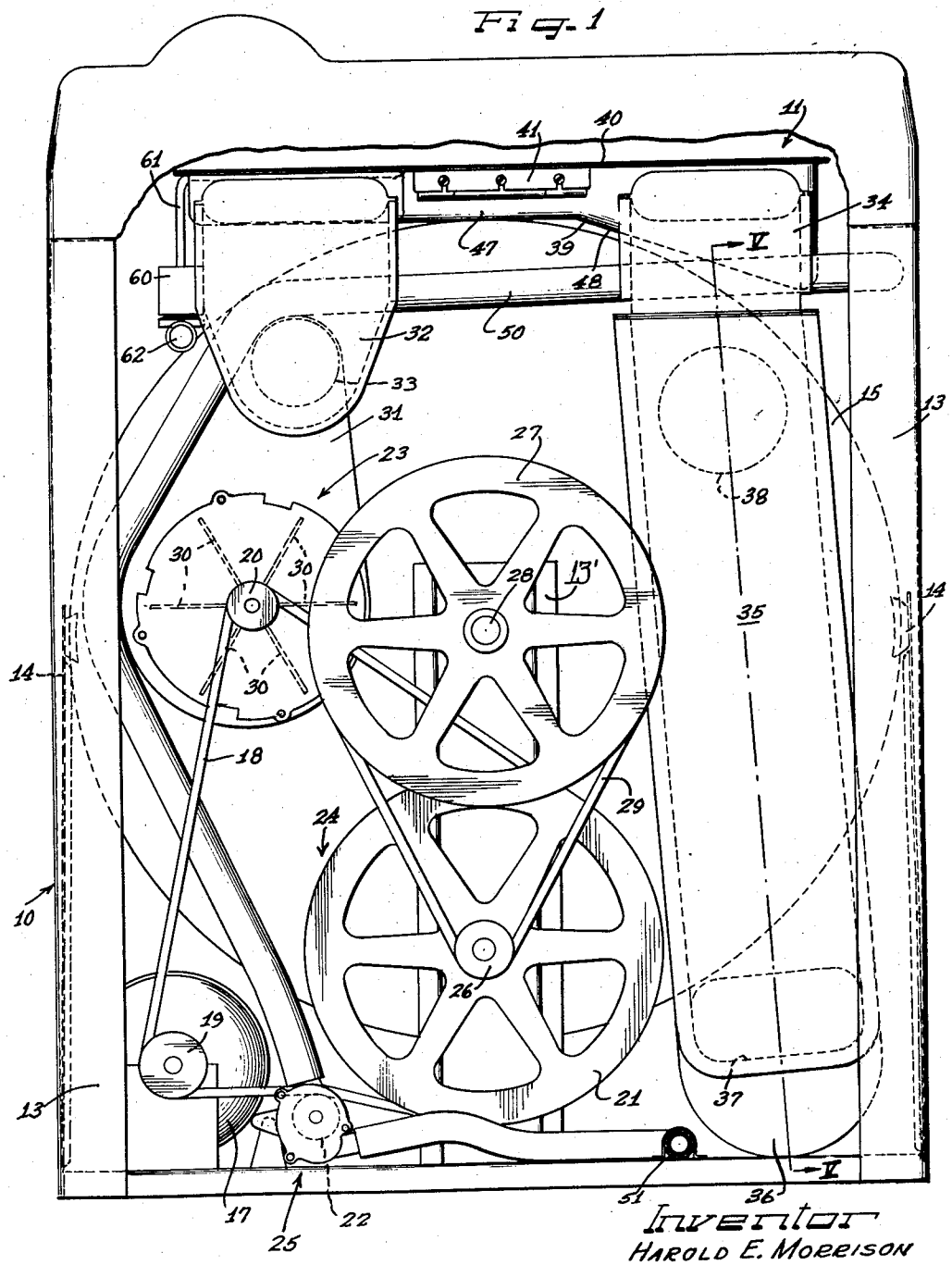
Sept. 30, 1958 H. E. MORRISON 2,853,798

CLOTHES DRIER AND CONDENSER THEREFOR

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Fig. 1



