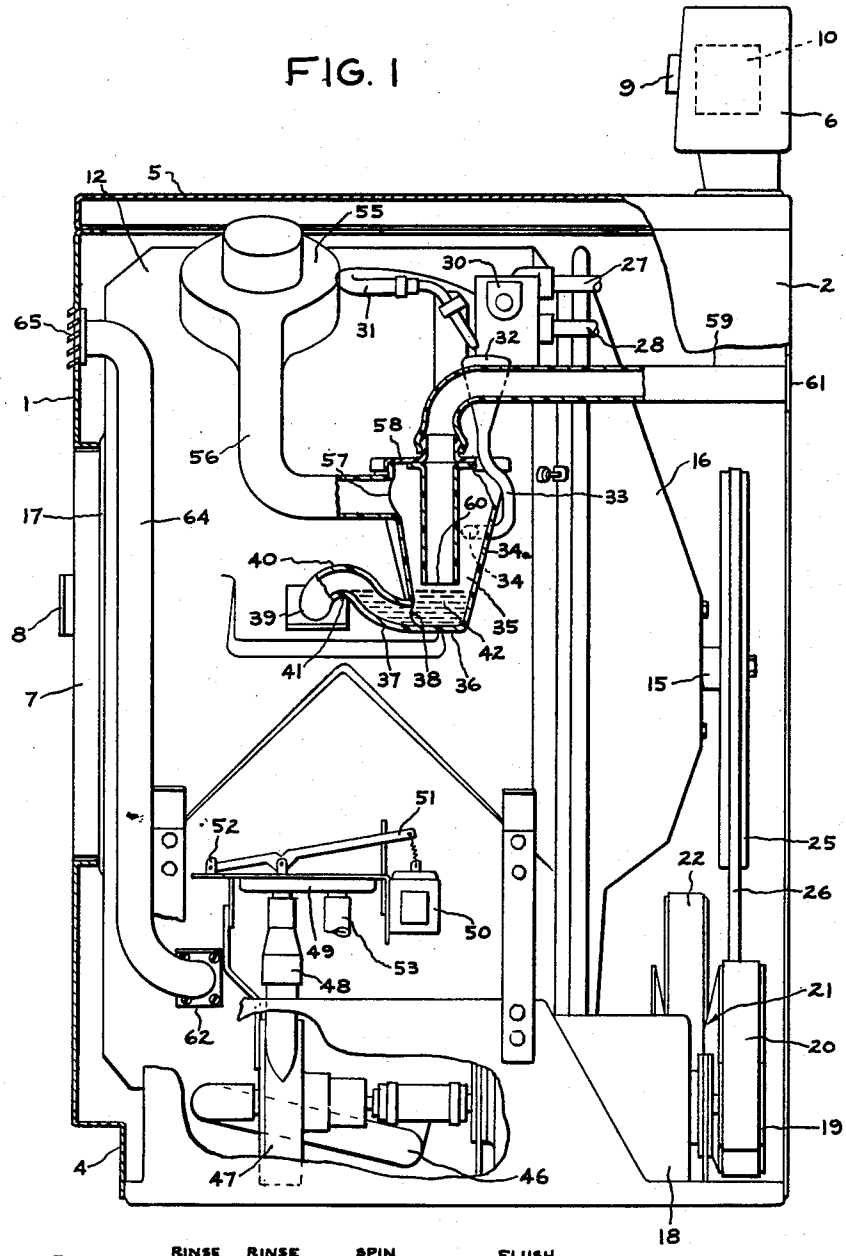
Nov. 8, 1960 A. M. STONE 2,959,044

LINT FILTER FOR COMBINATION WASHER-DRYER

Filed March 23, 1959 2 Sheets-Sheet 1

FIG. 1



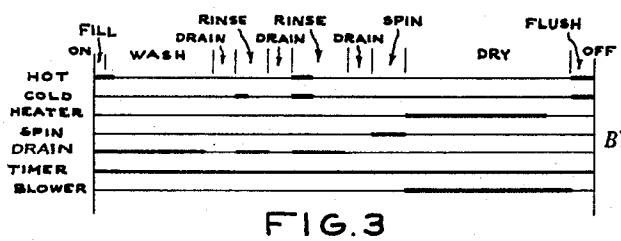


FIG. 3

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LINT FILTER FOR COMBINATION WASHER-DRYER

