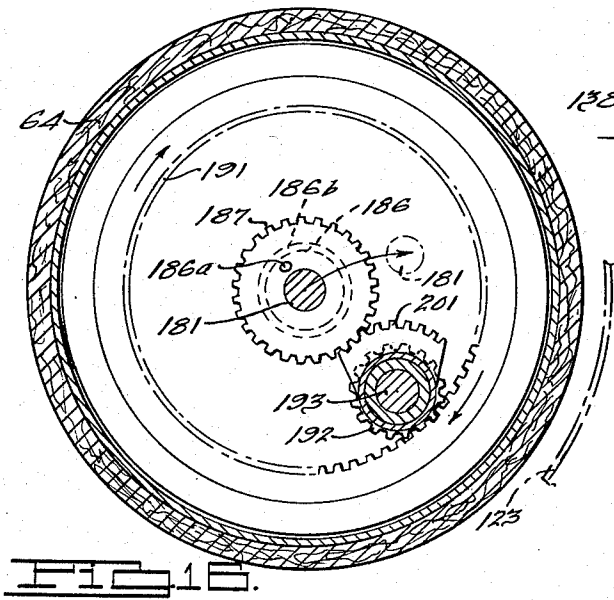


FIG. 17.

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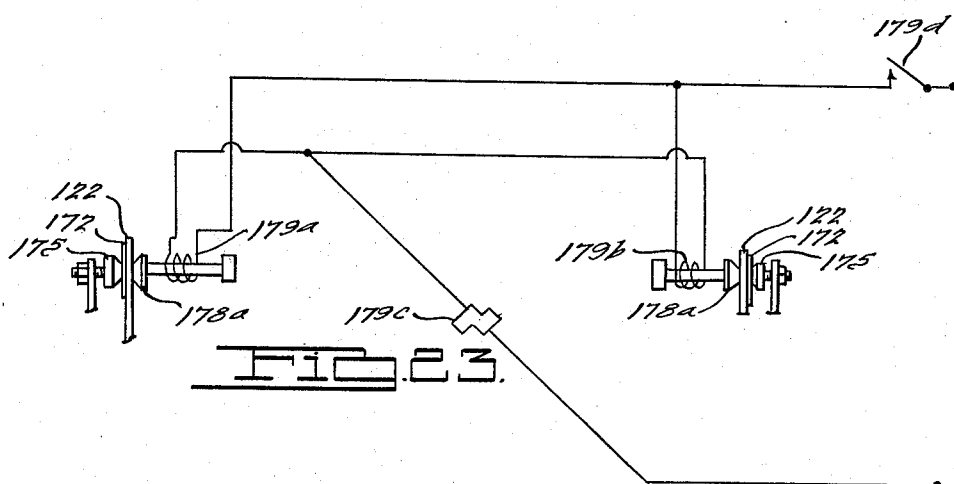
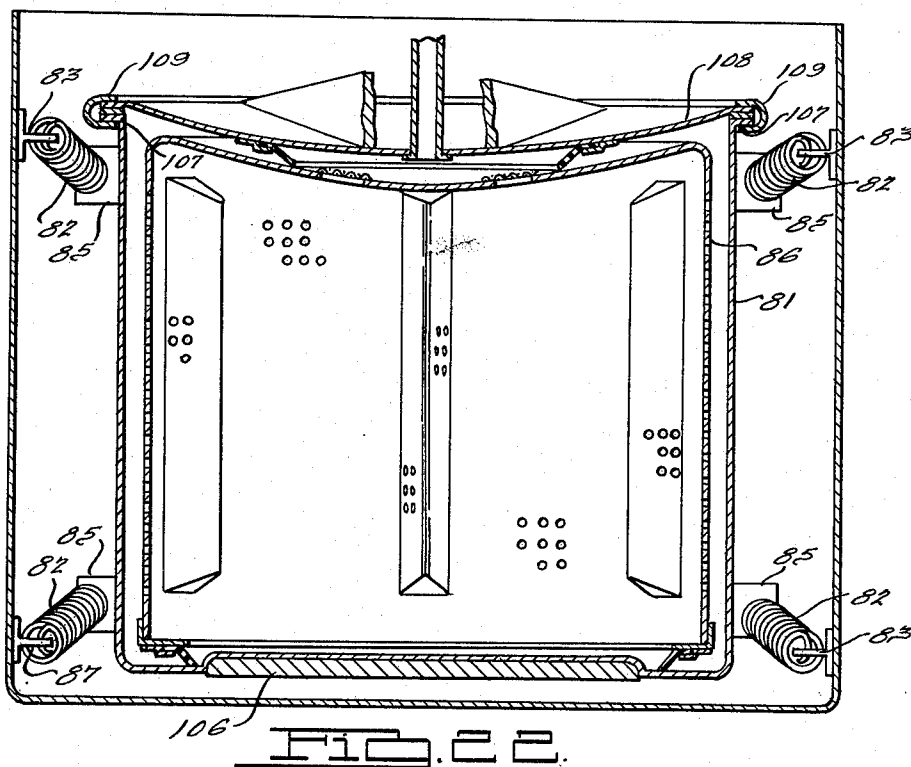
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12 Sheets-Sheet 9



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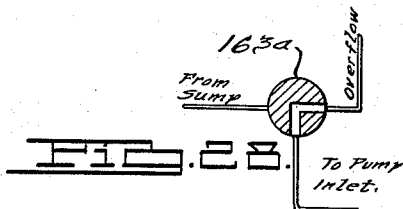
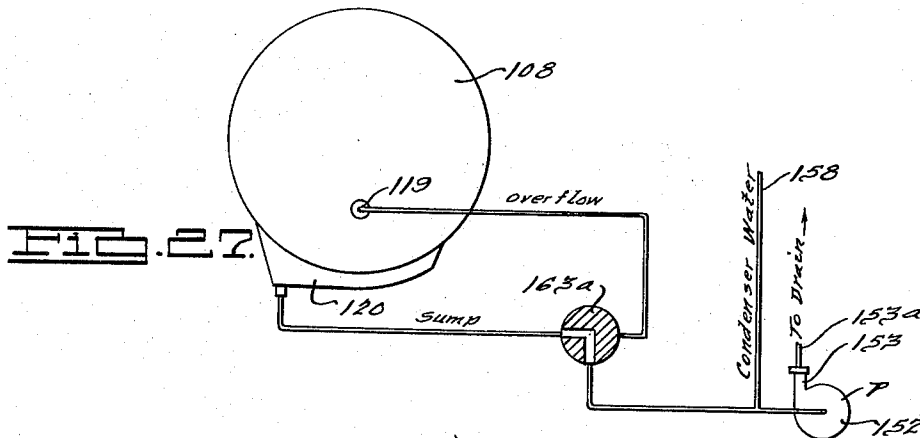
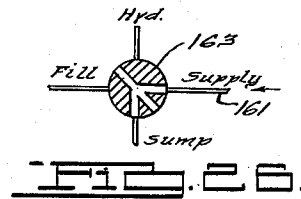
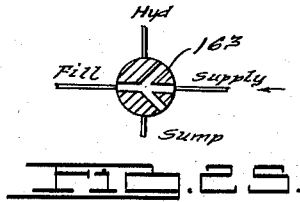
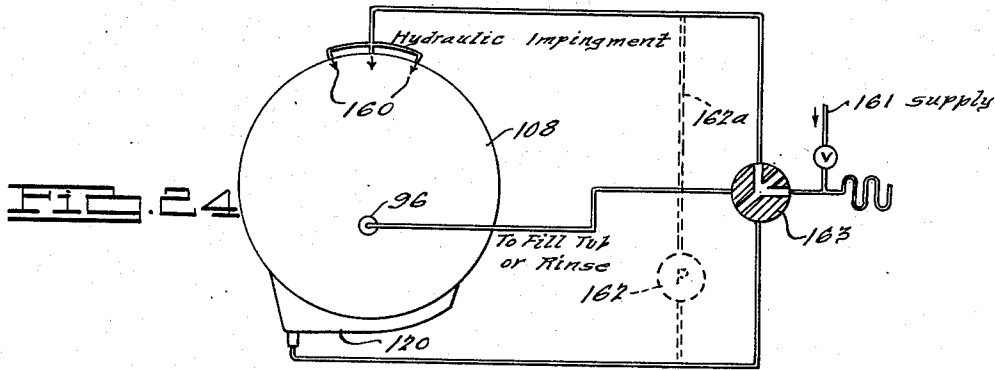
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APPARATUS FOR THE COMPLETE LAUNDERING OF FABRICS