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Fig. 2

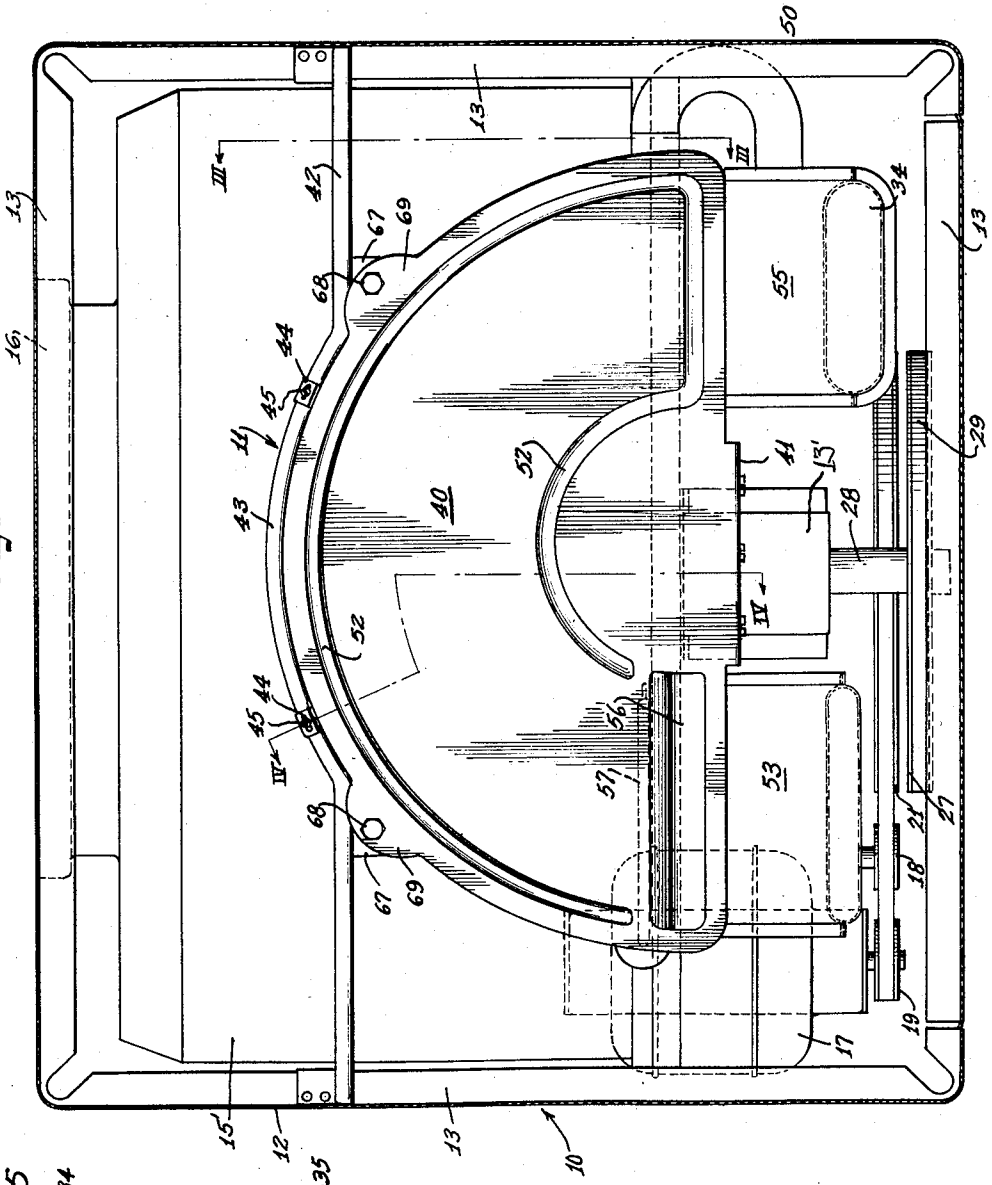
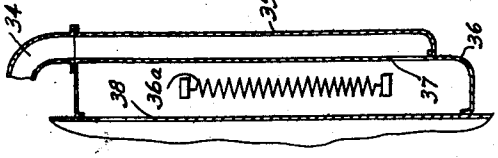