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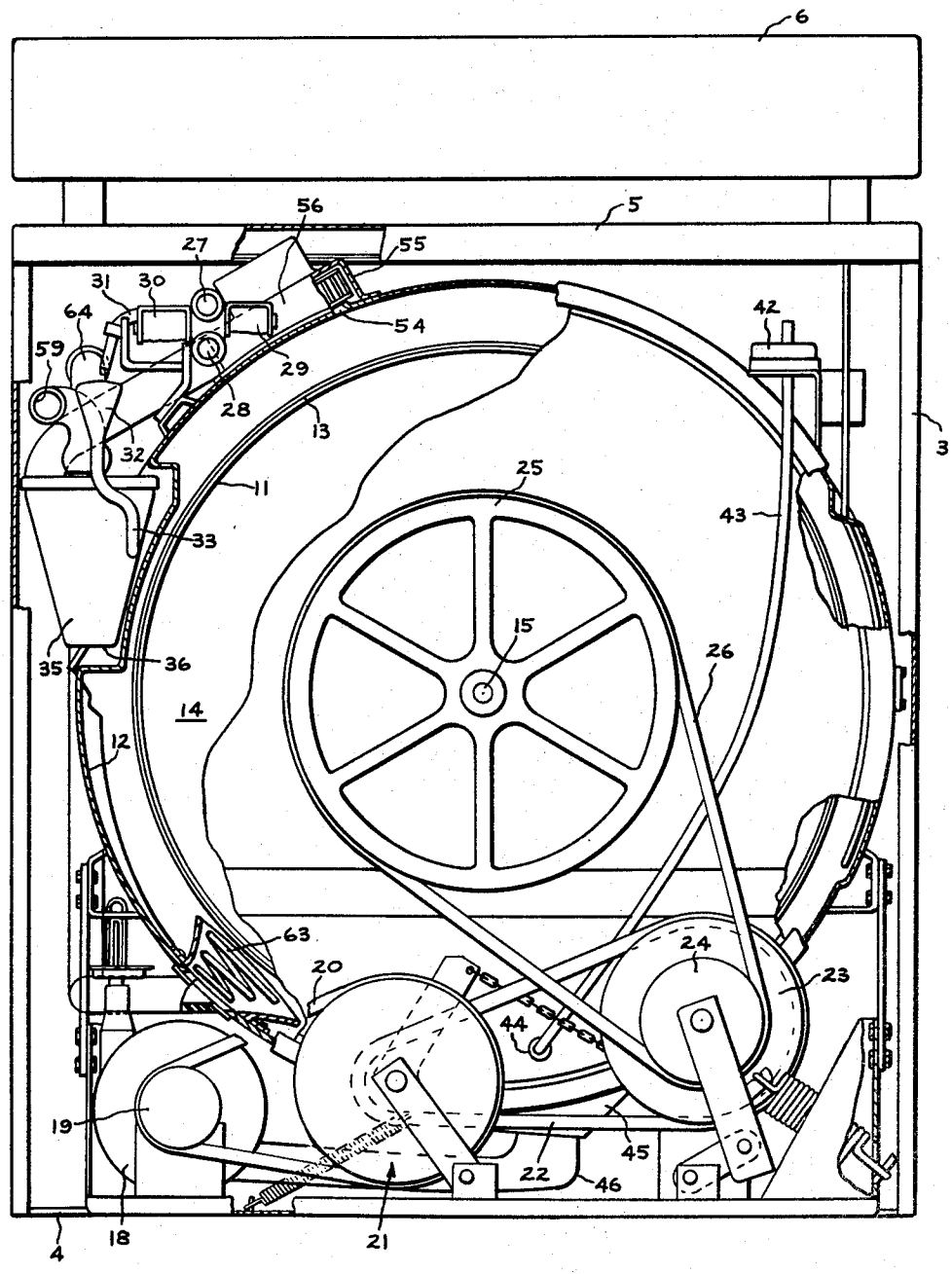