Filed Sept. 7, 1951

12 Sheets-Sheet 10



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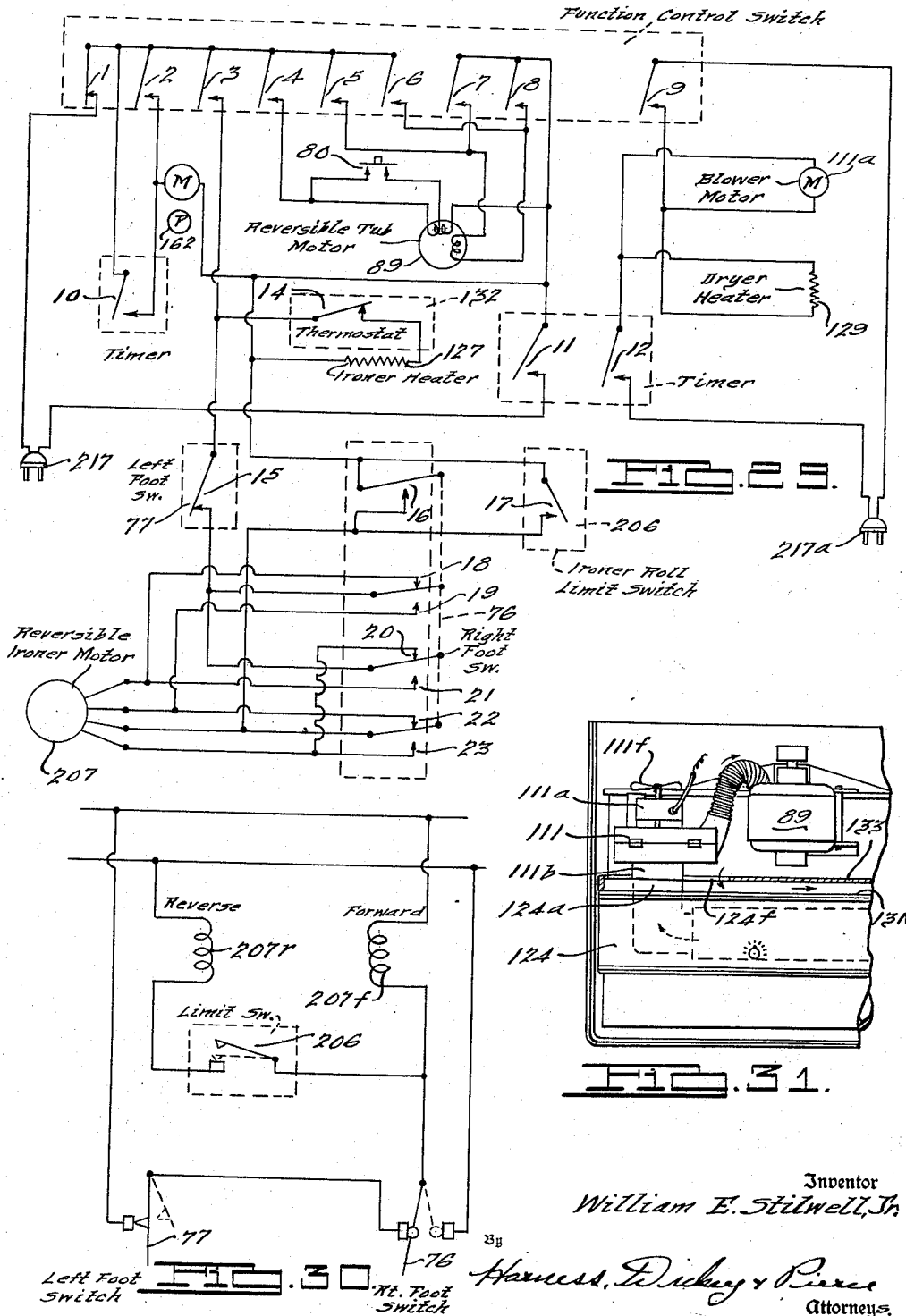
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APPARATUS FOR THE COMPLETE LAUNDERING OF FABRICS

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APPARATUS FOR THE COMPLETE LAUNDERING OF FABRICS

Filed Sept. 7, 1951

12 Sheets-Sheet 12

FUNCTION	MINUTES									
	CONTROL									
TUMBLE WASH	12									
TUMBLE DRAIN	2									
TUMBLE RINSE	3									
TUMBLE DRAIN	3									
SPIN EXTRACT	5									
SPIN RINSE	2									
SPIN DRY	15									
IRONER DRY	5									
FLUFF DRY	10									

FIG. 3 E.

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APPARATUS FOR THE COMPLETE LAUNDERING OF FABRICS

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Filed Sept. 7, 1951, Ser. No. 245,585

2 Claims. (Cl. 38—2)

My invention relates to laundering machines, and particularly to a machine in which fabrics to be laundered may be washed, rinsed, damp-dried, completely dried and ironed.

The primary objects of my invention are: to provide a unit washing, drying and ironing machine capable of processing a standard loading of soiled fabrics yet dimensioned within the limits conventionally established by single purpose machines; to utilize the common and concurrent mass, means and energies of one laundering subfunction to assist the operation and the results produced by one or more other laundering subfunctions; to locate the access opening to the laundering machine, the operating controls therefor and the ironer components adjacent to each other to permit the entire laundering operation of washing, drying and ironing to be conducted by the operator while in a single sitting position; to provide thermal energy accumulating means which is so utilized that the thermal power requirement rating is substantially less than in conventional laundering machines; to provide means for heating, circulating, delinting and/or dehumidifying the circulated air not only for the purpose of evaporatively drying the clothes but also for heating the clothes and the water during the washing, rinsing and extracting cycles; to provide novel washing, rinsing, extracting, drying and ironing mechanism in combination with novel transmission, control, mounting and vibration isolation structure in a single laundering machine; to provide a novel laundering machine having a receptacle which, when loaded with fabrics in accordance with the requirements of the evaporative drying cycle, provides better washability than when said receptacle is conventionally loaded in accordance with the requirement of the washing cycle; and, in general, to provide a laundering machine of the multipurpose type which is simple in construction, positive in operation and economical of manufacture.

