

July 23, 1963

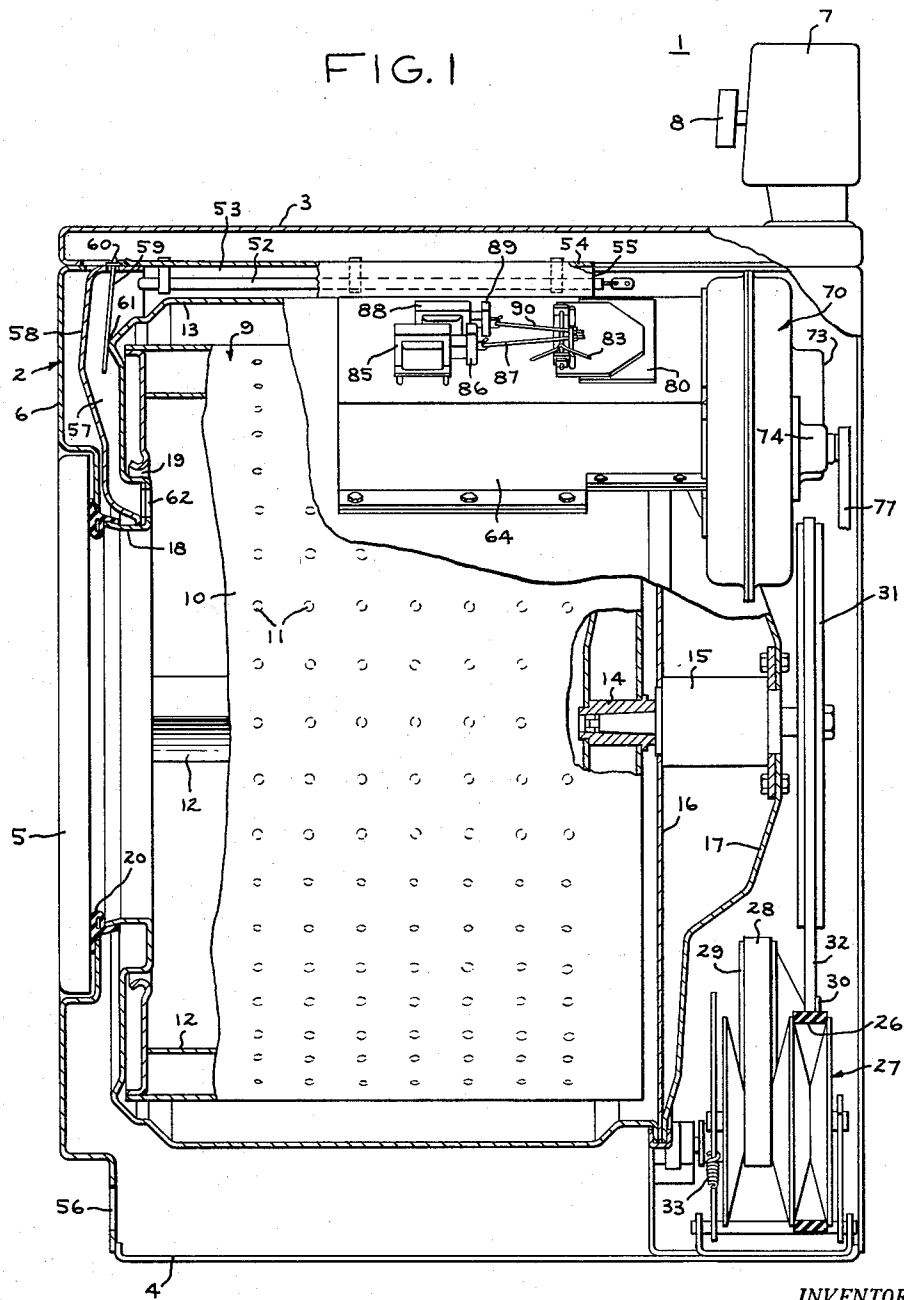
A. M. STONE

3,098,726

CLOTHES DRYING MACHINE

Filed Feb. 27, 1961

5 Sheets--Sheet 1



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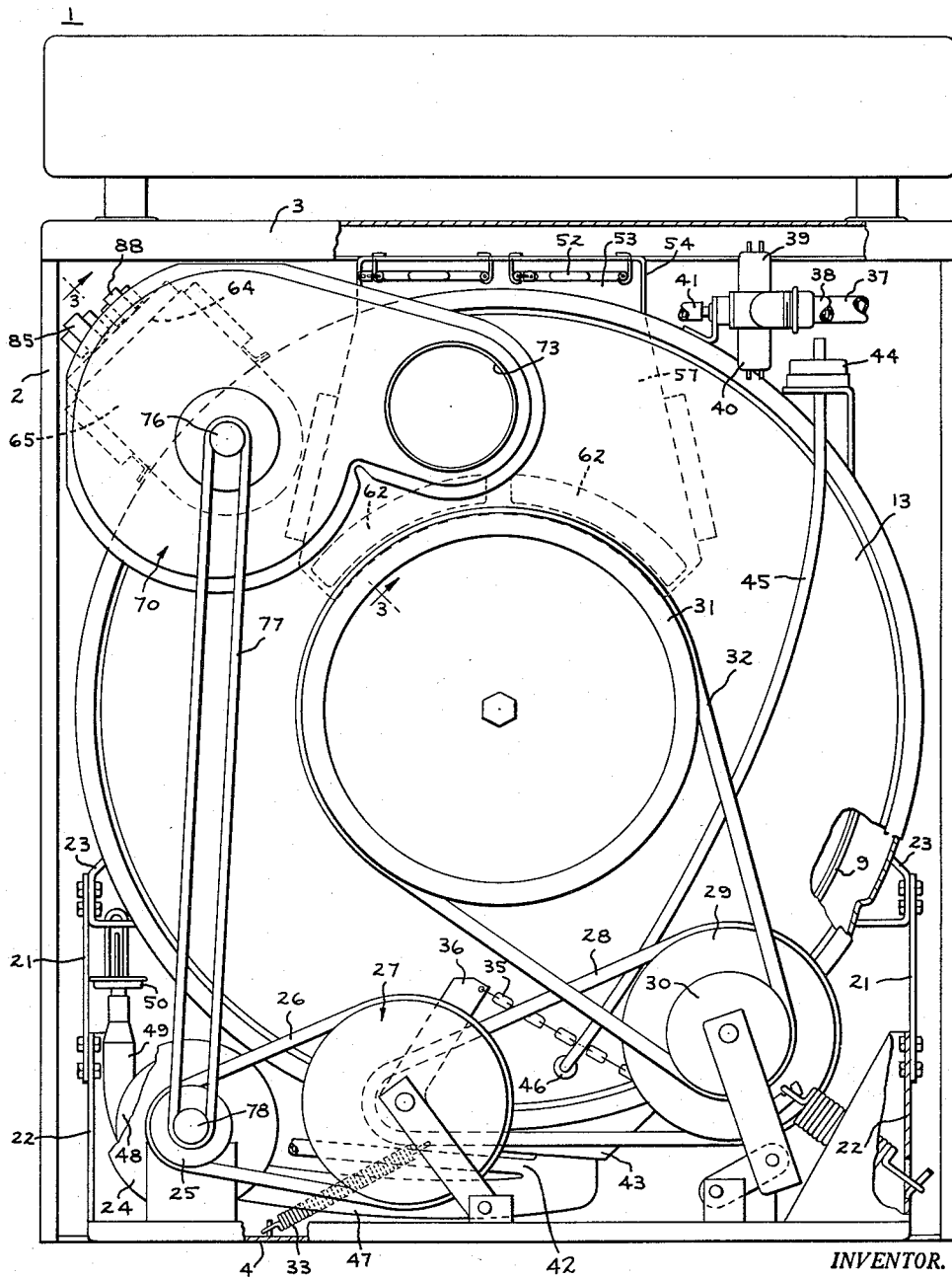


