Sept. 8, 1953 W. R. MILBY ET AL 2,651,113

CLOTHES DRIER

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Fig. 3

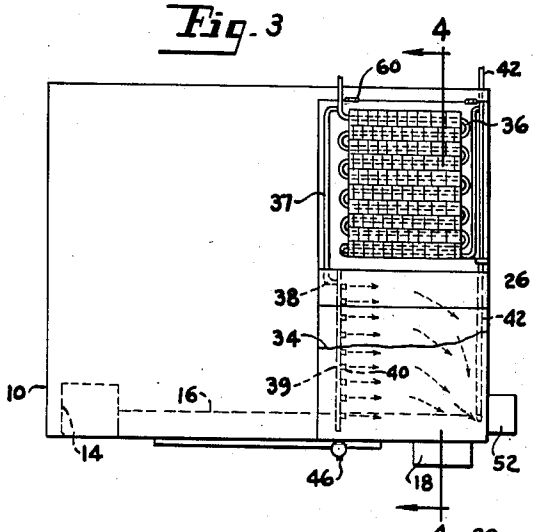
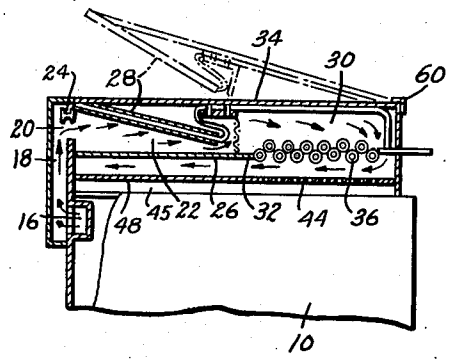