Other objects and features of novelty of the invention will be specifically pointed out or will become apparent when referring, for a better understanding of the invention, to the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a perspective view of a laundry unit constructed according to my invention, with the ironer cover and loading door closed;

Fig. 2 is a perspective view of the laundry unit, with the ironer cover and loading door in open positions;

Fig. 3 is an enlarged fragmentary sectional view, taken on the line 3—3 of Fig. 1;

Fig. 4 is a similar view taken on the line 4—4 of Fig. 1;

Fig. 5 is a front view in elevation, with a part of the cabinet structure broken away to show the inner and outer tubs, the baffles and part of the spring suspension;

Fig. 6 is a rear view in elevation of the machine;

Fig. 7 is a side view in elevation of the machine, showing the tub assembly, with parts in section and parts broken away;

Fig. 8 is a top plan view of the machine, with the top of the cabinet removed;

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Fig. 9 is an enlarged vertical sectional view through the ironer roll and its cantilever beam support;

Fig. 10 is an enlarged end sectional view, taken along the line 10—10 of Fig. 9;

Fig. 11 is a vertical sectional view through the tub assembly;

Fig. 11a is an enlarged fragmentary perspective view of the nozzle illustrated in Fig. 11;

Fig. 12 is an enlarged broken view of Fig. 2, illustrating the control elements;

Fig. 12a is a further enlarged view of the function-timer dials illustrated in Fig. 12;

Fig. 13 is an enlarged perspective view showing the damper and operating mechanism as employed on the heat exchanger;

Fig. 14 is an enlarged exploded view of the driving mechanism for the receptacle;

Fig. 15 is an enlarged vertical sectional view through the heat exchanger, taken along line 15—15 of Fig. 12;

Fig. 16 is an enlarged sectional view through the ironer roll, taken on line 16—16 of Fig. 9;

Fig. 17 is an enlarged top plan view, partly in section, of the vibration isolator friction dampers illustrated in Fig. 8;

Fig. 18 is a diagrammatic view illustrating the air and thermal circulatory system for the drying cycle;

Fig. 19 is an enlarged vertical sectional view of a desiccant dehumidifier;

Fig. 20 is an enlarged vertical sectional view of a water spray dehumidifier;

Fig. 21 is an enlarged vertical sectional view showing a condenser type dehumidifier;

Fig. 22 is a horizontal sectional view of the machine, showing the tub assembly and spring suspension;

Fig. 23 is a diagrammatic view, including the wiring diagram for providing the automatic operation of the friction dampers;

Fig. 24 is a diagrammatic view of structure illustrating the water circulatory system;

Fig. 25 is a diagrammatic view of the supply valve shown in the tub-filling position;

Fig. 26 is a diagrammatic view of the supply valve shown in the overflow rinsing position;

Fig. 27 is a diagrammatic view of structure illustrating the overflow and the sump circulatory system;

Fig. 28 is a view showing an alternative position of the valve of Fig. 27;

Fig. 29 is a view of a wiring diagram showing the electrical circuits for semi-automatic and automatic operations of the machines;

Fig. 30 is a view of a wiring diagram showing a two-motor control for the ironer roll;

Fig. 31 is a fragmentary view of structure, similar to that illustrated in Fig. 8, showing an alternative arrangement of the blower;

Fig. 32 is a time cycle diagram for automatic self-cycling operation of the machine.

General arrangement

Figs. 1 and 2 illustrate the preferred embodiment of my invention, combining into a single appliance, with a view to maximum compactness and utility, all of the laundering functions of washing, drying and ironing. The cabinet 61 is in two main sections: the lower section 62 that houses the tub assembly, and the upper section 63 that houses the ironer component 64, the control elements 65, 66, 67 and 68 (better shown in Figs. 12 and 12a), and the various prime movers and auxiliaries. The front top section 69 of the cabinet is hinged, as shown at 70, to permit access to the ironer and the controls; the rear top section 71 is attached to the lower section 62 of the cabinet by screws or bolts (not shown).

to permit easy removal for servicing. The tub filling or loading door 72, locked by a latch 73a which is actuated by a button 73, is located in the lower section 62 of the cabinet, immediately below the ironer roll 64, so that the control elements for both operations of ironing and of filling and emptying the tub are convenient to the housewife as she sits before the unit. The location of the control panel 74 rearward of the ironer roll support casting and gear box 75 and the location of the ironer foot switches 76, 77 at the sides of the two toe-recesses 78 in the bottom front edge of the cabinet, complete the operational accessibility and convenience of the preferred embodiment of my invention.

In Figs. 12 and 12a are shown: the function control element 65 which is a dial marked off into the five sub-functions of "iron," "wash," "drain," "spin" and "dry"; the timer switch control element 66 is a dial marked off into the predeterminable minutes that each subfunction may persist before being shut off automatically; the motor brake push button 80; the control element 67 which is a handle for the water inlet valve; and the control element 68 which is a handle for the manual operation of a friction damper camshaft later to be described in detail.

Figs. 5 and 6 illustrate the compact yet simple arrangement of the major elements of the preferred embodiment of my invention. All of the functions of washing, rinsing, draining, spin extracting, ironer-drying, and fluff-drying are performed within the single receptacle assembly 79 whose outer tub 81 is resiliently hung from the cabinet walls by four coiled springs 82, the upper ends of which pivot on stationary hooks 83 and the lower ends of which are screw-attached at 84 to U-shaped cradles 85 welded or otherwise suitably fixed to the bottom of the outer tub 81. There is a rotatable inner receptacle 86 single, cantilever shaft 87 (see Fig. 7) is supported by ball bearings 88, and which is power-rotated by the electric motor prime mover 89 and belt transmission 90, to be later described in detail. The lateral peripheral wall 91 of the receptacle 86 has baffles 92 thereon to assist in the tumbling action of the clothes and is perforated to provide for the air and the water circulation, to be described later. As best seen in Figs. 7 and 11, the rear end plate 93 of the receptacle 86 has ribs 94 thereon for structural strength, and has a screened, segmented annular opening 95 to permit both the inlet water to enter the receptacle from the spray nozzle 96 and the heated, drying-cycle air to enter the receptacle through the venturi duct 97. The exterior side of the end plate 93 outwardly of the annular opening 95 is circumscribed by the wiping gasket 98 which assures that all of the hot air for the drying cycle and from the duct 97 will enter the receptacle and come into contact with the fabrics before escaping through the perforations in the peripheral wall of the receptacle and into the plenum chamber 100 formed by the clearance between the receptacle and outer tub which is preferably $\frac{3}{4}$ ".

The front end of the receptacle has a concentric, circular opening 101 approximately equal to the diametral distance between opposing baffles 92; the edge of the receptacle defining the inner edge of this opening 101 supports a wiping gasket 102 which bears lightly against the inner, front wall of the outer tub, and which serves to prevent the fabrics from being caught between the rotating receptacle and the stationary outer tub.