FIG. 2

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3,098,726

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FIG. 3

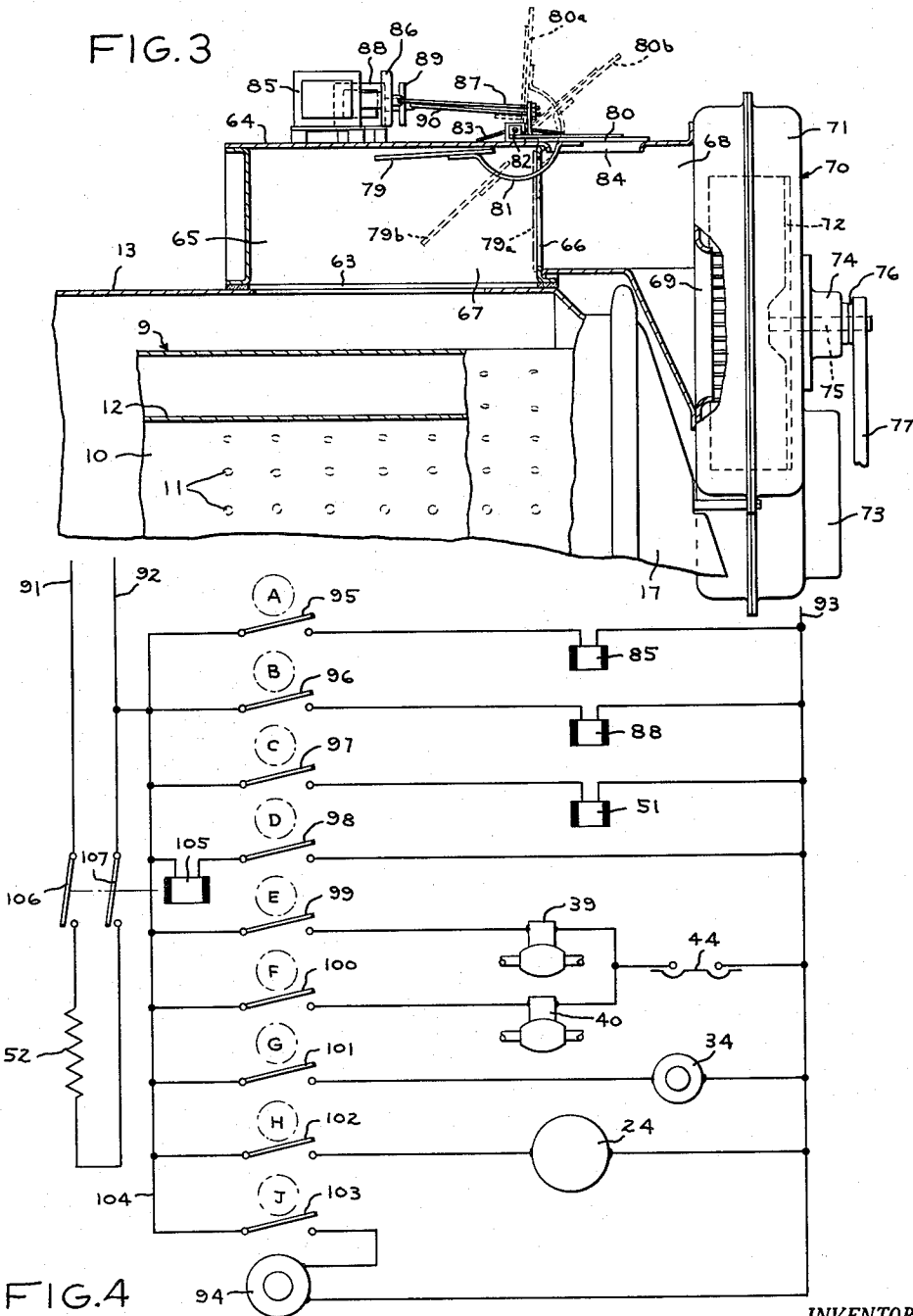
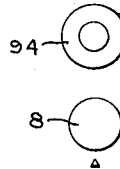