Fig. 4



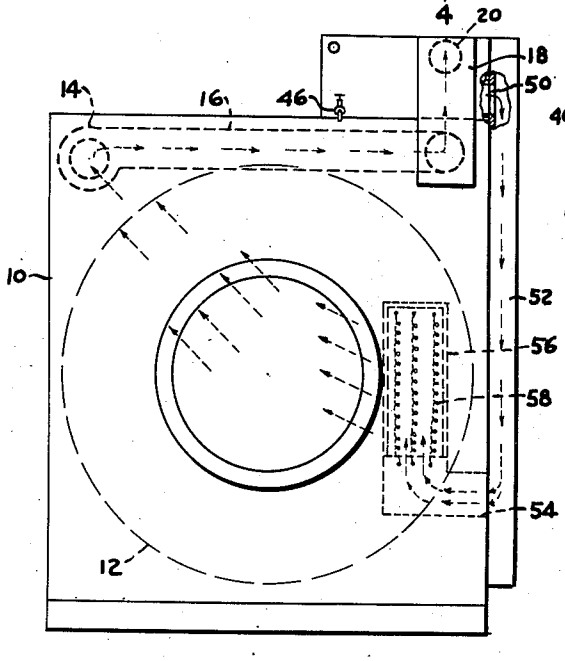




Fig. 1

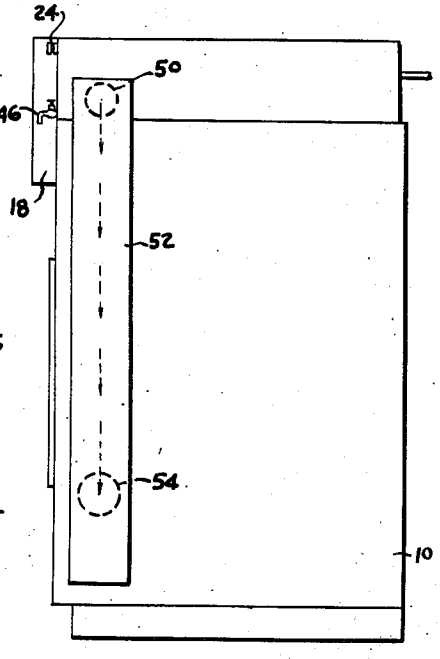



Fig. 2

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Fig. 7

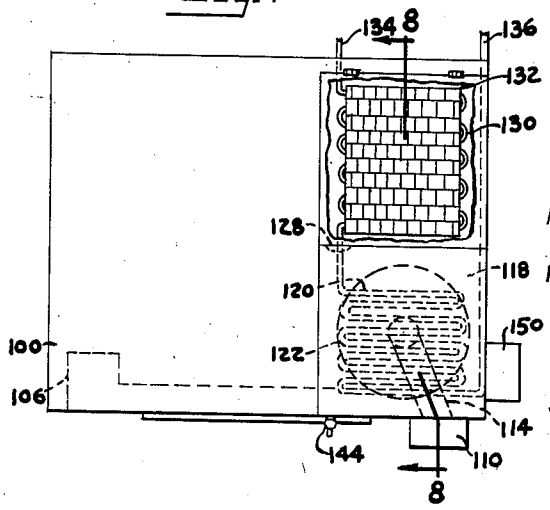



Fig. 8

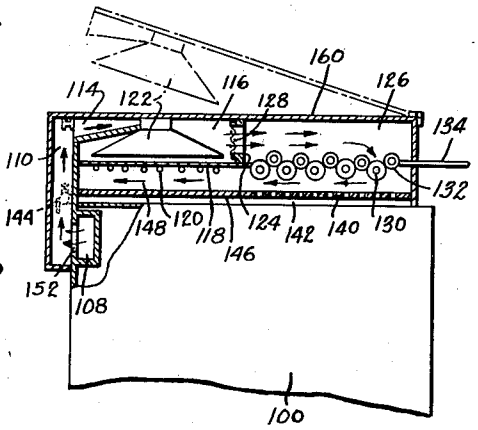
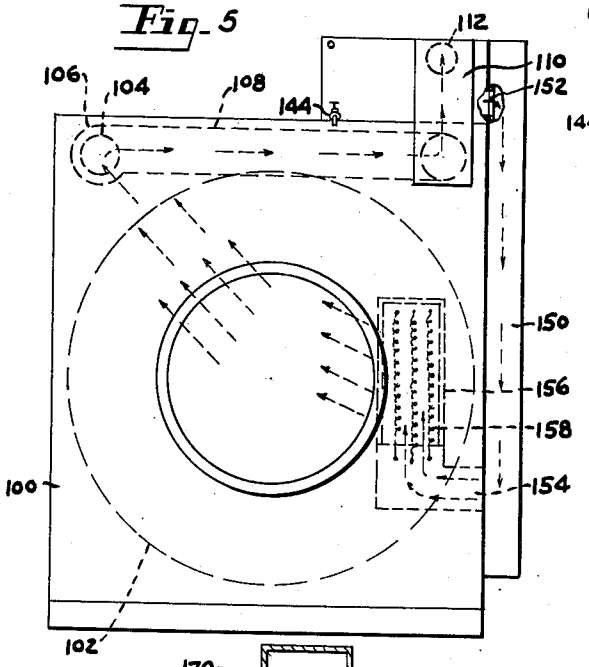



Fig. 5



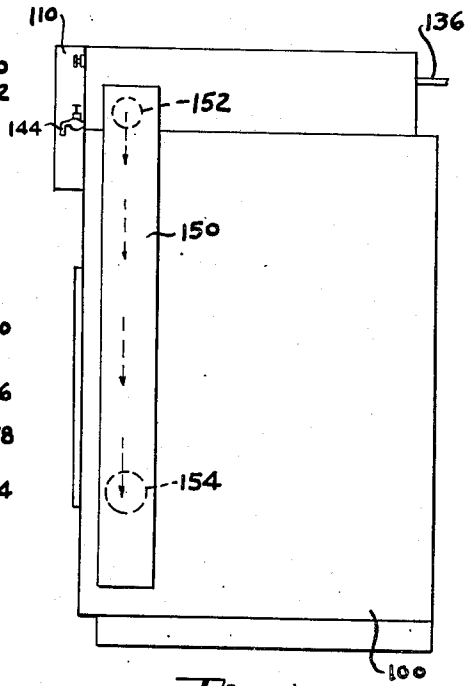




Fig. 6

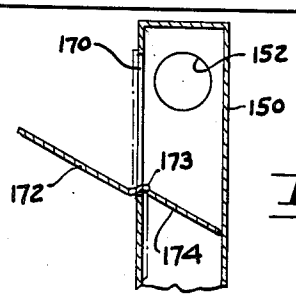



Fig. 9

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# UNITED STATES PATENT OFFICE

2,651,113

## CLOTHES DRIER

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Application September 19, 1949, Serial No. 116,494

2 Claims. (Cl. 34—78)

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The present invention relates to clothes dryers and more particularly to improved apparatus for circulating air through clothes dryers in a closed system, removing lint from the damp air and thereafter condensing the moisture from the air before returning the air to the drying compartment.