In the illustrated embodiment of my invention, the perforations 86a of the receptacle are $\frac{1}{4}$ " holes on $\frac{5}{8}$ " centers; there are six baffles 92 equally spaced, equilateral in section and $1\frac{1}{4}$ " radially high; the diameter of the receptacle at the base of the baffles is substantially 24", and the axial length of the tub is approximately 16". A receptacle so dimensioned and so configured is adequate to handle the tumble, evaporative fluff-drying of substantially six pounds of clothes and the tumble washing of approximately fourteen pounds of clothes.

In order to increase the impact effect at the terminus

of the parabolic trajectory of the fabrics as they are tumbled in the receptacle, the trailing surfaces of the baffles 92 or other lifting means are angled normal to the trajectory.

The outer tub 81 is illustrated as being a wrap-around type approximately $1\frac{1}{2}$ " greater in diameter than the inner receptacle. Its front opening 103 is eccentrically positioned and registers with the eccentrically positioned opening 104 in the lower cabinet section 62. The fabric filling opening is not only well above the working water level but also is within convenient reach of the operator when seated before the machine. The openings 103 and 104 are aligned with the upper half of the opening 101 in the receptacle. As best shown in Figs. 3 and 4, a bellows-type, watertight, throat gasket 105 connects the outer tub opening 103 with the cabinet opening 104, and the cabinet door 72 seals against the gasket 105 in the closed position. The gasket is formed with convolutions to permit maintenance of the watertight seal despite the various gyrating movements of the outer tub during the spin-extracting cycle.

Referring again to Fig. 7, there is recessed within the front face of the outer tub a counterweight 106 which serves to locate the front-to-back static center of the tub assembly approximately midway the axial depth of the inner tub. This results in better control of the excursions of the tub assembly during the spin-extracting cycle.

The rear of the outer tub is open and flanged outwardly as at 107 for its full diameter, not only to receive the inner receptacle but also the coned and ribbed bearing support plate 108. The plate 108 serves as the rear wall of the outer tub and is rigidly held to the flange 107 with a sealing gasket therebetween by a clamp ring 109 that is demountable by means of a threaded connector 110 (Fig. 6). Preferably the plate 108 is drawn from metal and is embossed with ribs and a central cup to serve as a bearing housing.

Several auxiliaries are attached to the outer surfaces of this double tub assembly. The centrifugal blower 111 (Fig. 6), the blower discharge duct 112, the venturi duct 97, the tub air discharge duct 136, the flexible blower inlet duct 113 (Fig. 8), the capacitor start motor 89 with its adjustable bracket 115, the high speed unidirectional driven pulley 116 and the low speed unidirectional driven pulley 117, the compound, intermediate pulley 118, the water inlet nozzle 96, the water overflow outlet 119, the sump 120 (Fig. 11), the suspension cradle 85, a centering member 121a (Fig. 8), and the friction damping blades 122.

The centering member 121a (see Fig. 8), is an up-standing blade fixed to the outer tub and positioned between a pair of tension springs 121 mounted on the frame. These springs acting on the blade 121a restrain undue oscillation of the tub assembly and maintain it in suitable operative relation with respect to the front and back of the cabinet when the friction damping blades 122 are not held against the stationary friction pads 175 by the cams 178 and 179 (see Fig. 17).

Heat exchange component

Immediately behind the ironer roll 64 (see Fig. 7), and both structurally and operationally associated therewith through the ironer shoe 123, is the heat exchanger 124, rigidly mounted to the cabinet on top of the clothes-return chute 125. Referring now to Fig. 15, in one embodiment of my invention the heat exchanger comprises a serrated or finned aluminum extrusion and heating element sandwich, all tightly bolted to the ironer shoe 123. In order of assembly, first comes the ironer shoe 123 with horizontally projecting, projection welded, screw studs 126, a spacer block 126a, then a mica-enclosed, resistance wire heating element 127, then the heat exchanger finned duct 128, then another mica-enclosed heating element 129, then a layer of thermal insulation 130, and finally a pressure plate 131. Insulating plates

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130a are provided at the top of the assembly and an insulating plate 130b is provided at the bottom thereof. Midway of the length of the ironer shoe is a thermostat 132 that controls the first heating element 127. A cover or shell 133 surrounds, and is spaced a short distance away from the rear of the heat exchanger, thus forming an air duct. The incoming air enters the orifice 124x and is drawn through the duct, thus warming the primary air before it enters the inlet end 134 (see Figs. 8 and 13) of the heat exchangers. At this inlet end there is a damper 135 actuated by a cam 135a by the operation of the function control dial 65. The output end of the heat exchanger (Fig. 8) is connected by a flexible duct 113 to the centrifugal blower 111.

To increase the thermal pickup efficiency of the heat exchanger, the ambient input air is drawn over the blower housing and through the space separating the heat exchanger cover from the heat exchanger itself. Under such conditions, I prefer that the blower inlet port 11b (see Fig. 31) be integral with the heat exchanger outlet 124a and that the blower itself be driven independently by its own motor 111a: the operational control is more flexible and the motor cooling fan 111f results in added pressure and heat for the air entering the heat exchanger through the entrance orifice 124f. The storing of heat in the exchanger when wattage is available before and during the washing and rinsing operations provides initial high heat from the low wattage source at the beginning of the drying cycle when the fabrics are saturated with water. The high temperature of the stored heat progressively lowers as the moisture content of the fabrics becomes less and less so that the stored heat is expended by the time the fabrics are dried.

Waste air conditioner

Closely associated with the drying cycle use of the heat exchanger are the special means I provide for the treatment of the hot, humid output air, to eliminate the steaming of the room walls and windows, as well as the pollution of the room air by the inevitable lint from the clothes as they are being fluff-dried. The drying cycle output air leaves the confines of the tub assembly through the tub discharge duct 136 (Fig. 8) and thence into the flexible air hose 137. In the preferred installation of my machine, this outlet duct may be directly connected to another ducting that leads to the outdoors atmosphere. When this type of installation is not practicable, I provide a removable screen or delinter 138 in the air outlet duct and I may, in addition, provide alternative means (Fig. 19) for dehumidifying the output air either by desiccating it with anhydrous calcium sulphate 138a for example, or by lowering its temperature with a cold water jet 139 (Fig. 20) or a cold water condenser (Fig. 21). Thus I provide for the installation of the delinter 138 and/or dehumidifier either within the drying cycle output duct 137 or as a separate attachment mountable to the machine at the air discharge port.

In the event that a desiccant is used for dehumidifying the drying cycle output air, I provide for the desiccant itself to be housed within a removable, screened container. After any single use of the desiccant, the operator must remove the container and place it in a heated oven for approximately one hour at 450° F.; this effectively steams off the absorbed moisture and reactivates the sulphate to the anhydrous state. On the other hand, when a desiccant is used as part of the heat exchanger system, as explained above, the reactivating cycle can be carried on in the machine itself prior to the desiccating function, and such a procedure permits the desiccant to be used additionally as a heat accumulator.