Fig. 5



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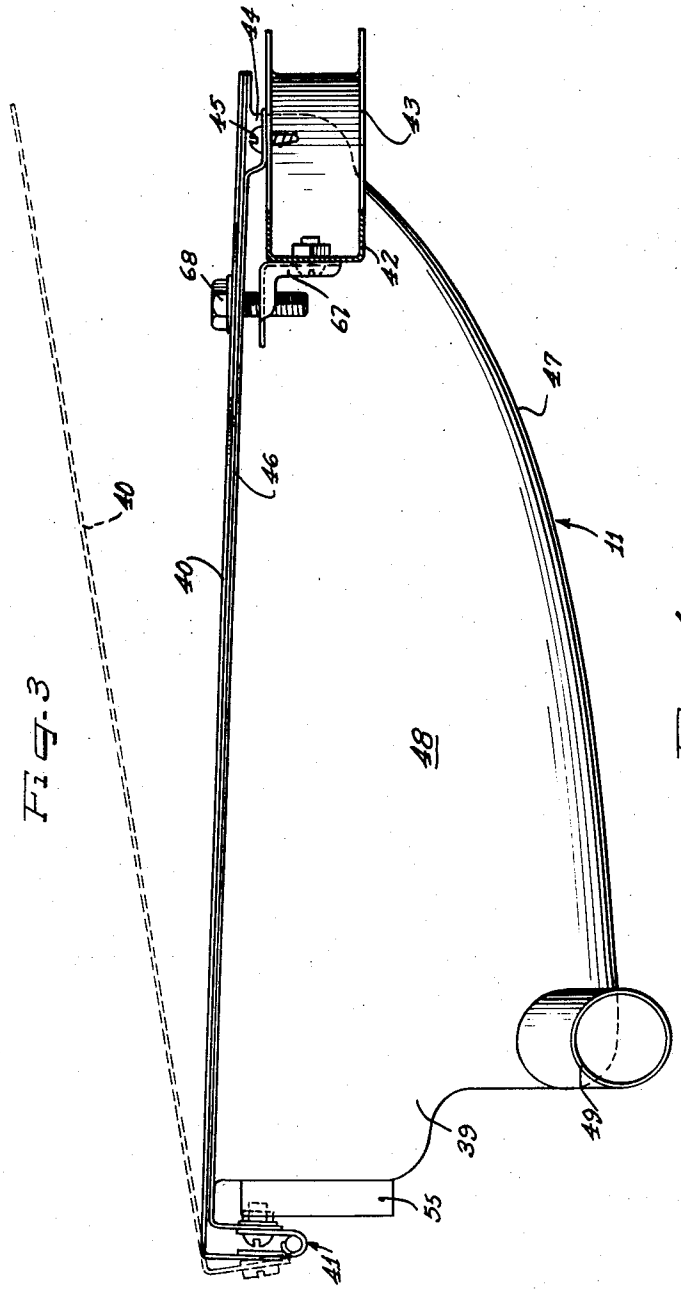