It is an object of the present invention to provide a clothes dryer designed to prevent the escape of lint moisture and heat into the room.

It is a further object of the present invention to provide means for removing the lint from moist lint-laden air prior to condensation of the moisture to avoid clogging the condenser with lint.

It is a further object of the present invention to provide means for removing the lint from moist lint-laden air prior to condensation of the moisture to avoid clogging the condenser with lint.

It is a further object of the present invention to provide an improved lint-collector comprising an air passage having converging walls in the direction of air flow, at least one of which walls is cooled to effect sufficient condensation to maintain the wall in moist condition so as to provide a surface on which the lint will deposit.

It is a further object of the present invention to provide lint collecting means and condensing means in a structure designed to be attached to present clothes dryers.

It is a further object of the present invention to provide an improved clothes dryer in which the lint-collector and condenser are built into the equipment.

It is a further object of the present invention to provide an automatic washer adapted to have a spin drying cycle and an air drying cycle so as to dry clothes to the desired final stage of dryness.

It is a further object of the present invention to provide an improved clothes dryer modified to operate as means for drying room air.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a front elevation of the clothes dryer to which the improved lint collecting and condensing devices are attached.

Figure 2 is a side elevation of the dryer shown in Figure 1.

Figure 3 is a plan elevation of the dryer with parts broken away.

Figure 4 is a section on the line 4—4, Figure 3.

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Figure 5 is a front elevation of a modified clothes dryer including lint collecting and condensing apparatus.

Figure 6 is a side elevation of the dryer shown in Figure 5.

Figure 7 is a plan view of the dryer shown in Figure 5 with parts broken away.

Figure 8 is a fragmentary section on the line 8—8, Figure 7.

Figure 9 is a fragmentary section showing a modified construction rendering the unit useful in drying room air.

Referring now to Figures 1–4 there is illustrated a clothes dryer comprising a main cabinet 10 providing an interior compartment including a rotary tumbler 12 in which the clothes to be dried are located. A closed system for circulation of air is provided and comprises a blower 14 adapted to withdraw air from the interior of the compartment 12 and to force the air through a duct 16 to a vertical duct 18 whence the air is admitted through an opening 20 into a lint-collecting chamber 22. An adjustable pressure relief vent is provided as indicated at 24 to prevent attainment of excessive pressures within the unit. However, the vent 24 is normally closed and the system provides for continued recirculation of air.

The lint-collecting chamber 22 is provided at its bottom with a floor plate 26 which conveniently may be a metallic plate. Located above the plate 26 is an inclined lint-collecting plate 28 which together with the floor plate 26 defines an air passage which converges in the direction of flow of air. Means subsequently to be described are provided for continuously cooling the lint-collector plate. The purpose of cooling the plate is to effect a small amount of condensation as the warm moist lint-laden air from the clothes dryer enters the lint-collecting chamber. It is contemplated sufficient moisture will be condensed on the lint-collector plate to keep the surfaces of the plate in moist condition. It has been found that when the lint-laden air is directed along such a plate, and particularly when air diffusing baffle means are provided which define with the plate a converging path in the direction of flow of air, that substantially all of the lint in the air will deposit upon the lint-collector plate.

As best seen in Figure 4, the air passage is around the inner end of the plate 28 and thence it is directed into a condenser chamber 30. Intermediate the lint cooling chamber and the condenser chamber is a partition 32 which how-

ever is spaced below a cover 34 so that an air passage is provided between the lower surface of the cover 34 and the upper edge of the partition 32.

Inside the condenser chamber 30 is provided a pipe 36 for a cooling medium, which may be in the form of tap water. The pipe 36 may have any desired configuration but is illustrated as bent to form a plurality of parallel sections interconnected at their ends. Preferably cooling fins are provided to effect maximum condensation of moisture as the air passes through the condensing chamber.

A pipe or flexible hose 37 extends into the hollow lint-collector plate as indicated at 38 and is connected to a pipe 39 provided with a plurality of nozzle outlets 40 to distribute cooling water longitudinally of the plate. The discharge from the interior of the hollow plate is through a pipe 42 which extends to a drain.