Tub drive means

The means illustrated in Figs. 5, 6, 7 and 14 comprising belts and pulleys for driving the ironer tub at two different speeds (say 49 r.p.m. and 490 r.p.m.) deserves special

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attention. To minimize the shock loads generally inherent in all washing actions, I provide for a unique all-belt drive, having neither gears nor remotely operated clutches. I provide, instead, an electrically reversible motor 89 having a driver pulley 89a and a driving belt 89b, the inside edge of which directly rotates the high speed unidirectional, driven pulley 116 at 490 r.p.m. and the outside flat of which rotates, in a reverse direction, the flat, compound pulley 118 at 350 r.p.m.; the smaller pitch diameter pulley 118a of the compound pulley 118 drives the larger unidirectional driven slow speed pulley 117 at 49 r.p.m.; each of the two driven pulleys is mounted on the inner tub drive shaft 87 and connected thereto by overrunning, spring-urged, roller clutches 143 and 144, both of which are designed to drive the tub only in the desired direction: namely, counterclockwise, when viewed from the rear end of the unit. Referring specifically to Fig. 14, shaft 89a rotates clockwise, as indicated by the arrow X, driven pulley 116 likewise rotates clockwise and idles, not driving the shaft 87, but the compound pulley 118, 118a rotates counterclockwise and so through belt 118b rotates the driven pulley 117 counterclockwise, the direction of rotation for which the overrunning clutch 144 is designed to pick up and drive the tub shaft 87. Thus, the tub is driven at low speed. When the motor is reversed, as indicated by the dotted arrow X₁, the driven pulley 116 and the overrunning clutch 143 rotate counterclockwise to drive the tub at 490 r.p.m. while the other overrunning clutch 144 and pulley 117 idle. When the tub has been running at its top spinning speed, and when the motor is de-energized momentarily and reversed to the direction needed for the slow speed (49 r.p.m.) of the drying cycle, the tub will coast and will be activated by neither driven pulley until it reaches 49 r.p.m., at which speed the slow speed driven pulley 117 will take over.

Water circulatory system

Since a desirable location for my combination laundering machine is in the kitchen, in alignment with other appliances or cabinets and against the wall, I provide plumbing connection in a recess at the top rear edge of the unit. As shown in Figs. 1 and 6, there are two threaded connections: one, 146, is for the hot and cold water inlet hose that, preferably, is connectable to the swing faucet of the kitchen sink; the other connection, 147, is for the drain hose that may have a hooked end fastenable over the front edge of the kitchen sink. Such a plumbing arrangement is primarily for a manually operable or removable unit. It is to be understood that a hot and cold water mixing valve may be attached to the hose 148 and that the hose 153a may be directly connected to drain for permanent installation. A conduit 139a connects a spray nozzle 139c of the dehumidifier 139b to the cold water line at the connector end 146a.

The inlet water flows from connection 146 through the hose 148, the manually operated valve 148a, the hose 148b and then through the jet nozzle 96 located in the end plate 108 of the outer tub 81, radially inward to the fabric orbit or annulus. The jet nozzle 96 is slotted vertically, as shown at 96a in Fig. 11a, so that the water spray impinges against the full axial length of the tub; this assures a more thorough rinsing action during the spin-rinse cycle of operation.

The draining of the outer tub 81 and of the inner receptacle 91 through the latter's lateral perforations 86a is accomplished in a semiconventional fashion. I provide a sump 120 (Fig. 7) that covers a large part of the lower section of the outer tub and that accepts water from the tub assembly through the perforations 120a. A flexible drain hose 150 (Fig. 6) connects the sump 120 with the inlet port 151 of the motorized vane-type drain pump 152 through the optional valve 156. The discharge port 153 of the pump is connected by hose 153a directly to the drain connector 147 in the recess at the top rear edge of the cabinet. In the event the valve 156 is eliminated, the

draining of the tub is merely a matter of energizing the motorized pump 152. In the event that an overflow port 119 is installed at the working water level of the tub assembly and connected to the inlet of the pump by the flexible hose 154, the valve 156 is kept closed and the pump energized during the tub filling operation; as soon as water appears in the drain hose from the unit, the inlet water is turned off because then the tub has its proper water loading.

Drain hose 158 joins with the pump inlet hose 153 or the overflow port hose 154 (Fig. 6) to carry off the condensate and/or cooling water from the dehumidifier 139b located in the air output duct 136 from the outer tub. Several types of dehumidifiers are variously shown in Figs. 19, 20 and 21; they may be installed in a nonrecirculatory system (Fig. 18); they may be dispensed with entirely, letting the hot, moist, lint-laden air escape to the surrounding atmosphere or be piped to the out-of-doors through an auxiliary duct system; or, as in Fig. 8, the outer tub outlet duct 136 may be connected by a flexible duct 137 to and through a removable delinter screen 138. In the event a cold water spray dehumidifier (Fig. 20) is used, the delinter 138 may be eliminated since the water spray actually washes out the air suspended lint; thus the lint, the condensate and the cooling water are carried off by the drain hose 158. Fig. 21 shows, in general, a condenser type dehumidifier in which the output air passes over internally-water-cooled surfaces. Since the cooling water is under tap pressure, it may be self-draining, or it may connect directly to the condensate drain hose 158, or through an aspirator (not shown) it may serve as the draining medium for the condensate, thus eliminating the need for operating the drain pump 152 during the drying cycle. Fig. 19 shows the use of a desiccant (anhydrous calcium sulphate) for the removal of excess moisture from the drying cycle output air; the desiccant is held in a removable, screened container. It must be reactivated after each use either by supplying heat in situ when embodied in the heat exchanger 124, or by heating in a separate appliance.

Referring next to Fig. 24, a further arrangement involves a form of hydraulic impingement that comprises water jets 160 located in the upper section of the outer tub 81 and directed toward the inner receptacle 91 to assist in both the tumbling action and in the rinsing action. The jets may be connected to a forced circulatory washing solution system, as indicated by the dotted lines 162a, whereby a pump 162 circulates water from the sump 120 through the nozzles of the jets 160 or, as shown in full lines, the jets may be connected to the inlet supply line 161 by means of valves 163.

Fig. 25 shows a position of the valve 163 whereby the supply water is directed to fill the tub.

Fig. 26 shows a position of the valve 163 whereby the supply water is directed into the sump line for the purpose of overflow rinsing.

Figs. 27 and 28 show a valve 163a suitable for connecting the sump 120 to the drain pump P or, in its alternate position (Fig. 28) connecting the overflow 119 to the drain pump.

Friction damping means

Previously I have referred to the friction dampers that constitute an important part of the vibration isolation system. In Fig. 17 the friction dampers comprise two rigid blades 122 mounted on the top outer section of the outer tub. The rearward faces of these blades are covered with suitable friction material 172. The blades themselves are free to gyrate within the frameworks 173 that are rigidly mounted on the cabinet itself. In the rearward, vertical faces 174 of these brackets, are mounted adjustable buttons 175 having frictional material 175a secured to the faces thereof. Arranged to cooperate with these members is a horizontal shaft 177 carrying two cams 178, 179 which are actuable by the control handle

68. In the "off" position these cams allow all of the freedom apparently necessary for the gyrating of the tub assembly during the spinning cycle. In the "on" position, as seen in dotted lines of Fig. 15, and as obtaining preferably only during the acceleration and deceleration of the rotating receptacle, these cams 178, 179 lock the friction material faced blades 122 against the friction material faced buttons 175 and so impose the friction damping needed to reduce the amplitudes of the spinning cycle vibrations, that is, while I provide damping preferably only when the receptacle is passing through its resonant velocity. I further provide a leaf spring locking clip 180 (Fig. 12) for holding the camshaft operating handle in the "on" position.