Fig. 3

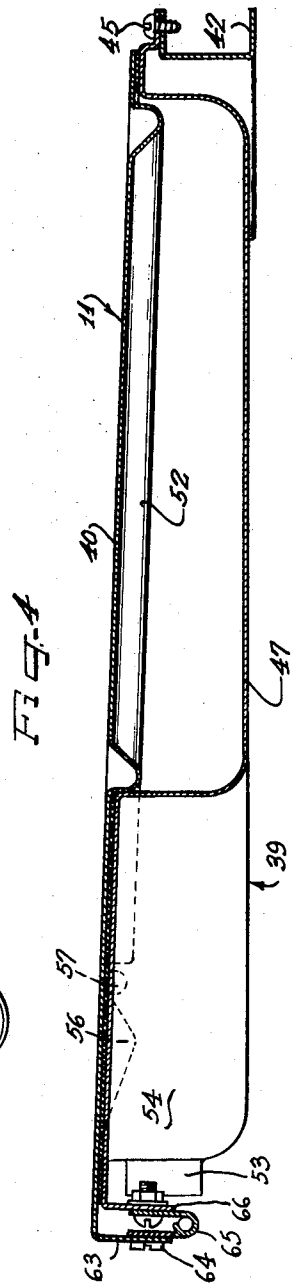


Fig. 4

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CLOTHES DRIER AND CONDENSER THEREFOR

Harold E. Morrison, Benton Harbor, Mich., assignor, by mesne assignments, to Whirlpool Corporation, a corporation of Delaware

Application July 14, 1955, Serial No. 522,097

2 Claims. (Cl. 34—75)

The present invention relates to a clothes drier and condenser therefor.

More particularly, the present invention relates to a combination of a clothes drier and condenser with the condenser disposed in a substantially closed air circulating system for the clothes drier and physically positioned over the drier drum.

While clothes driers with condensers in a closed air circulating system for the clothes drier have been known and constructed in the laundry equipment art, considerable expense and difficulty in utilizing the same has been experienced. Many of these difficulties occur due to the fact that heretofore it has almost invariably been considered necessary in the combination to dispose the condenser in a position either at the side of the horizontal axis clothes drying drum or at the rear of the mechanism behind the drum. Such placement of the condenser was heretofore considered necessary due to considerations concerned with the air flow path and manufacturing techniques. By such placement of the condenser in the combination units, the units have necessarily been substantially larger than clothes driers without the condensers included therein with the result that there has been a substantial increase in the expense of producing the combination beyond the additional expense of the mere inclusion of a condenser in the system.

Another difficulty which has accompanied the use of condensers in the clothes drier condenser combination has been the extreme temperature gradient through which the air must be heated for effective clothes drying since the more effective of the known condensers substantially reduced the temperature of the air below the designed inlet temperature for the air heating duct and the heating elements. Difficulties of this type resulted in either highly inefficient clothes drying by the clothes drier or the expense of redesigning and substantially increasing the heat capacity of the air heating elements in the air duct.

All of these difficulties and numerous other have been obviated by the present invention which permits not only highly efficient condenser operation and highly efficient drying operation but also permits the utilization of improved manufacturing techniques and the assembly of a combination clothes drier with a condenser, in combination, substantially without increasing the size of the combined unit over that of a clothes drier without the condenser. Also, clothes driers embodying the principles of this invention are effective to substantially preheat the air flowing between the condenser and the air heating duct thereby substantially increasing the efficiency of the air heating operation while reducing heat energy losses and permitting the utilization of heating elements no larger than the heating elements necessary in a clothes drier without a condenser, or possibly even smaller heating units.

The combination clothes drier with a condenser in accordance with the principles of this invention has a condenser which overlies the rotatable drum in the clothes drier in the usually free space between the top of the drum and the top of the cabinet housing for the clothes drier. The condenser itself may have a substantially horseshoe configuration so that both the inlet thereto and the outlet therefrom are disposed in the vicinity of the back of the drier housing or cabinet with the inlet thereby conveniently placed substantially adjacent to the exhaust fan which draws spent air from the drier. The outlet from the condenser is also conveniently disposed for connection with an air duct having one face thereof immediately adjacent to or in interfacial engagement with or formed as a part of the air heating duct along the back face of the air heating duct whereby air passing through the outlet duct from the condenser will be preheated prior to entering the air heating duct in the vicinity of the lower end thereof thereby substantially increasing the efficiency of the operation and substantially reducing the cost of production.

It is, therefore, an important object and principle of the present invention to provide a new and improved drier condenser combination mechanism.

Another important object and feature of the present invention is to provide a new and improved condenser and horizontal rotary drum clothes drier combination with the condenser for a closed air circulating system for the drier overlying the drier drum within the housing for the complete combination.