Moisture condensed in the condenser chamber falls to a perforated baffle plate 44 into a condensate reservoir 45 at one end of which is provided a tap 46 for draining condensate from the device. The air after passing through the condensing coils flows forwardly above the perforated baffle plate and over an imperforate portion 48 thereof whence it flows through a port 50 into a vertical duct 52 and thence through a dryer inlet 54 into a heating chamber 56 located within the cabinet 10. The heating chamber 56 is provided with suitable heating means such for example as electric resistance elements 58.

As best seen in Figure 4, the cover 34 is hinged as indicated at 60 and the partition 32 and the lint-collecting plate 28 are secured to the cover. Accordingly, when the cover is lifted to the dotted line position indicated in the figure the lint-collector plate 28 and the bottom plate are exposed so that the lint may be readily removed therefrom. At the same time, the condenser coils provided by the pipe 36 are exposed and lint may periodically be removed from these coils. However, since substantially all of the lint is collected by the lint-collector plate, cleaning the coils is very rarely required.

Attention is directed to the fact that the warm moist lint-laden air is first acted upon by the lint-collector as it emerges from the drying compartment. Substantially all of the lint is removed in this chamber before any substantial condensation of the moisture takes place. Thereafter, the clean warm air enters the condenser chamber where it is coiled and the moisture therein is condensed. Thereafter, the clean dry cool air passes through the heating chamber where it is heated, and from the heating chamber it is discharged into the drying compartment of the cabinet 10 for absorbing more moisture from the clothes.

Referring now to Figures 5–8 there is illustrated a modified construction of clothes dryer. In this case the cabinet is indicated at 100 and contains the usual tumbling container 102. Wet, moist lint-laden air is discharged from the interior compartment of the cabinet 100 through a port 104, the air being withdrawn by a blower indicated at 106. The air passes through a duct 108 and thence upwardly through a connecting duct 110 and through a port 112 into a passage 114. Located in the lint-collector chamber 116 is a lint-collector plate 118, to the underside of which is secured a plurality of cooling coils 120. Located abcve the collector plate 118 is a conical air diffusing baffle or cone 122. The



passage 114 opens through the conical air baffle 122 near its vertex. As a result of this construction the lint-collector plate and the conical air baffle, together define an air passage whose walls converge in the direction of air flow. In this modification this air passage, while the walls are converging, is of increasing extent since the flow of air is radial with respect thereto.

A partition 124 closes one end of the lint-collector chamber 116 and separates it from a condensing chamber 126. Preferably, the flow of air from the lint-collecting chamber to the condensing chamber is through a relatively small port indicated at 128, this port being closed by a screen to catch any lint which has escaped the lint-collector plate.

Located within the air condensing chamber 126 is a cooling coil 130 which is preferably provided with fins as indicated at 132 to effect most efficient cooling of the air and condensation of the moisture therefrom. The cooling coils 120 which cool the lint-collector plate are provided in series with the cooling coils in the main condenser and inlet and outlet pipes are indicated respectively at 134 and 136. These may be connected to a suitable supply of cooling liquid, tap water being perfectly satisfactory for this purpose.

Located at the underside of the condensing chamber is a perforated plate 140 through which condensate falls and is received within a condensate reservoir 142. Suitable drain means as indicated at 144 are provided for draining condensate from the reservoir periodically. Forwardly of the perforate plate 142 is an imperforate plate 146 which together with the underside of the lint-collecting plate defines a return air passage 148. A vertical duct 150 is provided which communicates through a port 152 with the air passage 148 and is provided adjacent its lower end with a port 154 through which the cleaned cooled dry air is admitted to a heating chamber 156. The heating chamber 156 is provided with suitable air heating means such for example as electric resistance elements indicated at 158 and the air is discharged from the air heating chamber into the interior of the cabinet 100.

As best seen in Figure 8, a hinged cover 160 is provided on the top of the unit from which the conical air baffle 122 and the passage 114 are suspended. When the cover 160 is raised the upper surface of the lint-collecting plate 118 is exposed and the lint may be readily removed therefrom. At the same time the screen over the port 128 is exposed and may be cleaned and also any small amount of lint which may have collected on the condenser coils 130 may be removed.