FIG. 4



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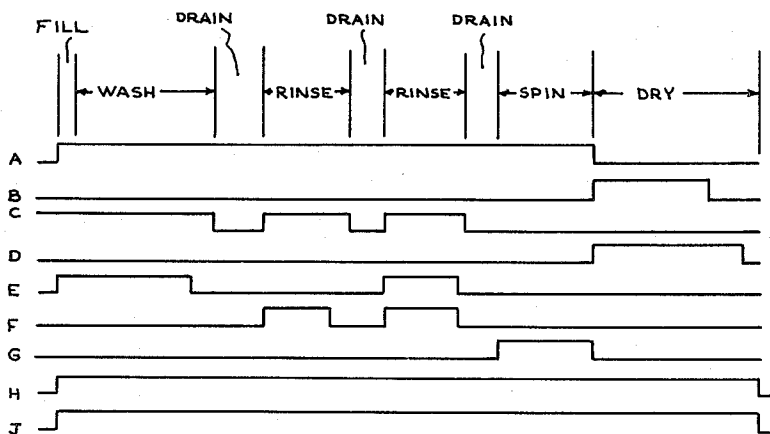
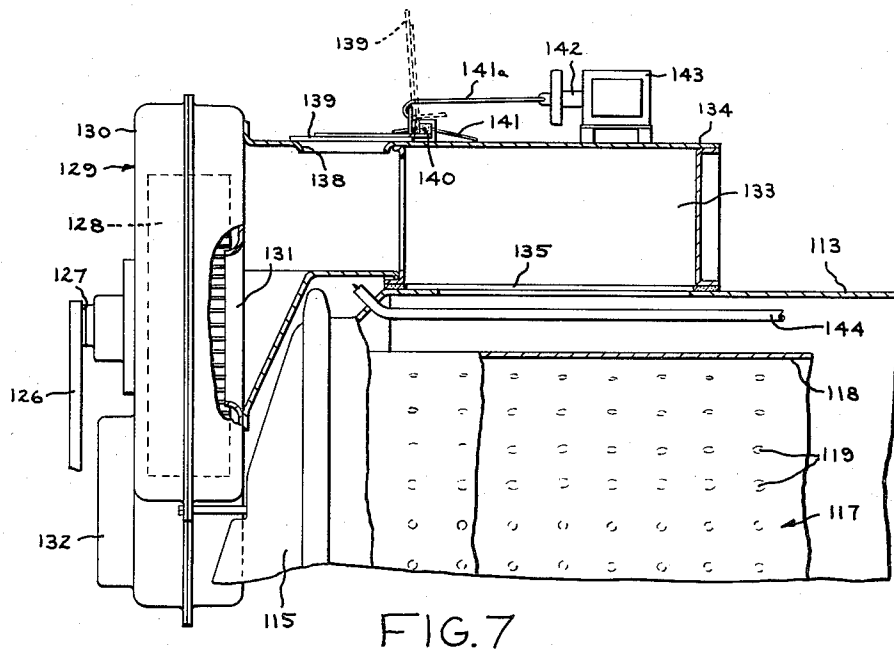


FIG. 5

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5 Sheets-Sheet 5

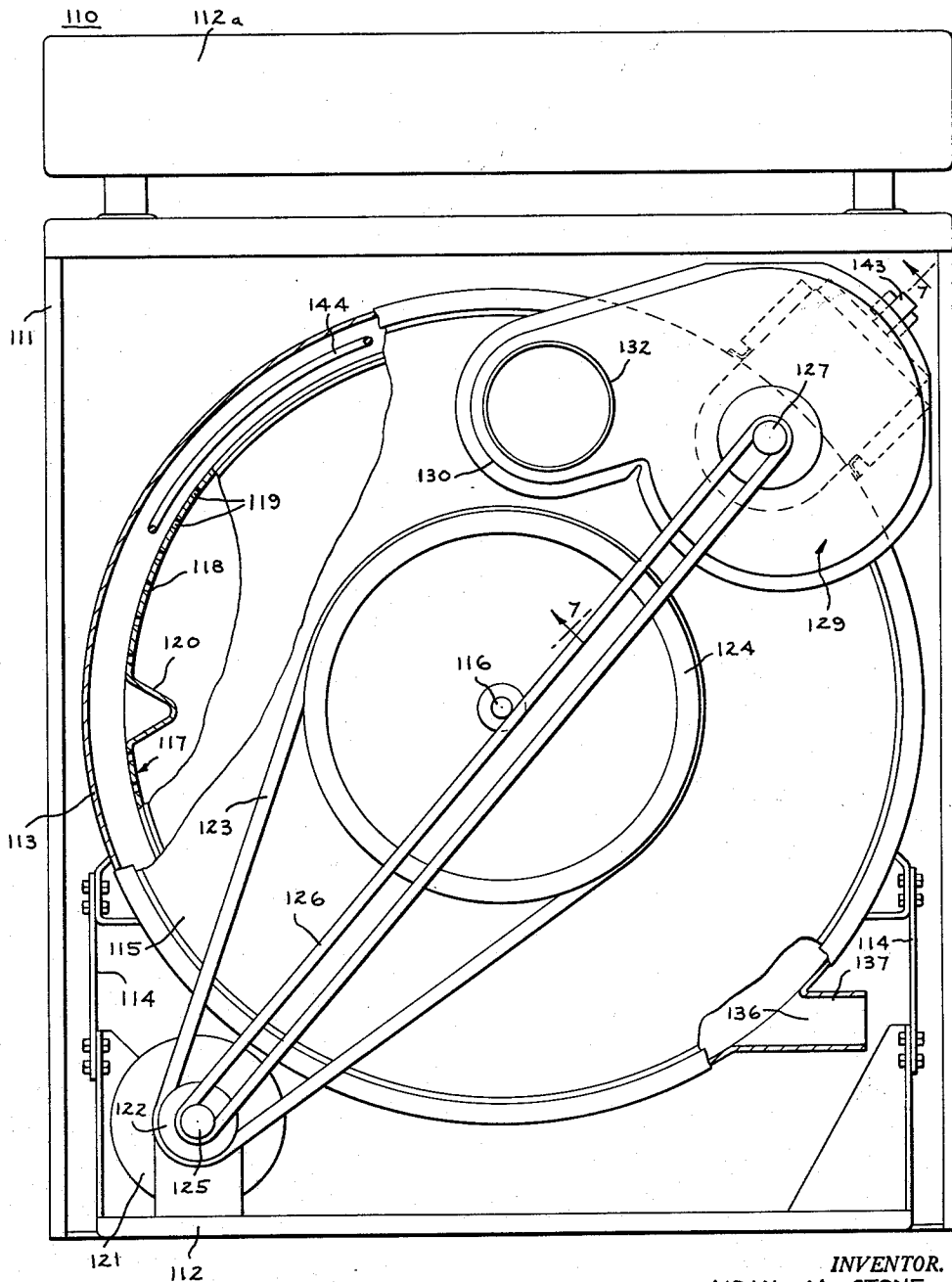


FIG. 6

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3,098,726

CLOTHES DRYING MACHINE

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Filed Feb. 27, 1961, Ser. No. 91,934

2 Claims. (Cl. 34—133)

This invention relates to clothes drying machines, and more particularly to such machines of the type wherein drying air is pulled from atmosphere through the chamber in which the clothes are contained, and is then expelled again to atmosphere.

One advantageous form of clothes drying machine which is marketed for home usage provides a container for clothes in which the clothes are tumbled, and through which a stream of air is caused to enter through one opening and leave through another. The stream of air passes over the clothes so as to remove any moisture which has been vaporized out of the clothes.