Referring to Fig. 23, automatic operation of the dampers may be readily provided by use of solenoids. When the solenoids 179a and 179b are energized by closing the switch 179d, the friction members 178a are urged against the blades 122, previously disclosed as mounted on the outer tub, and into contact with the fixed friction members 175 mounted on the frame. The solenoids are de-energized by a centrifugal switch 179c mounted to rotate in conformance with the tub rotation.

When the function control dial is moved to the spin-extract position requiring high speed operation of the tub, the switch 179d is closed, thus energizing the solenoids 179a and 179b and actuating the friction dampers to prevent resonant vibration which occurs during the accelerating period. However, as the tub approaches its maximum speed, where damping is no longer required, the centrifugal switch 179c opens to break the circuit to the solenoids and release the friction devices. When the function control dial is moved off the spin-extract position, the rotating receptacle decelerates; the centrifugal switch closes but the friction dampers are not activated as the switch 179d is now open.

Ironer component

In Fig. 2 the cabinet ironer cover 69 is shown in the open or operating position. The ironer roll 64 itself is of conventional design, being a metal tube covered with a semipermanent padding and a removable, draw-string covering. Referring now to Figs. 9 and 10, the roll is capable of two degrees of movement, the first a rotation as indicated on the drawing by arrow Y on its concentric axis 181, and the second a rocking motion towards and away from the stationary ironer shoe 123 on an eccentric axis that is concentric to the fixed tubular cantilever beam 182 which is rigidly held by the roll support casting and gear box 75. The roll concentric axis 181 is essentially a stub shaft, the inboard section of which is rigidly fastened, as by weld 183, to two Y-shaped yokes 184 that, in turn, are pivotally mounted on the tubular cantilever beam 182 by the spaced sintered oil-impregnated bearings 185. The outboard section of the shaft supports a sleeve 186, to one end of which is keyed or otherwise affixed, as by a pin 186a, the rocking gear 187, and to the other end of which is slidably keyed a series of metal discs 188 that constitute part of the multiple disc clutch 189. The clutch housing 190 has the ironer roll fixedly mounted thereto by screws 190a and its inboard face has an internal gear 191 which meshes with the driver gear 192 which is keyed to the driver shaft 193. The housing 190 is rotatably mounted on the sleeve 186 on the oil-impregnated bearing 185a and within its outboard cavity are housed the friction discs, alternate ones being slidably keyed to it by the integral, axial bosses 194. The extreme outboard end of the stub shaft 181 is threaded as at 181a to receive the adjusting wing nut 195 that serves as the means for establishing the friction torque of the clutch 189 through the coiled spring 196 and the two pressure caps 197 and 198. A thrust bearing 199 is inserted next to the inboard face of the rocking gear 187.

The rocking action is obtained by the meshing of gear 187 (see Fig. 16) with a segment gear 201 that is concentrically and fixedly mounted to the outboard end of the tubular, cantilever beam roll support 182. The two spaced Y-yokes 184 (Fig. 9) have radial extensions 184a at the ends of which are mounted rollers 203 that bear on internal bands 204 spot-welded to the inner surface of the ironer roll 64 and serve to stabilize the ironer roll. A stationary bumper 205 (Fig. 10), fixed to the beam 182, limits the extent of the open position of the ironer roll when engaged by a roller 203, as illustrated in broken lines. A limit switch 206, actuated by the cradle stub shaft 181 when the ironer roll is in open position, de-energizes the ironer prime mover 207 by opening the reversing circuit. A groove 208 (Fig. 9) in the inboard end of the ironer roll serves to keep the tightened draw-string of the ironer roll covering clear of the tubular, cantilever beam.

The roll supporting casting and gear box 75, in one embodiment of my invention, is semi-permanently, rigidly mounted to the reinforced plate 210 that serves as the top of the lower section of the cabinet 62. The gear box is compact and is mounted as low as possible to permit maximum use of the so-called "closed-end" of the ironer roll. The inboard end of the tubular cantilever beam 182 is firmly held within gear box 75 by set-screws or other means not shown. Within the gear box 75 (Fig. 7) is the speed reducer spur gear train 212 that drives the shaft 193 through the gear 193a at such a speed that the reduction through pinion gear 192 and internal gear 191 results in the desired ironer roll speed, generally 7.5 r.p.m. The ironer prime mover 207 (Fig. 7) can be a $\frac{1}{20}$ horsepower, electrically reversible motor that drives the gear box primary shaft 212a by means of a V-belt 213.

Within the two toe-recesses 78 (Fig. 1) are mounted the switches for controlling the two motions of the roll 34. Switch 76 is a multiple pole, double throw, motor reversing switch. In the normally open position, the electrical connections of this switch are such that the motor will cause the roll-shoe sandwich to open, that is, will cause the ironer roll 34 to rock about the supporting beam 182 and move toward the operator. This opening movement away from the ironer shoe 123 is automatically limited by rod 205 and at the end of the movement the opening of the reversing circuit through limit switch 206 within the ironer roll 64 interrupts the motor operation. In the closed position, arrived at by the operator's foot pressure on actuating blade, switch 76 is so connected electrically that the drive shaft 193 within the tubular cantilever beam will rotate clockwise, as seen in Fig. 16, and in turn will rotate the internal gear 191, the ironer roll 64 and the rocking gear 187 clockwise; gear 187 rides on the stationary fixed segment gear 201 and thus rocks the stub shaft 181 and the supporting cradles 184 clockwise and toward the ironer shoe 123. All of these clockwise movements will continue until the ironer roll 64 comes into such predetermined ironing pressure contact with the ironer shoe 123 that the previously established friction torque reactions of the multiple disc clutch 189 will be exceeded; at such a point the rocking action ceases, the clutch slips and relative motion is then established between the still rotating clutch housing 190 and the then stationary rocking gear 187, so that the ironer roll 64 is rotated as required for ironing operation.

Foot switch 77 is a single pole, single throw, normally closed and is used in series with the electrical supply to the ironer prime mover 207. No matter in which direction the motor 207 is rotating, whether to rotate the ironer roll 64 clockwise or counterclockwise, the direction of rotation cannot be reversed unless this foot switch 77 is actuated to the open circuit position. Taking full advantage of this switching characteristic of reversible, split phase motors, I have been able to achieve a unique and

highly desirable ironing action. If the operator actuates foot switch 76 and then releases it to its normal position, the ironer roll 64 will rotate clockwise on both its concentric and its eccentric axes and continue to rotate on the concentric axis after the ironing pressure has been established. If the operator then momentarily actuates foot switch 77, the main electric supply to the prime mover 207 will be disconnected long enough for the motor rotor speed to drop to that value required for reversing at the instance of foot switch 76 which, under the condition specified immediately above, is in the normal or counterclockwise rotation position; then the ironer roll rotates and rocks backwards, toward the operator, until the limit switch 206 opens the reversing circuit to the motor. This is the type of series of roll movements normally required in the process of ironing.