Another object of the present invention is to provide a clothes drier with a condenser overlying the drier drum to thereby cool the cabinet top for the drier.

Still another object and feature of the present invention is to provide a new and improved clothes drier and condenser combination wherein the condenser overlies the clothes drier drum and the inlet to the condenser is substantially adjacent to the spent air exhaust fan and the outlet from the condenser is substantially adjacent to the air heating means for the drier.

Yet another object and feature of the present invention is to provide a new and improved condenser for combination with a hot air type clothes drier.

Still another object of the present invention is to provide a new and improved condenser and clothes drier combination wherein the condenser is disposed to provide for convenient outlet thereof adjacent to the air heating means for preheating the air passing from the condenser to the air heater.

Still other objects, features and advantages of the present invention will become readily apparent from the following detailed description of the present invention and an embodiment thereof, from the claims, and from the accompanying drawings in which each and every detail shown is fully and completely disclosed as a part of this specification, in which like reference numerals refer to like parts, and in which:

Figure 1 is a rear elevational view of a clothes drier with the back cover removed and a portion of the top cover broken away to better illustrate certain parts of the assembly;

Figure 2 is a top plan view of a clothes drier and condenser combination in accordance with this invention with the top cover removed therefrom;

Figure 3 is a side view of the condenser showing a part of the supporting bracket therefor in section viewed as taken substantially along the line III—III of Figure 2 and further showing in dotted line phantom illustration the top cover of the condenser hingedly displaced from the remainder of the condenser;

Figure 4 is a sectional view of the condenser viewed substantially as taken along the broken line IV—IV of Figure 2, and

Figure 5 is a sectional view taken along line V—V of Figure 1.

As shown on the drawings:

As illustrated in the drawings, a clothes drier and condenser combination mechanism having a drier mechanism **10** in combination with a condenser **11**. Through the use of a condenser in combination with a clothes drier, the clothes drier may be provided with a completely or substantially closed air recirculating system so that none of the hot moist lint-laden air from the drier need be exhausted into the room where the drier is positioned such as in a utility room or a kitchen or the like in the case where the drier is a home appliance such as the one illustrated in Figures 1 and 2. The combination unit is entirely enclosed in a housing or casing **12** which is reinforced by edge peripheral reinforcing members **13** serving as legs to support the combination mechanism and also serving as a supporting structure for various parts and mechanisms therein.

Within the mechanism, a pair of additional structural supports **14** operate in combination with the peripheral supports **13** to securely and fixedly mount a bulkhead **15** which carries and substantially encloses a horizontal axis rotatable drier drum into which the clothes are placed as through the cabinet door **16** in the housing or cabinet **12**. The drum **15'** (Figure 2) is rotatably driven about its horizontal axis by such motor means as an electric motor **17** mounted on the framework of structural supports **13** and the base plate for the mechanism.

More particularly, the motor **17** is directly coupled through a belt **18**, such as a V belt or the like, and pulleys such as the pulley **19** on the motor shaft, the pulley **20** on the blower or fan shaft, a pulley **21** on an idler shaft, and a pulley **22** on a pump shaft to the fan or blower **23**, an idler arrangement **24**, and a pump mechanism **25**. The idler pulley **21** driven by the motor driven belt **18** has a multifold greater diameter than the pulley **19** on the motor shaft so as to effect a substantial reduction in rotational speed between the motor shaft and the idler shaft. By then providing a small diameter pulley **26** on the idler shaft and a relatively large diameter pulley **27** on the drum shaft **28**, a still further reduction in rotational speed is effected so that the drum supported by the support post **13'** will rotate at a proper tumbling speed while the motor **17** may operate at standard or conventional speeds for electric motors. The small idler pulley **26** is coupled to the large drum pulley **27** also by means of a belt **29** which may be a V belt or the like.