The more recent commercially available structures of this type provide the means for creating the air stream—usually a blower—on the downstream side of the clothes container in order to minimize the collecting of lint (created by the usual tumbling action imparted to the clothes) on the various operating parts of the machine. The downstream position of the blower does this by causing the clothes container to be under a slight vacuum so that any leakage between the clothes container and other parts of the machine causes air to pass into the clothes container. This is directly opposite to the result reached where the air moving equipment pushes the air into the clothes container, i.e., it is upstream of the clothes container: the pressure in the clothes container is then slightly higher than atmospheric and any leakage of air is from the container out toward the other parts of the machine.

In drying machines of the type described, it has been found desirable to vary at different times the amount of air flowing through the clothes container. One reason for desiring such a variation is that a low air flow may provide the optimum drying conditions for removal of moisture from clothes, whereas a high air flow is to be desired at the end of a drying cycle during the period when it is intended that the clothes cool down for convenient handling. Another reason for desiring to vary the air flow arises in a combination clothes washer-dryer, where no air flow at all may be desired in the clothes container during the washing operation although a substantial air flow will be desired during the drying operation.

Regardless of the air flow variations desired in the basket, it is nonetheless desirable to maintain a full flow of air through the air moving means. In the case of the variation in air flow during drying and cooling, the purpose is to insure a strong air flow through the air moving means so as to prevent accumulation of lint on the impeller blades normally provided in connection with such air moving means. Where air flow through the clothes container is decreased to zero for a period, as in a combination washer-dryer during washing, a full air flow through the air circulating means during this period is nonetheless desirable if the air circulating means is continuously driven during the operation (as is often necessary for maximum economy), for various reasons fully discussed herebelow. Thus, in summary, while the circumstances creating the need for variation in air flow through the dryer container without an accompanying air variation through the air moving means may vary, the same desirability is nonetheless present in the different circumstances.

It is, therefore, an object of my invention to provide a clothes dryer wherein the suction head at the air exit of

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the clothes container may be varied while at the same time a substantial air flow through the air moving means is continuously provided.

A further object of my invention is to provide the above mentioned object by causing the clothes container to constitute a first air path from atmosphere to the air moving means inlet and by providing a second path, which may be selectively opened or closed, from atmosphere to the inlet.

Yet a further specific object of my invention in one form thereof is to provide a clothes dryer wherein the selective means mentioned directly hereabove is used to provide a low air flow through the dryer during at least the initial part of a heat drying operation and a high air flow for a period of time thereafter, while continuously maintaining a high air flow through the air moving means throughout the operations.

Another object of my invention in one form thereof is to provide a combination washer-dryer structure (which, it will be understood, is a specific type of "dryer" in the context of my invention) wherein a closure member closes the outlet opening from the container at the same time that an alternative air flow path is provided from atmosphere to the air moving means inlet.

In carrying out my invention in one form thereof, I provide a clothes dryer in which a drying chamber has first and second openings, one connecting with atmosphere and the other connecting with the inlet of an air moving means which exhausts to atmosphere. In this manner, a complete path is provided for air to enter the chamber from atmosphere, and then be passed by the air moving means back to atmosphere. Suitable heating means are provided to evaporate moisture from damp fabrics placed within the drying chamber so that the combination of the heating means together with the air stream flowing through the chamber evaporates moisture from the fabrics, the moisture then being carried off by the moving air. Suitable means, which may be selectively opened and closed, are provided to form a second path from atmosphere to the air moving means inlet. By means of this selective provision of a second path, the suction head at the outlet opening of the drying chamber may be varied while at the same time a substantial flow of air is provided through the air moving means.

The subject matter which forms my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention itself, however, both as to organization and method of operation, together with further objects and advantages, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings,

FIGURE 1 is a side elevational view, partly broken away and partly in section, of a domestic laundry machine, specifically a combination washer-dryer, which incorporates my invention;

FIGURE 2 is a rear view of the machine of FIGURE 1 with the rear panel removed and partially in section in order to illustrate details;

FIGURE 3 is a view along line 3—3 in FIGURE 2;

FIGURE 4 is a schematic electrical diagram illustrating a simplified electrical control circuit for the machine of FIGURES 1 and 2;

FIGURE 5 is a schematic view of a development of the surfaces of the cams shown in FIGURE 2, thereby illustrating the operating sequence of the switches controlled by such cams;

FIGURE 6 is a rear elevational view of a domestic laundry machine, specifically a dryer, which incorporates a second embodiment of my invention; and

FIGURE 7 is a view along line 7—7 in FIGURE 6.

Referring now to FIGURES 1, 2 and 3, I have shown my invention in one form applied to a domestic laundry machine 1 comprising a combination washer and dryer. Machine 1 includes a cabinet 2 for enclosing the components of the machine, the cabinet including a separate top portion 3 and being mounted on a supporting structure 4. Access to the machine for loading and unloading of clothes is provided by a hinged door 5 disposed in the front wall 6 of the cabinet. A back-splasher 7, mounted at the back of the top surface 3, serves as a mounting means for suitable operator controls for the machine such as those shown at 8.

Machine 1 is of the type which includes a clothes basket rotatable about a non-vertical axis; specifically, referring to FIGURES 1 and 2, it includes a cylindrical basket 9 disposed for rotation about a generally horizontal axis. The peripheral wall 10 of basket 9 is provided with a substantial number of spaced perforations 11, and with a number of inwardly extending vanes, such as that shown at 12, which help to tumble the clothes in the basket.

Basket 9 is mounted within an imperforate tub structure 13 which encloses it on all sides. The basket is rotatably supported from the tub structure by a horizontally extending shaft 14 mounted in an elongated bearing 15 hung between the two vertically separated rear wall sections 16 and 17 of the tub structure. Shaft 14, as well as supporting the basket, also serves as the means for turning it during operation of the machine. The tub and basket are provided, respectively, with openings 18 and 19 in the front walls thereof, the openings being aligned with the door opening in the front wall 6 of cabinet 2 so that clothes may be placed into or removed from the basket when door 5 is opened. The door 5 seals against a gasket 20 around the tub opening 18 to close off the tub completely during operation of the machine.