FIG. 2

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United States Patent Office 2,959,044 Patented Nov. 8, 1960

2,959,044

LINT FILTER FOR COMBINATION WASHER-DRYER

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Filed Mar. 23, 1959, Ser. No. 801,236

8 Claims. (Cl. 68—12)

This invention relates to laundry machines of the type which provide a sequence including a washing operation and a subsequent drying operation, and more particularly to such machines wherein the drying operation includes improved means of trapping lint evolved as a result of the tumbling of the clothes in a stream of warm air.

Domestic laundry machines of the type which first wash and then dry the clothes, generally known as combination washer-dryers, usually fall into two categories insofar as the method of drying is concerned. In the first category a forced stream of warm air is circulated over the clothes, the air being heated prior to its entry into the basket; this arrangement may provide for either a closed system or a system where the air is pulled into the machine, through the basket, and then expelled from the machine. In the second arrangement the system is always a closed one, with the only air circulation being caused by the movement of the clothes and of the clothes container, that is, no special arrangement is provided for forcing the air into, through and out of the basket. While the first of these two systems generally provides a faster drying action than the second, it inherently creates the problem that a substantial amount of lint is eventually carried out of the basket with the air stream as a result of the forced stream of air contacting the clothes as they are tumbled. If the system is an entirely closed one where the same air is de-humidified and then reused, the lint may create a clogging problem or a problem of lint. Where the system is an open one it is objectionable if large quantities of lint be carried out of the exhaust duct of the machine.

Consequently, in machines which provide a forced stream of warm air over the clothes, some system for trapping and then disposing of the lint is necessary. This problem has generally been met in the past by providing a lint trap consisting of a screen in the path of the air flow after it has passed out of the clothes container so that a major part of the lint is caught on the screen. This in turn requires some means of disposing of the lint caught on the screen, and the only solution which has so far been provided in commercial machines is manual cleaning of the screen at appropriate intervals, preferably after each drying operation. While this is effective, it represents an additional demand on the operator, and it is highly desirable to provide some solution to the problem wherein the trapping of the lint and the subsequent disposal of the lint are effected automatically as an inherent part of the operation of the machine, without any attention from or additional operation by the operator being required.

It is therefore an object of this invention to provide an improved construction in laundry machines, particularly combination washer-dryers, wherein lint evolved as a result of the use of a forced stream of warm air over the clothes being tumbled in a clothes container is separated from the air stream and disposed of by the machine without any attention from the operator.

A more specific object of the machine is to achieve

the trapping of the lint in the air by means of a centrifugal extraction device.

A further specific object of the invention is to dispose of the lint thus trapped by suitable operation of the water supply and drain means, already required in the machine for the washing operation, to clean out the lint caught in the trap subsequent to each drying operation as an inherent part of the operation of the combination machine.

In carrying out the invention in one form thereof, I provide a combination clothes washer-dryer which has the usual sequence including a washing operation and a subsequent drying operation. The machine has a clothes container with drain means for removing water from the container so that a suitable washing operation may be effected. In addition I provide duct means which has an inlet and an outlet both communicating with the container in spaced relation to each other. Air is circulated through the duct means and the container by any suitable arrangement such as a blower, and suitable means are provided for heating the air prior to its entry into the container so that the air flowing through the container is warm so as to dry the clothes.

The duct means includes a substantially vertically positioned closed hollow trap member located downstream of the container air outlet and connected to the outlet by first conduit means which causes the air to enter the trap at the upper portion thereof in a tangential manner so as to effect a swirling or cyclone movement of the air within the trap. This air movement centrifuges the lint out to the side wall of the trap so as to separate the lint from the main air flow. A second conduit extends down into the trap and has an open bottom end which is positioned substantially coaxially with the trap member and slightly above the bottom thereof.