In operation, warm or hot moist lint-laden spent air is drawn from the clothes drier drum through an aperture in the bulkhead substantially coaxially with the fan mechanism **23** by action of the rotating impellers **30**. The air is then forced by the fan through an exhaust duct **31** to the inlet duct **32** with which it mates as at **33**. The air then passes through the inlet duct **32** to the condenser assembly and through the condenser assembly to the outlet duct **34** from the condenser assembly. From the outlet duct **34** of the condenser the air passes through an air duct **35** having a face thereof in engagement with the back face of the heater duct **36** or which may even be formed as a partitioned part of the heater duct assembly and from which air passes into the heater duct through an inlet **37** in the region of the lower end of the heater duct. From that inlet **37** the air passes through the heater duct **36** and over the air heating elements **36*a***, which may be electrically energized as illustrated, or have another fuel energization such as gas or the like, from which the air passes to an outlet **38** from the heater duct. The outlet **38** from the heater duct also serves as an inlet to the drier drum and passes through an appropriate aperture in the bulkhead **15** of the drier mechanism assembly.

While the air is passing through the condenser assembly **11**, it is substantially cooled, cleaned and dehumidified so that it is substantially fresh air as it passes into the preheater duct **35**. After passage through the main heater duct or primary heater duct **36**, the air is heated to a relatively high temperature and is in a substantially

dry, hot and clean condition when it passes into the drier drum to flow over the clothes and take moisture and lint therefrom. As will be seen from the following detailed description of the condenser assembly **11**, it is operable to effect the described functions of cooling, cleaning and dehumidifying the air passing therethrough since it is a substantially closed chamber except for the inlet and outlet provided thereon and is further provided with a cold water spray which is effective to wash the lint from the air as well as cool the air whereby cooling and dehumidification take place. In addition, the spray is provided near the inlet to the condenser and the water thereupon flows over the bottom of the condenser toward the outlet side so that the air passes over the cold water and is still further cooled and dehumidified and any moisture droplets and the like sprayed into the air by the spray may precipitate therefrom together with other moisture precipitated from the air through the cooling and dehumidification process.

To these ends, the condenser **11** is formed of a sheet material body such as sheet metal or the like in the configuration of a semi-doughnut or horseshoe-like pan **39** and a similarly plan configurated cover **40** which is hingedly mounted on the pan **39** as by a hinge assembly **41**. The entire condenser assembly is supported to overlie the drum and bulkhead **15** so as to lie in a substantially horizontal plane and is so mounted and secured in position as by being secured to a cross brace **42** which is in turn secured to the peripheral frame structural members **13** and may be formed as a channel structural member or the like as viewed in section in Figures 3 and 4. This channel **42** has an arcuate portion **43** which matches the curvature of the front of the condenser so that the condenser may be conveniently secured thereto. To this end, the pan **39** is provided with a pair of outwardly extending flange lips **44** for conveniently securing the pan to the channel **42** in the region **43** thereof as by screws **45** or the like. At the rearward end of the condenser **11**, the condenser is supported on the bulkhead **15** and is further supported and secured in place by being secured to the inlet duct **32** to the condenser from the fan **23** and the outlet duct **34** from the condenser leading to the preheater duct **35**.

The horseshoe or semi-doughnut pan **39** has a relatively flat planar upper edge flange **46** with depending side walls extending to the pan bottom **47**, all of which are formed from a single piece of sheet material. The pan itself is relatively shallow in the region of the inlet thereto as may be seen in Figures 1 and 4 and this shallowness extends to an area in the region of the air outlet where the depth of the condenser is substantially increased as at **48**, the increasing depth occurring over a tapered length leading to a liquid coolant outlet **49** at the deepest region of the condenser and substantially adjacent to the air outlet.

This liquid coolant outlet **49** is connected through a hose or tube **50** or the like to the pump and valve mechanism **25** which leads to an outlet **51** at the bottom of the combination assembly.