Tub 13 is supported from base 4 by means of a plurality of brackets or arms 21 which are mounted on an upstanding plate 22 fixedly attached to the base 4. Four of these arms 21 may be provided, two of them on each side of the tub. Although arms 21 can be secured directly to the wall of the tub 13, I prefer to attach them, as shown, by means of suitable brackets 23. With tub 13 supported in the manner shown, it vibrates sideways in a plane parallel to the front of the machine if the basket 9 should be unbalanced during high speed rotation thereof; however, for vibrations in the front to rear directions and in the vertical direction the arms 21 are not at all flexible and they prevent substantially any vibration in those directions.

Referring now particularly to FIGURE 2, during operation of the machine the basket 9 is driven from an electric motor 24. The drive from the motor to the basket includes a pulley 25 secured to the motor shaft so as to rotate therewith, and over which passes a belt 26. Belt 26 drives an adjustable sheave assembly 27 of the type which is well known for use in achieving variable output speeds from a constant input speed source. The adjustable sheave assembly in turn operates a belt 28 to cause rotation of a pair of pulleys 29 and 30 secured to each other so as to be rotatable together. The rotation of pulley 30 is passed on to a large driving pulley 31 by a belt 32, pulley 31 being rigidly secured on the end of basket shaft 14. In this manner, motor 24 may be driven at a constant speed, and, through the adjustable sheave assembly 27 the speed imparted to pulley 31 and basket 9 may be varied so as to provide an appropriate range of speeds for the basket. For instance, for tumbling purposes during the cleansing and rinsing operations, and also during the heat drying operation, a speed of approximately 47 r.p.m. may be provided to the basket 9, while a centrifuging speed of several hundred r.p.m. may be provided to the basket for effecting centrifugal extraction of liquid from the clothes prior to the heat drying operation.

When the sheave assembly 27 is in the position shown

it provides the tumbling speed. However, when it is pulled over to the right as viewed in FIGURE 2 it provides the higher speed. The assembly is biased to provide the lower of the two speeds by means of a spring 33. The action of this spring may be overcome by means of a small synchronous motor (shown only schematically by the numeral 34 in FIGURE 4) which, through a chain 35 and rigid member 36 pulls the sheave assembly 27 over to the right against the action of the spring. Thus, when motor 34 is not energized a low speed rotation is provided to the basket 9, and when gear motor assembly 34 is energized the high speed rotation is provided. The operation of the variable speed drive briefly described above does not form any part of the present invention, and is set forth merely to provide a substantially complete description of an operative machine. A complete detailed description of such a drive is provided, for instance, in Patent 2,950,613, issued on August 30, 1960, to John Bochan and assigned to the General Electric Company, assignee of the present invention.

In order to admit water to the machine, connections 37 and 38 are provided through which hot and cold water may be supplied to the machine 1 for washing operations. A valve controlled by a solenoid 39 admits hot water to the machine and a valve controlled by an opposed solenoid 40 admits cold water to the machine. The hot and cold water valves under the control of solenoids 39 and 40 discharge through a common outlet 41 which leads through a suitable air gap (not shown) into a conduit 42 at the base of machine 1. Conduit 42 connects with a sump 43 formed at the bottom of tub 13 so that water passing from conduit 41 enters tub 13 through sump 43. A pressure actuated sensing device, or water level control, 44, may be provided to control both solenoids 39 and 40 so as to provide the proper water level in the machine during the washing operation. Sensing device 44 may be connected to the interior of tub 13 by a suitable conduit 45 which connects with the tub adjacent the bottom thereof at 46 as shown.

The wash and rinse water used during washing operations may be discharged from the machine through sump 43 formed at the bottom of the tub. A suitable discharge hose 47 leads from the sump to a pump 48 which may be attached directly to the motor 24 so as to be continuously driven thereby and which in turn discharges through a conduit 49 to a valve 50 which is suitably controlled by a solenoid (schematically shown at 51 in FIGURE 4). When the solenoid 51 is energized the valve 50 is closed, and when the solenoid is not energized valve 50 is open. In other words, for water to be retained in tub 13 the solenoid must be energized to close valve 50 so that the continuous operation of the pump will not be effective to drain the tub. It will be understood that from valve 50 a connection is made to a suitable drain (not shown).

Machine 1 is, of course, designed to provide a heat drying operation, i.e., to effect complete drying of the clothes after they have been washed and a substantial amount of liquid has been first extracted from them by centrifuging of the basket 9. In the conventional manner, the heat drying operation is effected by providing a source of heat to cause vaporization of the moisture out of the clothes in basket 9, together with air moving means which causes air to flow through the tub from atmosphere so as to pick up the moisture vaporized from the clothes and then carry this moisture out to atmosphere once again. In order to heat the air being drawn into tub 13, I provide a heating assembly 52 which is supported in a passage 53 formed by a metal housing member 54 arranged to co-operate with the top of the tub so as to form the passage 53. Air is caused to enter the passage 53 at its inlet end 55, it being understood that the inlet end 55 communicates with the remainder of the interior of cabinet 2, and that ambient or atmospheric air is permitted to enter the cabinet 2 through any suitable openings provided in

the cabinet. For instance, such an opening is shown by the numeral 56 at the bottom of front panel 6 adjacent base 4.

After the air passes forward from inlet 55 over heater 52, it passes into a substantially downwardly extending passageway 57 formed in the same manner as passageway 53 by a rigid sheet metal member 58 cooperating with a portion of tub 13 so as to form the conduit 57. Preferably, there is provided a depending closure flap member or damper 59 which is suspended from its top portion 60 and hangs downwardly by gravity against protruding part 61 of the tub front so as to form a closure between conduit portions 53 and 57.

It will be noted that conduit portion 57 terminates in an opening arrangement 62 communicating with the front of tub 13. During washing operations, it is possible, where too much soap or detergent has been provided in the machine, that suds may back up through openings 62. In the event this occurs, the suds are stopped by the damper member 59 from passing into contact with the heater 52 and from passing through conduit portion 53 into contact with other operating elements of the machine. Thus, the damper 59 serves as a safety measure for preventing suds from passing into portions of the machine where they could do harm. However, when a pressure differential is created, as will be explained, between the upstream and downstream sides of damper 59, the damper is light enough (for instance, it may be made of very thin aluminum sheet) that it moves open by the air pressure differential; thus, air may then flow from conduit portion 53 into conduit portion 57 and out through openings 62 into the tub 13. In this manner, air may pass over the heater 52 to be heated and then pass into the tub 13 through openings 62.