Referring now to Figure 9 there is illustrated a modified construction which renders the unit useful in drying room air. In this case the return duct 150 is provided with an opening 170. A cover 172 is provided which may be hinged as indicated at 173 and which may include a duct closure portion 174. The arrangement is such that when the cover 172 is swung to the position illustrated in the figure so as to permit dried air to escape through the opening 170, the element 174 closes the duct 150 so as to prevent return of air to the interior of the dryer.

In use the heating element located within the dryer is de-energized and the blower is operated independently. The door of the dryer is open as an air intake. Air is thus circulated through the clothes dryer over the condenser,

condensing moisture in the air. Thereafter the air is directed through the opening 170.

It is contemplated that the present structure may be provided as an attachment for existing clothes dryers. It is further contemplated that it may be built in as an original part of new clothes dryers. It is also contemplated that the drying structure illustrated in the figures may be supplied in automatic washing machines so that a complete washing, rinsing, and drying cycle may take place therein.

In case the drying apparatus is built into a complete washing machine its overall efficiency is greatly increased. This is due to the fact that the final hot rinsing of the clothes in the machine leaves the clothes in heated condition so that it is unnecessary to use additional heat to bring the clothes to a temperature at which the moisture contained therein will evaporate. The entire closed system will be at an elevated temperature when the spin drying cycle of the machine is completed. Accordingly, a minimum amount of energy is required to remove the additional moisture from the clothes. Moreover, the conventional spin drying equipment, operated at a slow speed serves as an efficient tumbling device for facilitating drying of the clothes by passage of warm dry air therethrough. It is desired to emphasize the fact that the improved drying structure cooperates in a novel and very efficient manner with the washing and rinsing equipment so that the complete washing, rinsing, spin drying and air drying operation may be completed most economically in a minimum time cycle.

The three basic operating parts of the clothes dryer disclosed herein are the heating unit, the condenser, and the fan or blower. The capacity of these units are interrelated for maximum efficiency. Preferably, conventional means are provided for varying the effectiveness of at least the heating unit and the blower, and this means may take the form of suitable controls for selecting the number of sections of electrical resistance heating elements employed in the heating unit, and a suitable rheostat or other control for varying the speed of the blower. The effectiveness of the condenser is of course directly variable by controlling the flow of the cooling medium therethrough. Tests under operating conditions have established that when the three variables are properly correlated the efficiency of the dryer is approximately 25% greater than dryers in which the condensing unit is not employed. Since the condensing unit requires no power and operates on inexpensive and readily available household water supply, it will be appreciated that this increase in efficiency is obtained with substantially no increase in operating cost. It will further be appreciated that the principal operating cost of dryers is the heat required and that an increase of 25% in the overall operating efficiency is directly reflected as a 25% savings in operating cost.

The drawings and the foregoing specification constitute a description of the improved clothes dryer in such full, clear, concise and exact terms



as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What we claim as our invention is:

1. In a clothes dryer including means for circulating air through the clothes compartment thence upwardly to a lint collecting chamber, thence to a condensing chamber, thence to air heating means, and thence back to the clothes compartment, comprising a transverse partition adjacent the top of the dryer, side walls extending upwardly from said partition to the top of said dryer, end walls extending upwardly from said partition to the top of said dryer, one of said end walls having an opening therein for the admission of air from the clothes compartment of said dryer, the other of said end walls being of foraminous material, a cover for said dryer adapted to define a lint collecting chamber with said transverse partition, said side walls and said end walls, a lint collecting plate depending from said cover and adapted to extend into said lint collecting chamber, said lint collecting plate being downwardly inclined from the end wall having the opening therein toward the end wall of the foraminous material to define an air passage of continuously decreasing cross-section, means for cooling said plate to cause condensation of a minor portion of moisture from the air passing through said lint collecting chamber, said lint collecting plate being thereby maintained in moist condition to effectively collect substantially all of the lint passing through the space between said transverse partition and said lint collecting plate, means mounting said cover for upward movement to expose said lint collecting plate and the upper surface of said transverse partition and the foraminous end wall for ready removal of lint therefrom.

2. In a clothes dryer, a lint collecting chamber including opposed walls converging in the direction of air flow, at least one of said walls being provided with cooling means to maintain said one wall in a moist condition due to condensation of a minor part of the moisture of moist lint containing air passing through said chamber, said walls defining an air passage of constantly decreasing cross-section in the direction of air flow, a closure for said chamber, one of said walls being carried by said closure so that opening of said closure exposes said lint collecting chamber for removal of lint therefrom.

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