The water supply for the container is first caused to pass into the trap member through a suitable inlet formed therein, and then out to the clothes container through a water outlet conduit leading from the trap. The water outlet conduit is formed so that at all times there is retained in the trap enough water to reach a level slightly below the bottom of the second air conduit. The lint centrifuged out of the air flow moves down the side wall of the trap and is then caught by the water at the bottom of the trap.

Together with the components set forth above, I provide sequence control means for controlling all of these components; during the washing operation the control means causes suitable operation of the water supply means and the drain means so as to provide a conventional washing operation. During the drying operation the control means causes operation of the drain means, of the air heating means, and of the air circulating means so that a suitable drying operation is effected. A third important function of the control means, according to my invention, is to effect operation of the water supply means subsequent to each drying operation or intermittently during each drying operation but prior to the next washing operation so that all the lint caught during the drying operation is flushed from the trap member prior to the next use of the machine. Preferably, the drain means is operative at the same time as the water supply means during the flushing operation so that the lint and water thus removed from the trap is flushed down the drain and so removed without any attention from the operator having been required.

The subject matter which forms this 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 descrip-

tion when taken in conjunction with the accompanying drawings.

In the drawings,

Figure 1 is a side elevational view of the improved machine of this invention, partially in section and with certain surfaces broken away to show details;

Figure 2 is a rear view of the machine, with the rear panel removed to illustrate details; and

Figure 3 is a cam chart illustrating the control sequence provided by the control apparatus of my improved combination washer-dryer.

Referring now to Figures 1 and 2, I have shown a combination washer-dryer wherein the operating elements of the machine are included within an outer cabinet structure including a front panel **1** and side panels **2** and **3**. The panels are supported on a base and toe board assembly **4** and in turn support a top closure **5** provided with an integral backsplash portion **6**. Access to the interior of the machine is provided by a door **7** which may be mounted on panel **1** by concealed hinges and opened by suitable means such as latch control **8**. The machine is so constructed that when a load of soiled clothes is placed therein, it proceeds through a sequence of operations, first washing the clothes and then drying them. In order to provide completely automatic and flexible operation of the machine, operating controls such as **9** are mounted on the backsplash panel **6**, and are connected to control apparatus **10** secured within the backsplash panel. The particular form of the control provided does not form a part of the invention, and it will be understood that any suitable control mechanism, conventionally the type with a timer motor driving one or more cams for programming the opening and closing of appropriate switches, may be provided.

As shown in Figures 1 and 2, the machine is of the horizontal axis type with the clothes basket or drum **11** mounted for rotation on a generally horizontal axis within an outer enclosing tub structure **12**. The basket as shown comprises a perforated cylindrical shell **13** which is closed at its rear by means of a suitable wall **14** and which has a similar front wall (not shown) generally provided with a suitable loading opening aligned with the door **7** so that clothes may be introduced into the container **11** when the door is open. The basket is rotatably supported by a shaft **15** rotatably mounted within the rear wall **16** of tub **12** which is also provided with an access opening **17** in the front wall thereof aligned with the basket access opening and door **7**. Basket **11** and tub **12** thus form a container for the clothes during the treatment thereof.

During machine operation, basket **11** is rotatably driven from an electric motor **18**. The drive from the motor to the basket includes a pulley **19** which is secured to the motor shaft so as to rotate therewith, and over which passes a belt **20**. Belt **20** drives an adjustable sheave assembly **21** 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 belt **22** to cause rotation of pulleys **23** and **24**. The rotation of pulley **24** is passed on to a pulley **25**, which is rigidly secured on basket shaft **15**, through a belt **26**. In this manner the motor **18** may be driven at a constant speed and, through the adjustable sheave assembly **21**, the speed imparted to pulley **25** and basket **11** 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 operation, and also during the heat drying operation, a speed of approximately 47 r.p.m. may be provided to a basket of approximately 26 inches in diameter, and 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 a heat drying operation or removal of clothes from the container.

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 and detailed description of such a drive is provided, for instance, in application Serial No. 731,362, filed on April 28, 1958, by John Bochan and assigned to the General Electric Company, assignee of the present invention.