The position of openings 62 causes the air to enter the interior of the clothes basket 9 so that the clothes tumbling in the basket are sure of entering into intimate contact with the flow of air. Thus, the warm air performs both the function of heating the clothes to evaporate moisture therefrom and the function of carrying off the moisture so evaporated. Tub 13 is provided with an outlet opening 63 which connects with the interior of an assembly 64. Assembly 64 forms a conduit 65 which includes an opening portion 66 connecting the first portion 67 of the conduit to a second portion 68 of the conduit. Portion 68 of the conduit leads downwardly to the inlet 69 of air moving means generally indicated by the numeral 70. In the conventional manner, the air moving means may, as shown, include a suitably formed housing 71 within which is a bladed air impeller 72 of the centrifugal type. Impeller 72 draws air in at the inlet 69 and discharges it through an outlet 73 (see FIGURES 1 and 2). The housing 70 includes a suitable bearing support member 74 for the shaft 75 to which impeller 72 is secured. Shaft 75 is rigidly connected to a pulley member 76 driven through a belt 77 which in turn is driven by a pulley 78 directly connected to the motor shaft, so that impeller 72 is continuously rotated at a suitable high speed such as 2,000 r.p.m. during operation of the motor 24.

Opening 66 in conduit 65 is closable by a member 79 which, together with a member 80 to which it is secured by connecting piece 81, is pivotably mounted on a pin 82 secured on the assembly 64. A spring 83 is provided to bias the members 79 and 80 to the position shown in solid outline. As stated, the member 79 controls the closure of opening 66; in similar manner, member 80 controls the closure of an opening 84 formed in portion 68 of conduit 65, the relationship of members 79 and 80 being such that when member 80 is entirely closing opening 84, as shown, member 79 is entirely in its open position. By the same token, as shown in dotted outline by the numerals 79a and 80a, when member 79 is in position to close opening 66 member 80 is entirely in its open position.

In order to move the members 79 and 80 to the posi-

tion in dotted outline shown by numerals 79a and 80a, wherein opening 66 is closed and opening 84 is open, suitable means may be provided to overcome the action of spring 83. In the present case, such means is shown in the form of electrically operated means, specifically a solenoid member 85 having a plunger 86 which is connected through member 87 to the closure members 80 and 79. Upon energization of the solenoid 85, the plunger 86 moves to the left, as seen in FIGURE 3, and this pivots the members 80 and 79 in a counter-clockwise direction about pin 82 to move them to their positions 79a and 80a as shown. At other times, the spring 83 causes them to assume the position shown in solid outline. In the preferred form of my invention, a second solenoid member 88 may be provided having a plunger 89 connected by a member 90 to the closure members 80 and 79. Solenoid 88 is so formed that when it is energized it also overcomes the action of spring 82, but moves only sufficiently far for the closure members 80 and 79 to assume the intermediate position shown in dotted outline by the numerals 79b and 80b in FIGURE 3 so that in effect both openings 66 and 84 are substantially open.

It can thus be seen that, in effect, two paths from atmosphere to the inlet 69 of blower 70 are provided. One causes the ambient air to enter from opening 56, and then be pulled through the cabinet so as to pass over heater 52, into basket 9 through openings 62, and then out from the basket 9 and the tub 13 through opening 63, and through conduit 65 to the inlet 69. The blower then forces the air out through its outlet opening 73 so that the air may be returned to atmosphere; in this connection, it is contemplated that opening 73 may be connected to a suitable vent duct to cause the air to be led to the outside atmosphere.

The second path from atmosphere to inlet 69 causes the air from atmosphere, that is, air entering the cabinet 2 through appropriate openings such as opening 56, to pass directly through opening 84 into the conduit portion 68 and then to the inlet 69 of blower 70. The second path may be alternatively opened and closed by the positioning of member 80, while the first path is alternatively and concurrently closed and opened by the positioning of member 79. Similarly, an intermediate position may be provided by virtue of the provision of solenoid 88: the first path remains substantially open notwithstanding energization of solenoid 88, but the second path is opened in response to energization of the solenoid 88 and is otherwise closed.

Referring now to the schematic circuit diagram of FIGURE 4, there is shown a simplified control arrangement for the machine 1 including an appropriate sequence of control for the heater 52 and the solenoids 85 and 88. The electrical system of the machine 1 is energized across a suitable source of power through conductors 91, 92 and 93. Generally, in commercial practice, 220 volts are impressed across conductors 91 and 92 with 110 volts appearing between each of them and the neutral conductor 93. Directly connected to neutral line 93 is a timer motor 94 of any conventional well known type. Timer motor 94 forms a part of a conventional sequence control assembly wherein a number of cams A, B, C, D, E, F, G, H and J control a number of switches such as those indicated by the numerals 95 through 103. When the timer motor 94 is energized, cams A through J are rotated and cause the switches 95 through 103 to open and close in a suitable sequence so as to effect the desired operations within the machine. In addition, it will be understood that in the conventional manner the manually operable dial member 8 positioned on the backplaster of the machine may be used to control manually the positions of the cams A-J and to advance them from their "off" positions, which they normally attain at the end of a cycle, to a "start" position when another cycle of operation is desired. Generally, when this is done, the switch 103 closes so as to complete an energizing circuit

for the timer motor 94 between conductor 93 and a conductor 104 which is connected to conductor 92. Thus, when the dial is released after having been put in the start position, the operation of the timer motor will cause the switches which it controls to open and close in the predetermined sequence.

For illustrative purposes, the switches have been shown as controlling various components of the machine. Thus, switch 95 controls the solenoid 85, switch 96 controls solenoid 88, switch 97 controls the drain valve solenoid 51, switch 99 controls hot water solenoid 39, switch 100 controls cold water solenoid 40, switch 101 controls the energization of speed control gear motor assembly 34, switch 102 controls the energization of main drive motor 24, and switch 103 controls the energization of the timer motor 94. Switch 98 controls the energization of a relay 105 having a pair of movable contacts 106 and 107 positioned electrically at each end of heater 52 in series therewith so that energization of the relay 105 closes switches 106 and 107 to energize the heater across 220 volts, and deenergization of the relay 105 deenergizes the heater.

When the dial 8 is rotated into cycle starting position, cams A, C, E, H and J close their associated switches 95, 97, 99, 102 and 103. Closure of switch 95 energizes solenoid 85, and as explained above this moves the closure members 79 and 80 about 90° counterclockwise so that opening 66 is closed and opening 84 is uncovered. Also, the closure of switch 97 energizes valve solenoid 51 to close the drain valve 50 thereby to permit water to remain in tube 13 without being pumped out. Closure of switch 99 energizes solenoid 39 thereby causing the entry of hot water into tub 13 through sump 43. Closure of switch 102 energizes the main drive motor which serves the triple function of rotating the basket at tumble speed, running the pump 48, and rotating blower impeller 72. Closure of switch 103 energizes the timer motor 94 which then starts to rotate the cams so as to toll a sequence of operations.