In the embodiment of the invention illustrated in the drawing, the condenser is substantially semi-doughnut or horseshoe shaped and the top **40** is provided with a plurality of seal forming depressions **52** therein which are effective to cooperate with the condenser pan side walls having a semi-doughnut or horseshoe configuration to seal the condenser. Thus, when the air enters the condenser through the inlet **53** thereto, which is a sheet material inlet formed of a pair of symmetrical flanged and secured-together sections further secured to the back wall **54** of the pan **39**, the air will flow through the condenser in a horseshoe pattern to the outlet **55** which is similarly formed of a pair of secured-together symmetrical flanged sections secured to the back wall **54** of the pan **39**. (The inlet **53** is in direct air communication with the duct **32** while the outlet **55** is in air flow communication with the duct **34**.)

To clean, cool and condense the air flowing through

the condenser from the inlet **53** thereof and to wash the lint from the air, in the region of the inlet to the condenser the top is provided with a still another indented formed region **56** at the inner edge of which a condenser spray tube **57** is secured to the top of the condenser on the inner face thereof and extends between the ends of the seal forming depressions **52** of the top of the condenser. This spray tube **57** is provided with a plurality of aligned apertures for spraying a pair of substantially complete sheets of coolant such as cold water or the like across the condenser disposed at substantially a 45° angle to each other. These spray sheets of water are directed with one thereof extending into the condenser and the other thereof extending vertically across the condenser so that all air passing through the condenser is sprayed and washed for removing the lint from the air as well as to cool the air and thereby condense moisture therefrom as picked up in the drier drum. The water then flows over the bottom **47** of the pan **39** to the drain end **49** and as the air passes over the cold water it is further cooled and the moisture therein is further condensed so that the air passing through the outlet **55** is clean, cool and substantially dry.

To supply water to the spray tube **57** in the condenser, the tube **57** extends radially outwardly from the condenser (Figures 1 and 2) and connects to a controllable coolant valve **60** through a lead tube **61** at the outlet from the valve **60**. An inlet pipe **62**, Figure 1, leads to any appropriate source of coolant such as the cold water supply.

By virtue of the construction of the condenser as described hereinabove, the condenser is not only efficient but substantially self-flushing to drain away substantially all of the lint washed from the air. For convenient maintenance of the condenser, however, the top **40** is hinged as at **41** by a flanged rear edge **63** secured as at **64** to a hinge **65** secured to the pan **39** so that the top **40** of the condenser **11** may be hingedly displaced from the pan **39** as indicated by the dotted line illustration in Figure 3.

During operation, however, it is best that the condenser top be fixedly locked in place and for this purpose a pair of angle brackets **67—67** are secured to the supporting channel bar **42** and are provided with threaded apertures for receiving locking screws **68** which pass through apertures in ears **69** in the top **40**.

From the foregoing it will be seen that by the principles of the present invention there is provided a new drier and condenser combination which is provided with a highly new condenser structure of economical construction, economical maintenance and efficient operation. It will also be observed that numerous variations and modifications may be effected without departing from the true spirit and scope of the novel concepts and principles of this invention and I, therefore, intend to cover all such modifications and variations as fall within the true spirit and scope of the novel concepts and principles of this invention.

I claim as my invention:

1. In a clothes drier having a drier drum and a substantially closed air circulating system therefor, a condenser in the system, and means to mount the condenser over the drier drum, said condenser having a pan with an air inlet thereto and an air outlet therefrom and further having a liquid coolant inlet thereto and a drain therefrom and means in said condenser directing coolant over substantially all of the air entering the condenser, the condenser having a bottom pan configurated to direct the air into a substantially horeshoe path.

2. In a clothes drier having a drier drum and a substantially closed air circulating system therefor, a condenser in the system, means to mount the condenser over the drier drum, first air duct means defining a flow path for air from the drier drum to the condenser, and second and third air duct means defining a flow path for air from the condenser back to the drier drum, said second air duct means extending from the condenser downwardly to the base of the drier drum, said third air duct means leading upwardly from the lower end of the second duct to an inlet into the upper end of the drum, said ducts being in juxtaposed relationship for heat transfer from the third to the second duct, and heating means in said third duct.

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