The means whereby water is supplied to and discharged from tub **12** during operation of the machine includes connections **27** and **28** through which hot and cold water is supplied to the machine for the washing operation. A valve controlled by a solenoid **29** admits hot water to the machine and valve controlled by an opposed solenoid **30** admits cold water to the machine. The hot and cold water valves under the control of the solenoids **29** and **30** discharge through a common outlet conduit **31**, through a suitable air gap, and into a funnel **32** which leads to a conduit **33**. Conduit **33** has an outlet **34** which enters the side wall **34***a* of a vertically positioned trap member **35** approximately at the mid-portion thereof and substantially tangentially thereto. Trap member **35** may preferably, as shown, be in the form of an inverted frustrum of a cone. Adjacent the bottom **36** of trap member **35** an outlet conduit **37** communicates with the trap member, also preferably tangentially, but joining the trap member 180° removed from the position which would be required to receive a stream of water spiraling down the wall of trap member **35** from outlet **34**, through opening **38**. At its other end **39** conduit **37** is connected to the interior of tub **12**. Conduit **37** is formed with a slight rise **40** therein so that the lowest portion **41** of the rise determines the level **42** of the water which will be retained in the trap member **35**. It will be understood that, once rise **40** is provided in conduit **37**, it may communicate with tub **12** at any suitable point. For instance, it could be made to communicate with the tub at the bottom thereof, i.e., at the sump **45**, in the manner that wash water is supplied to the tub in the machine now produced commercially by the assignee of this invention.

In this manner the water flows from the valve members through conduit **31** and conduit **33**, through the trap member **35** in a swirling motion, and then out through conduit **37** into tub **12**. Upon entering the tub **12**, the water then flows down the side of the tub to fill the tub. A pressure actuated sensing device or water level control **42** controls both solenoids **29** and **30** to provide the proper water level in the machine during the washing operation. Sensing device **42** is connected to the interior of the tub **12** by a suitable line **43** which connects with the tub almost at the bottom thereof at **44** as shown.

Water in the tub is discharged from the machine at appropriate times through the sump **45** mounted at the bottom of the tub. A suitable discharge hose **46** leads from the sump to a pump **47** which may, as shown in Figure 1, be driven directly from motor **18** and which discharges through a conduit **48** to a drain valve **49** controlled by a solenoid **50**. When solenoid **50** is energized it pulls down a lever member **51** pivoted at point **52** to close the valve. When solenoid **50** is de-energized valve **49** is opened permitting the continually operating pump **47** to pass liquid through conduit **48** and valve **49** to a drain conduit **53**.

The illustrated machine is of the type which uses an open forced air system during the drying cycle for drying the clothes. Specifically, an outlet **54** is provided at the top of tub **12** which leads to an air circulating device in the form of blower member **55**; the blower receives the air from the outlet **54** and forces it through a conduit **56** which terminates in an inlet **57** entering trap member **35** tangentially adjacent to the top portion **58** thereof so as to cause the air passing from blower **55** to swirl around the side walls of trap **35** in a swirling or cyclone

type of action. A conduit 59 enters traps 35 through the top portion 58 thereof and extends downwardly so as to terminate in an open bottom portion 60 which is positioned substantially coaxially with the generally vertical trap 35; conduit 59 constitutes an outlet for the air which enters the trap from the conduit 56. Conduit 59, after leaving the trap, then extends generally horizontally to the rear of the machine and communicates with atmosphere as shown at 61.

An air inlet 62 to the tub, in which are provided sheathed electrically insulated heating elements 63, is connected by a conduit 64 to a louvered opening 65 in front panel 1. Opening 65 is located substantially higher than the maximum liquid level possible in the machine. Energization of the heating elements 63 causes air entering through opening 65 to be heated prior to its entry into the tub 12 and basket 11. It will thus be seen that conduit 64, conduit 59 and trap 35 form duct means for causing a flow of warm air to be drawn from inlet 62 through the perforations in basket 11 so as to contact the tumbling clothes therein; the air is then pulled by blower 55 out of the basket, through outlet 54, and sent through conduit 56 to trap 35.