On the other hand, a pressing action, defined as maintenance of ironing pressure without relative rotational movement between the ironer roll and the ironer shoe, may be achieved with this same set of foot switches merely by altering the operational sequence. If the operator causes the ironer roll 64 to move into pressure contact with the shoe 123 by actuating foot switch 76, and retains the switch in actuated position, the ironer roll will continue to rotate clockwise in ironing pressure contact with the ironer shoe 123; as a matter of fact, this ironing action, once started, will continue whether the right foot switch 76 is in the actuated or in the normal position. Now if, while foot switch 76 is held in the actuated position, the foot switch 77 is likewise held in the actuated or "off" position, the clockwise, concentric axis rotation of the roll will cease, because the prime mover 207 has become disconnected and the desired pressing action will have been achieved.

The ironer roll will continue in this "pressing" position as long as both foot switches are held in the actuated position; however, if foot switch 77 is de-actuated first, the ironer roll 64 once more assumes its ironing or clockwise rotary movement; on the other hand, if foot switch 76 is de-actuated first and then the foot switch 77 is de-actuated immediately thereafter, the ironer roll will take on a counterclockwise rotary movement and return to its normally open position.

Electrical control circuits and means

Fig. 29 shows the complete, electrical wiring diagram for the preferred semi-automatic embodiment of my invention. There are twenty-three single pole switches involved. Switches No. 1 to No. 12 are all cam operated; switches No. 1 to No. 9 are operated by the cams (not shown) mounted on the function control dial shaft 157; switches Nos. 10, 11 and 12 are operated by cams (also not shown) mounted on the timer dial shaft 216. Switch No. 80 is the manually operated push button previously mentioned, located just beside the function control dial 65, and serves to shunt out the centrifugal starting switch normally associated with electric motors of the type herein described. Switch 80 is actuated by the operator immediately after the function control dial 65 has been so turned that a reverse in the direction of rotation of the tub motor 89 is required to produce the change in the tub operational function. Actually, the actuation of push button 80 serves to brake the motor dynamically and so condition the motor for quick reversal.

The motor braking push button 80 may be made automatic in its operation by incorporating it with the motor reversing switches as a momentary, wiping contactor.

In one embodiment of my invention there are two independent, separately fused 115-volt, 1650 watt supply circuits. In the event of the availability of three wire 220-volt electric supply service, the same wiring diagram prevails as will be readily understood by those skilled in the art. In the event that the drying cycle is operated on the thermal storage principle, the second 115-volt circuit, involving switches No. 9 and No. 12 may be eliminated,

As shown in the wiring diagram, this second circuit is used primarily for the booster heating element 129 at the back of the heat exchanger 124. The wiring diagram for this second circuit includes a motor 11a for the centrifugal blower 111. This individual drive for the blower (illustrated in Fig. 31) is alternative to the belt drive 111b shown in Fig. 6.

In the event that a belt drive is used, however, I have found it preferable to employ the damper 135 as previously described at the inlet of the heat exchanger (Fig. 13) and to operate the damper automatically by a cam 135a attached to the function control dial shaft 157 so that the damper 135 is closed during the washing and draining cycles.

Referring again to Fig. 29, the switch No. 1 is normally closed and is opened midway between each of the six positions of the function control dial. The purpose of this switch is to clear the main circuit between actuations of the other cam operated switches.

Switch No. 2 actuates the motorized pump 162 during the draining and the spinning cycles. In the event that the overflow outlet is provided for the tub assembly, along with the proper valving, the washing cycle is added to the functional periods that switch No. 2 is actuated to the "on" position. In the further event that a dehumidifier is used, the drying cycle is added to such actuating periods for switch No. 2.

Switch No. 3 is actuated to the "on" position during all of the functional cycles except spinning. The ironer motor circuit and the first heat exchanger heating element 127 are energized by switch No. 3. Thus, the ironer may be operated concurrently with all other laundering functions except during the start of spinning; the reason for the exception, patently not mandatory, is to minimize the line voltage drop when the inner tub is being accelerated to the top spinning speed.

Switches Nos. 4, 5 and 8 are actuated to the "on" position when the tub motor 89 is to be rotated clockwise (from the output end) for the low-speed operation of the inner tub, that is, during the washing, draining and drying cycles.

Switches Nos. 4, 6 and 7 are actuated to the "on" position when the motor 89 is to be rotated counterclockwise for the high speed spinning cycle.

Switch No. 9 is actuated to the "on" position during the drying cycle only. In the event, however, that line voltage conditions permit, I have found that the evaporative drying potential of the spinning cycle is greatly enhanced if the induced draft caused by the spinning tub is allowed to be drawn through the heat exchanger previously brought up to operating temperature by having switch No. 9 in the "on" position during the preceding cycles.

Switches Nos. 10, 11 and 12 are actuated to the "on" position by cams mounted on the shaft 216 driven by the timer 66 (Fig. 6). Switches Nos. 11 and 12 are actuated as long as the timer dial 66 is not in the "off" or zero time position. Switch No. 10, which controls the motorized pump 162, is timer-shaft actuated only during the last five minutes of a full revolution of the timer dial 66; this, fundamentally, is automatic self-cycling and may be used in two ways: first, to permit draining of the tub without rotation of the tub, and second, to permit the operator to fill the tub with the prescribed amount of clothes, water and detergent, to set the function control dial 65 at "wash," to set the timer dial 66 for any required time, and then leave the unit, knowing that for the last minutes of the washing period the washing water will be draining out of the tub; all other non-ironing functions can be made similarly automatically self-cycling.

Switch No. 14 is part of the thermostat 132 and is in series with the first heating element 127 of the heat exchanger 94. Should conditions warrant, a similar ther-

mostat may be placed in the heater circuit controlled by switch No. 9.

All switches from No. 2 to No. 12 and No. 80 are normally open.

Switches Nos. 15 to 23 are devoted exclusively to the ironer roll action, as previously described. Switch No. 15, normally closed, is the left foot switch 77 located in the cabinet, toe recess 78 and is in series with the main, cam operated ironer switch No. 3, but does not affect the circuit to the first heating element 127.

Switches Nos. 16 and 18 to 23 constitute the right foot switch 76 located in the cabinet toe recess 78. Switch No. 16 is single pole, single throw, but switches Nos. 18 and 19, 20 and 21, and 22 and 23 are paired as single pole, double throw switches.

Switch No. 17, in multiple with switch No. 15, is the limit switch 206 within the ironer roll 64. When switches Nos. 15, 17, 18, 20 and 22 are in the closed position, all other ironer switches being open, the ironer roll will rotate counterclockwise. At the end of this movement, the automatic opening of switch No. 17 (206) interrupts said counterclockwise rotation of the ironer roll 64. The manual opening of switch No. 15 (77) has the same effect. When switches Nos. 16, 19, 21 and 23 are closed, the ironer roll 64 will assume a clockwise rotation.

The spin extracting of clothes requires a higher momentary demand on the prime mover than does any other cycle. This high demand occurs during the tub accelerating period; as a precautionary assurance that full voltage will be available for accelerating the masses involved, I provide means for momentarily disconnecting all other major demands on the electric circuit at least during this accelerating period. The momentary disconnect principle applies especially to the heating element 127 and the ironer motor 207, the circuit to which is opened momentarily by cam-operated switch 3 when the switches 4, 6 and 7 are initially moved to "on" position. The resulting discontinuity in the supply circuits to the affected components is shown in Fig. 32 where it will be observed that the first heater 127 and the ironer motor are momentarily de-energized as the spin-extracting commences. Similarly, if the second heater 129 is also employed to provide heat for storage, the switch 12 will be removed from the blower circuit to control the heater 129 and will be opened momentarily when switches 4, 6 and 7 are initially moved to "on" position.