Although the impeller 72 is being rotated, no air is being pulled through tub 13, i.e., there is no suction at outlet 63, because of the fact that closure member 79 is covering opening 66 and closure member 80 has moved away from opening 84. As a result, the impeller pulls air in through opening 84 and exhausts it through outlet 73. This brings down to virtually nothing the suction exerted against closure member 79. This is important since, upon deenergization of solenoid 85, spring 83 must return the member 79 to its open position against such suction; the greater the suction, the larger the spring, and the larger the spring the larger the solenoid which must be used to overcome the spring, it being understood that the cost of a solenoid member varies somewhat proportionately with its size and strength. Thus, the arrangement described, whereby substantially free flow through the impeller is provided while at the same time shutting off opening 66 to prevent suds from being pulled through into the impeller, permits use of a small solenoid while at the same time permitting an arrangement whereby the impeller 72 is run continuously by the motor 24. This is necessary if use of a separate motor or a special clutch is to be avoided, it being understood that the provision of such elements constitutes a substantial expense and that the subject arrangement permits the desired result to be obtained while avoiding such expense.

The energization of solenoid 39 causes hot water to enter tub 13 as motor 34 tumbles the basket 9 until a predetermined liquid level is reached in tub 13, at which time switch 44 opens to deenergize solenoid 39 and stop the flow of water. At this time, the motor 24 continues to tumble the clothes in basket 9 so as to provide a washing operation. Toward the end of the washing operation, cam E opens switch 99 to insure that when the water is drained out hot water will not start to enter. At the end of the wash period, cam C opens switch 97 to deenergize drain valve solenoid 51. This opens the drain

valve permitting the pump 48 to drain the vitiated wash water out of the tub 13.

At the end of the drain period, cams C and F close their switches 97 and 100. This causes the drain valve to close and the cold water solenoid to be energized to introduce cold water for a first rinse operation until switch 44 is tripped. After a predetermined period of the rinse operation the cam F opens switch 100 and at the end of the rinse operation the drain valve is again opened to cause the pump 48 to remove the vitiated rinse water from the tub 13. All this time, of course, the solenoid 85 is energized to prevent any suction of air being exercised at opening 63 to tub 13 while at the same time permitting substantially a constant flow of air to be provided through the blower assembly 70. At the end of this drain operation, another rinse is provided with, preferably both water solenoids being energized to provide warm water for the second rinse rather than cold water, this second rinse being followed by a drain operation.

Following this third drain operation, cam G closes switch 101 to energize gear motor assembly 34 which, as explained above, raises the basket speed to several hundred r.p.m. so as to cause centrifuging of liquid out of the clothes in the basket prior to a heat drying operation. At the end of the spin operation cam A opens switch 95 to deenergize solenoid 85 thereby permitting spring 83 to return closure member 79 and closure member 80 to their solid outline positions in which member 80 closes opening 84. This causes the rotation of impeller 69 to be effective to pull air through the path which includes tub 13 and basket 9. However, at the same time, cam B is energized for the first time and this causes the members 79 and 80 to move to the intermediate position shown in which both openings 66 and 84 are in communication with atmosphere, opening 66 being connected through the basket and opening 84 being directly connected through the interior of cabinet 2. The resulting air flow that occurs through tub 13 and basket 9 is a relatively small air flow since a substantial part of the air being passed by the blower assembly enters through opening 84 and does not, thus, pass through the basket and tub.

At this time, also, cam D causes closure of switch 98 to energize relay 105 and this in turn causes switches 106 and 107 to energize the heater 52. The energization of the heater 52, of course, has the effect of heating the air flowing over the heater into the basket. In addition, it will be understood that because the air flow over the heaters is a relatively small one due to the open condition of opening 84, the air is heated to a relatively high temperature when it enters the basket 9. The other change occurring as the cycle passes from spin into dry is the opening of switch 101 by cam G which deenergizes gear motor assembly 34 to cause the basket's rotational speed to return to tumbling speed from centrifuging speed.

Drying thus proceeds in this manner, with a reduced air flow over the clothes causing high temperatures and consequent rapid evaporation of moisture from the clothes, the air flow being nonetheless sufficient to rapidly carry off all moisture so evaporated from the clothes. As the clothes become dryer, less energy input to them is necessary in order to cause evaporation of the moisture because of the reduced quantity of moisture remaining. Accordingly, I propose, as one feature of my invention, to deenergize the solenoid 88 by the opening of switch 96 as shown by the cam B configuration so that, with the heater still operating, solenoid 88 is deenergized thereby permitting member 80 to close opening 84. This means that the full suction of impeller of blower 70 is exercised through conduit 65 at opening 63 on the interior of tub 13 and basket 9. As a result, a substantially higher air flow occurs and the greater rate at which the air flows over the heater 52 causes a lesser heating effect thereby permitting lower temperatures to be used to evaporate the remaining moisture from the clothes.

When a suitable length of time has passed for the clothes to dry, cam D opens switch 98 thereby causing deenergization of heater 52, tumbling of the clothes by rotation of basket 9 continuing. At this time, the lack of heat together with the higher flow rate over the clothes serves to provide the optimum effect in cooling the clothes so that they are convenient for handling for the operator at the end of the cycle. After a few minutes of this heatless air operation, cams H and J open switches 102 and 103 so that respectively drive motor 24 and timer motor 94 are deenergized to terminate the cycle.

It will thus be seen that by my invention a high rate of air flow through the impeller is retained even when there is no air flow being permitted through the basket and tub. This has the advantage, as described above, of preventing escape of suds while at the same time permitting use of a small solenoid 85 and eliminating any need for clutches or separate motors for the operation of blower 70. During drying, the amount of air through the basket is varied, again without any substantially decrease in the total amount of air flowing through blower 70. This is deemed important since a high air flow during drying is desirable to help keep the blades of the air impeller free of lint which might collect thereon in a low air flow system. Furthermore, high air flow prevents lint from settling in exhaust ducting which, as stated above, is generally connected to outlet 73.

It will be understood that in the system described, particularly with regard to the circuit, a substantially simplified circuit without many of the conventional interlocks and optional features has been shown for clarity of illustration. For instance, many modern dryers provide automatic drying cycles which are not entirely or at all dependent upon time, a selection of water temperatures for different operations, selection or omission of a drying operation, and the like. It will be understood that while not shown, these may be included without any effect on the desirability of the features of my invention.