Referring now particularly to Figure 3, the operation of the improved combination washer-dryer of my invention will be described. It is to be understood that Figure 3 is in effect a development of the peripheries of the operating means (not otherwise shown) of the control mechanism 10 as provided in combination with suitable control circuit means of the conventional type. The heavy lines show the cam rises, when the devices controlled by the cams are caused to operate.

Let it be assumed for the purposes of explanation that the control knob 9 is set to provide a standard washing and drying operation wherein it is intended that hot water be provided for the washer, and that a drying operation follow the washing operation. To initiate the action, the control is manually advanced to a position just beyond the "on" line in Figure 3. As the selected cycle is started, it can be seen that the hot water supply, the timer (not otherwise shown) and the drain valve are energized. This energizes the solenoid 29 to open its associated valve and permit hot water to flow into the tub 11 through the conduit 31, funnel 32, conduit 33, trap 35, and conduit 37 so as to fill the tub to an appropriate level. When an appropriate amount of water has been provided, pressure sensitive switch 42 causes the flow to stop and the washing action is then provided by the continued tumbling of basket 11 which, by causing motor 18 to operate coextensively with the timer, is rotated during the entire operation from start to finish.

At the end of a predetermined amount of washing time, as determined by the timer, the drain valve is de-energized long enough to permit the pump to drain the water out of the tub 11. Clean water (preferably cold) is then introduced to provide a first rinsing action which continues for a predetermined amount of time, and then the drain valve is again de-energized to drain off the rinse water.

It will be observed at this point that each time water is introduced into the tub through trap 35 it causes the water to swirl around the trap, thereby providing a cleansing action, and that the shape of outlet conduit 37 causes water to remain in the trap to level 42.

Rinse water which may, as shown, be provided warm by energizing both the hot and cold valve solenoids may then be provided for a second rinse and then, at the end of this last rinse, the drain valve is again de-energized to drain the water out of the machine. Then the appropriate control mechanism (not otherwise shown) is energized to cause the speed transmission to provide a high speed rotation of the basket to cause a centrifugal liquid extraction operation. Effective removal of liquid by the pump by de-energization of the drain valve is normally continued during the spin operation to remove the water collected in the sump from the centrifugal extraction.

At the end of the spin an appropriate drying cycle is commenced with the heater and the air circulating means being in operation. This action causes air to be drawn through conduit 64 into the container, after being heated by heater 63, and then to be forced by the blower from the container to the trap 35. In the trap the air swirls around the wall of the trap thereby effecting a centrifuging action on the lint picked up from the clothes by the air so that the lint travels to the outside and passes down the walls of the trap into the water at the bottom of the trap. The air continues to swirl around until it reaches the bottom of the trap at which time it passes through outlet 60 into conduit 59. At this point, substantially all the lint has been removed from the air and is held in the water at the bottom of the trap. The air then passes out through conduit 59 to the exterior of the machine.

This drying action continues for a suitable period, as shown in Figure 3, with the lint continually being caught in the trap and collected by the water at the bottom of the trap. At the end of the drying operation, the heater shuts off, but the clothes continue to tumble in the basket with the blower continuing to operate in order to effect a cooling of the clothes prior to their removal. At the end of the cooling period the blower shuts off.

According to my improved construction, either the hot water solenoid, the cold water solenoid, or both, are then energized to provide a substantial amount of flow through conduit 33 into the trap 35. This flow of water will, as has previously been described, cause the water already in the trap to be flushed out through conduit 37 and flow down the side wall of tub 12 into sump 45. In this manner all the lint collected in trap 35 during the drying operation is flushed down into the sump 45. Provided, as is deemed preferable, the pump also becomes effective to remove liquid at this time due to the de-energization of the drain valve solenoid 50, this linty water is then drained out of the machine so that the lint is completely disposed of. It will be recognized that the point of importance is that one or the other or both of the solenoids 29 and 30 be energized subsequent to the drying operation but prior to the next washing operation so that the linty water is removed before the start of each washing operation. Thus, while in the preferred construction this occurs at the very end of a cycle, it is conceivable that it might also be provided at other times, such as at the very beginning of the next cycle or intermittently during the dry cycle so as to avoid large lumps of lint being flushed out at any one time.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment 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 the invention.