Operation

The operation of the preferred embodiment of my invention is fundamentally different from any and all conventional laundry appliances in that, in the subject instance only, are all of the laundering subfunctions so compacted and so operationally correlated that the total laundering operation can be performed more efficiently and more conveniently than heretofore possible.

In the first place, my machine can be installed even in a small kitchen or bathroom having the necessary plumbing and electrical facilities adjacent to the selected installation point. The top of the cabinet is a convenient continuation of the standard kitchen counter working surfaces; the depth matches that of standard kitchen cabinets; the unit may be fully operated without need for moving it away from the kitchen wall (as, for example, most console type conventional ironers must be moved) and, also, without need of open spaces to either side of the unit.

To prepare my unit for operation, the water filling connection 146 at the top rear of the cabinet is attached by a flexible hose to the swing, hot-cold water faucet. To the drain connection 147 is attached a flexible, drain hose that may be hooked over the edge of the sink, and the two electric conductors 217 and 217a are plugged into two 115 volt, alternating frequency, separately fused, standard wattage circuits. The machine itself should be leveled by adjusting the four buttons 218 at the bottom

corners of the cabinet; no bolting down is necessary since I have provided for a satisfactory vibration isolation system. It is to be understood that the water and drain connections may be permanently made to the supply line and drain, as mentioned above.

To start the laundering operation, turn on the hot water supply at the tap source. Swing back the ironer cover 69; set the timer dial 66, set the function control dial 65 to "off"; lock in the friction damper handle 68; set the thermostat 132 (Fig. 8) to the "high" position; turn the water valve handle 67 to "on" and permit the water to enter the tub until the level is even with the special marking (not shown) on the inner, back face of the receptacle; this will mean about six gallons of water, enough for six pounds of clothes, dry weight. Press the latch button 73 (Fig. 1) to open the filling door 72 and add the necessary amount of detergent; close the door and turn the function control dial 65 to "wash" for a minute or so to permit the detergent to go into solution; return the dial 65 to "off" and place approximately six pounds of fabrics in the receptacle; set the dial 65 to "wash" and allow the tumble washing action to proceed for some ten minutes. Turn the dial to "drain" and after all of the free washing solution has been pumped out, and while the receptacle is still rotating, admit rinsing water by turning the valve handle 67. This first rinse may be hot or cold, as desired. Allow the rinse water to drain out completely, set the dial 65 to "spin" and press the button 80 momentarily; it is optional whether to go directly from "drain" to "spin" or to stop the machine first, remove the fabrics and then place them one by one back in the receptacle after the latter has been brought up to full spinning speed. In either event, after the loaded receptacle has assumed its top speed, turn the damper handle 68 to the "off" position, thus essentially isolating all vibration from the cabinet.

After the spin extraction cycle has operated for some three minutes, admit hot water to the tub by turning the valve handle 67. In the subject design the spray nozzle 96 causes the inlet water to wet the impinged fabrics continuously as they pass by the jet; this affords not only a superior type of centrifugal rinsing action but in addition raises the temperature of the fabrics, an important advantage both to centrifuging and to subsequent evaporative drying. Turn off the hot spray rinse and allow the fabrics to centrifuge for several additional minutes; it is interesting to note that during this spinning period some 26 c.f.m. of hot moist air will flow out of the tub outlet 136, indicating a concurrent evaporative drying, a phenomenon that makes a combination washing and drying machine superior, for the spin-extracting cycle, to conventional single purpose machines.

The next step in the operation of my machine is to turn the function control dial 65 to "dry," press the push button 80 momentarily and relock the friction dampers with the handle 68. If the spin-extracting cycle has been properly operated, a normal six pounds loading of fabrics can reach the fluff-dry condition (i.e. the linen-closet-storing-condition) in approximately thirty-five minutes; this represents an evaporative drying efficiency quite superior to conventional machines. Under less careful handling of the spin-extracting cycle, however, the normal length of the evaporative drying cycle for my machine is thirty-five minutes for ironer-dry and an additional thirty minutes for fluff-dry. If the timer dial 66 has been set initially for such average drying periods, the unit will stop automatically and the fabrics may be removed for ironing or for storing, as the case may be. While I have indicated the operations as above set forth as being accomplished by manual operation of the control elements, the use of the motor operated timer illustrated in Fig. 29 automatically produces the machine operation in the same sequence.

In the event that all of the fabrics within the tub are to be ironed, it is good practice to leave them in the re-

ceptacle and remove them one by one as the ironing task progresses.

The ironing method to be followed in the use of my machine is somewhat similar to conventional machines; the fabrics are fed over the top of the ironer roll 64 and into the roll-shoe pressure sandwich, setting the function control dial 65 to "iron" or to any other position except "spin" (see above) and setting the timer dial 66 to the desired limit, is all that is needed to place the ironer component in standard operating condition. There are, however, certain important departures from standard practices; first, the ironing shoe 123 is stationary; second, the shoe temperature is evenly maintained by the heat exchanger mass; third, the ironing pressure is constant regardless of the thickness of fabrics put through the roll-shoe sandwich, due entirely to the slipping friction clutch principle; fourth, the so-called "closed-end" of the roll is more open due to the eccentric mounting of the roll; fifth, the roll 64 is 24' long—the distance between the shoulders of an average shirt, thus facilitating the ironing of shirts; sixth, the foot control of both the rotary and the rocking actions of the roll 64 is prerequisite to the marked improvement in freedom of the operator's hands for smoothing and guiding the fabrics into the roll-shoe sandwich; seventh, the finished ironing may be stored temporarily on the shelf made by the opening of the ironer cover 69; eighth, the fabrics to be ironed are not only more uniformly and properly dampened but are convenient to the operator sitting before the machine; ninth, the ironer may be considered definitely safer than conventional types, due to the dual foot control; and, tenth, the structural and functional, compact correlation with the other laundering functions makes the ironing function itself more efficient.

What is claimed is:

1. In a laundering machine for fabrics, a tub, a receptacle rotatably mounted in said tub, means for driving said receptacle, blower means for producing a flow of air to and from said receptacle, an ironer having a movable element and a shoe supported upon said cabinet, thermal storage means forming a part of said shoe having a passageway for air therethrough, heating means for said thermal storage means for storing heat in said thermal storage means and supplying heat to the shoe of said ironer, and means for connecting said blower means to the passageway through said thermal storage means and to said tub for delivering air thereto at a high initial temperature which decreases as the moisture content of the fabrics decreases during the drying thereof.

2. In a laundering machine for fabrics, a tub, a receptacle rotatably mounted in said tub, means for driving said receptacle, blower means for producing a flow of air to and from said receptacle, an ironer having a movable element and a shoe supported upon said cabinet, thermal storage means forming a part of said shoe having a passageway for air therethrough, heating means for said thermal storage means for storing heat in said thermal storage means and supplying heat to the shoe of said ironer, and means for connecting said blower means to the passageway through said thermal storage means and to said tub for delivering air thereto at a high initial temperature which decreases as the moisture content of the fabrics decreases during the drying thereof, whereby the initial thermal energy input to the tub during the drying cycle is greater than the thermal energy input to the machine during said cycle.

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