Referring now to FIGURES 6 and 7, there is shown a clothes dryer which embodies my invention in a modified form thereof. The machine 110 is a clothes dryer which includes a cabinet 111 mounted on a supporting structure 112. Access to the machine may be provided in any suitable desired manner such as, for instance, in the manner shown in the structure of FIGURES 1 and 2. Also, of course, a suitable backplasher member 112a may be mounted at the top of the cabinet and serve as a mounting means for suitable operator controls. As before, the machine may include an outer imperforate tub 113 which may be supported on assemblies 114 from the base 112. The rear wall 115 of tub 113 may, in the same manner as before, support a horizontally extending shaft, the end of which is shown at 116, and which in turn supports a cylindrical basket 117 having a peripheral wall 118 with perforations 119 formed therein. As before, vanes 120 may be formed on the peripheral wall 118 so that when the basket is rotated by the horizontal shaft 116 the vanes cause tumbling of the clothes in the basket.

Rotation of the basket at a suitable speed may be effected by a drive motor 121 which is mounted on the base 112 and has a pulley 122 connected through a belt 123 to a pulley 124 secured on shaft 116. By proper sizing of the pulleys, the motor operation causes rotation of the basket at an appropriate tumbling speed which may, for instance, be on the order of 47 or 48 r.p.m. At the same time that motor 121 is causing basket rotation at an appropriate speed, it drives a second pulley 125 secured on the motor shaft. Pulley 125 operates a belt 126 and a pulley 127 driving the impeller 128 of a blower assembly 129 having a housing 130 of the appropriate shape enclosing the blower impeller. The housing 130 has, in the conventional manner, an inlet 131 and an outlet 132, the impeller preferably being of

the conventional centrifugal type. The rotation of the motor thus also causes rapid rotation of impeller 128.

The inlet 131 of the blower 129 is connected through a duct 133 formed by a housing 134 to an opening 135 formed near the top right hand side of tub 113, as viewed in FIGURE 6. The tub 113 is also provided with an air inlet 136 which is connected through a conduit 137 to atmosphere so that operation of the blower 121 causes atmospheric air to be drawn into tub 113 through opening 136, then passed through the basket in contact with any clothes therein to the outlet opening 135, and then through the blower 129 and its outlet 132 back to the atmosphere, it being understood that in the preferred structure an appropriate connection is made to permit venting of the machine to the outdoors.

An opening 138 is provided in housing 134, and a closure member 139 is provided which is pivotable about a pin 140 and is biased by a spring 141 to the position shown wherein it closes opening 138. Member 139 is also connected through a joining piece 141a to the plunger 142 of a solenoid 143. When solenoid 143 is energized, it pulls the plunger inwardly (to the left as viewed in FIGURE 7) and this in turn causes the member 139 to pivot counterclockwise about pin 140 against the action of spring 141. When this occurs, the opening 138 is opened to atmosphere, being connected thereto through the interior of cabinet 111 and any appropriate openings provided in the cabinet for that purpose.

Thus, when the member 139 is in the position shown in solid outline the entire air flow through blower 129 must pass from opening 136 to opening 135 of the tub 113. However, when member 139 is moved to the position shown in dotted outline, a substantial amount of air passes to the blower inlet 131 from opening 139, thereby decreasing substantially the amount of air passing through the tub from opening 136 to opening 135.

Positioned between basket 117 and tub 113 is a heater assembly 144 arranged so that it provides heat primarily by radiation through perforations 145, and also by conduction through the thin peripheral wall 118, to the clothes in the basket 117. When a drying operation is provided, the heater assembly 144 is energized, and by radiation and conduction heats the damp fabrics in the basket 117 so as to cause vaporization of moisture therefrom. The air passing from opening 136 to opening 135 then carries away this moisture.

During the initial portion of a drying cycle, it is proposed that a low air flow be provided which, while ample to carry off the moisture evaporated from the clothes, has a relatively small cooling effect on the fabrics or clothes. This causes a substantially larger part of the energy from heater 144 to be used for vaporization of moisture than would be the case with a higher air flow. Then, toward the end of a drying operation, or when cool-down is desired, the solenoid 143 is deenergized to permit spring 141 to move member 139 to closing position. This increases substantially the air flow from opening 136 through opening 135, thereby cooling the clothes to a substantially greater extent and decreasing the amount of heat energy being provided to them for evaporation purposes. Also, the higher air flow causes a more rapid cool-down of the clothes if the heater has been shut off. It will be understood that a conventional control circuit, of a type similar to that shown in FIGURE 4, may be used to cause operation of the components in the desired sequence.

In summary, during operation of the structure of FIGURES 6 and 7, the damp fabrics are introduced into basket 117 for drying, and then the motor 121, the heater 144, and the solenoid 143 are energized. This causes heating of the clothes at a relatively high rate as they are tumbled, the basket air flow being kept at a relatively low level due to the fact that the cover 139 has been moved away from opening 138. Then, at a later

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time, the solenoid 143 is deenergized to increase the basket air flow rate, this being done either shortly before the heater 144 is deenergized or at the same time as the heater is deenergized. A beneficial effect by variation of the air flow to the drying chamber is provided while at the same time the desired high air flow through the blower unit 129 is provided to prevent to a substantial extent the accumulation of lint which might otherwise occur with a low air flow.

While in accordance with the patent statutes I have described what at present are considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A combination clothes washer and dryer comprising: means defining a washing and drying chamber having first and second openings formed therein; means for introducing water to and removing water from said chamber and means for washing fabrics therein; heating means for evaporating moisture from damp fabrics within said chamber; centrifugal fan means having inlet means and outlet means; said first chamber opening and said outlet means being respectively connected to atmosphere; conduit means connecting said second chamber opening

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to said inlet means, said conduit means having an additional opening formed therein intermediate said second chamber opening and said inlet means; first means for closing said conduit upstream of said additional opening; second means for closing said additional opening; said first and second closing means being joined and formed so that when they are in a first position said first closing means closes said conduit and said second closing means opens said additional opening and when they are in a second position said first closing means opens said conduit and said second closing means closes said additional opening; and means for moving said closing means between said first and second positions thereby to provide a stream of air flowing directly from atmosphere over said centrifugal fan means to clean said fan means when said conduit is closed and said additional opening is open.

2. The apparatus defined in claim 1 wherein said moving means includes spring means arranged to bias said closing means to said second position, and solenoid means are connected to said closing means and arranged when energized to move said closing means to said first position.

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