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

1. A combination clothes washer-dryer having a sequence including a washing operation and a subsequent drying operation comprising a clothes container; drain means for said container; duct means having an inlet and an outlet communicating with said container in spaced relation to each other; means for circulating air through said duct means and said container; means for heating air prior to its entry into said container; said duct means including a substantially vertically positioned closed hollow trap member downstream of said outlet; said duct means including first conduit means connecting said outlet to the upper portion of said trap member, and second conduit means extending down into said trap member and having an open bottom and terminating substantially coaxially with said trap member and in spaced relation to

the bottom thereof; water supply means having an inlet to said trap member; a water outlet conduit communicating with said trap member adjacent the bottom thereof, the bottom of said trap member being positioned above the bottom of said container; said water outlet conduit being connected to said container and being formed to retain in said trap member a predetermined water level spaced below the bottom of said second conduit means; and sequence control means controlling said water supply means, said drain means, said air heating means and said air circulating means, said control means effecting operation of said water supply means and said drain means during said washing operation, said control means effecting operation of said air heating means and said air circulating means during said drying operation, said control means further effecting operation of said water supply means subsequent to at least a part of the drying operation and prior to the next washing operation.

2. The apparatus defined in claim 1 wherein said control means effects operation of said drain means at the same time as said water supply means subsequent to at least a part of the drying operation and prior to the next washing operation.

3. The apparatus defined in claim 1 wherein said first conduit means communicates substantially tangentially with said trap member.

4. The apparatus defined in claim 1 wherein said second conduit means extends vertically down into said trap member and is positioned substantially coaxially with said trap member therewithin.

5. The apparatus defined in claim 3 wherein said water supply means inlet to said trap member is formed substantially tangentially to the side wall of said trap member.

6. The apparatus defined in claim 1 wherein said first conduit means, said water supply means inlet to said trap member, and said water outlet conduit from said trap member all communicate with said trap member substantially tangentially to said side wall of said trap member.

7. A combination clothes washer-dryer having a sequence including a washing operation and a subsequent drying operation; a clothes container; drain means for said container; duct means having an inlet and an outlet communicating with said container in spaced relation to each other, and inlet and outlet conduit means respectively

connecting said inlet and said outlet to atmosphere; means for circulating air through said duct means and said container; means adjacent said inlet conduit for heating air prior to its entry into said container; said duct means further including a substantially vertically positioned closed hollow trap member in said outlet conduit means downstream of said outlet; said outlet conduit means including a first conduit connecting said outlet to the upper portion of said trap member, said first conduit communicating substantially tangentially with said trap member; said outlet conduit means including a second conduit extending down into said trap member and having an open bottom end terminating substantially coaxially with said trap member and in spaced relation to the bottom thereof, said second conduit means having its other end communicating with atmosphere; water supply means having an inlet to said trap member; a water outlet conduit communicating with said trap member adjacent the bottom thereof, the bottom of said trap member being positioned above the bottom of said container; said water outlet conduit being connected to said container and being formed to retain in said trap member a predetermined water level spaced below the bottom of said second conduit means; and a sequence control means controlling said water supply means, said drain means, said air heating means and said air circulating means, said control means effecting operation of said water supply means and said drain means during said washing operation, said control means effecting operation of said air heating means and said air circulating means during said drying operation, said control means effecting operation of said water supply means and said drain means subsequent to at least a part of the drying operation and prior to the next washing operation.

8. The apparatus defined in claim 1 wherein both said water supply means and said drain means are operated by said control means subsequent to the drying operation in the same sequence therewith.

References Cited in the file of this patent

UNITED STATES PATENTS

1,530,073	Cutter	Mar. 17, 1925
1,637,166	Ullin	July 26, 1927
2,758,461	Tann	Aug. 14, 1956