May 23, 1950 E. W. DENMAN 2,509,137

AIR CIRCULATOR

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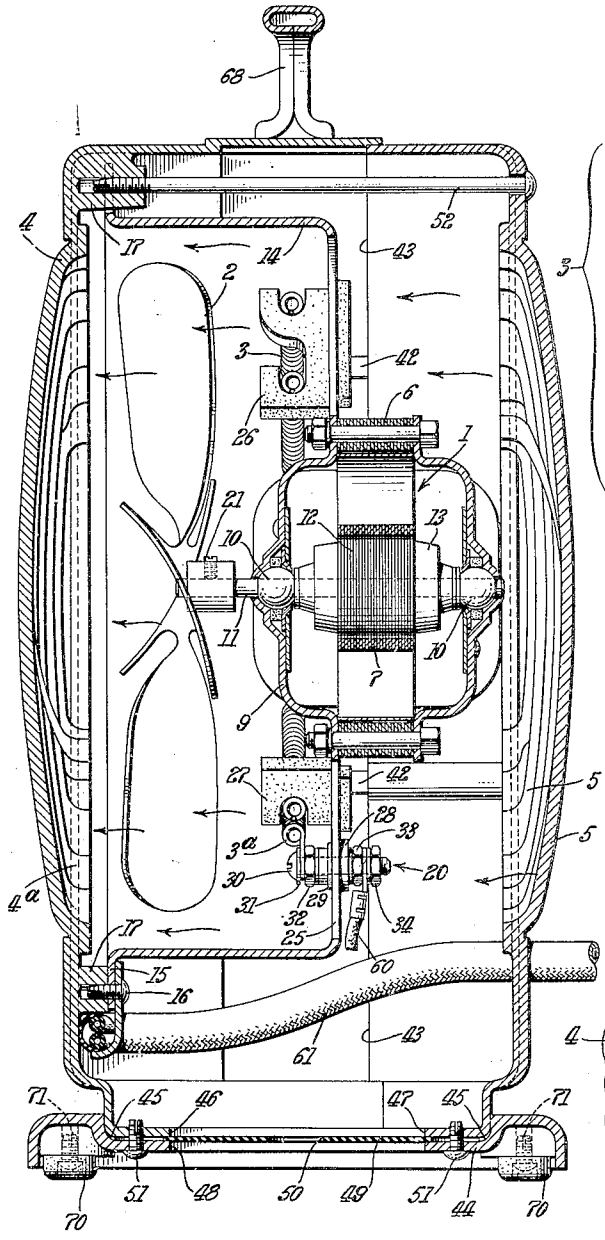


Fig. 1.

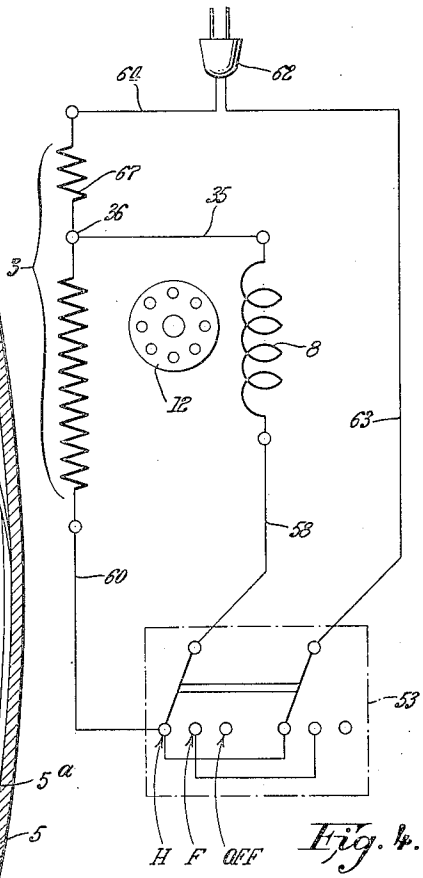


Fig. 4.

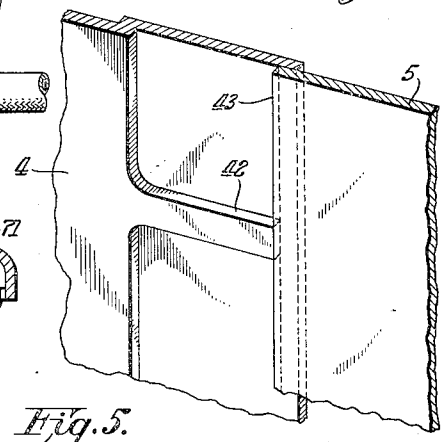


Fig. 5.

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AIR CIRCULATOR

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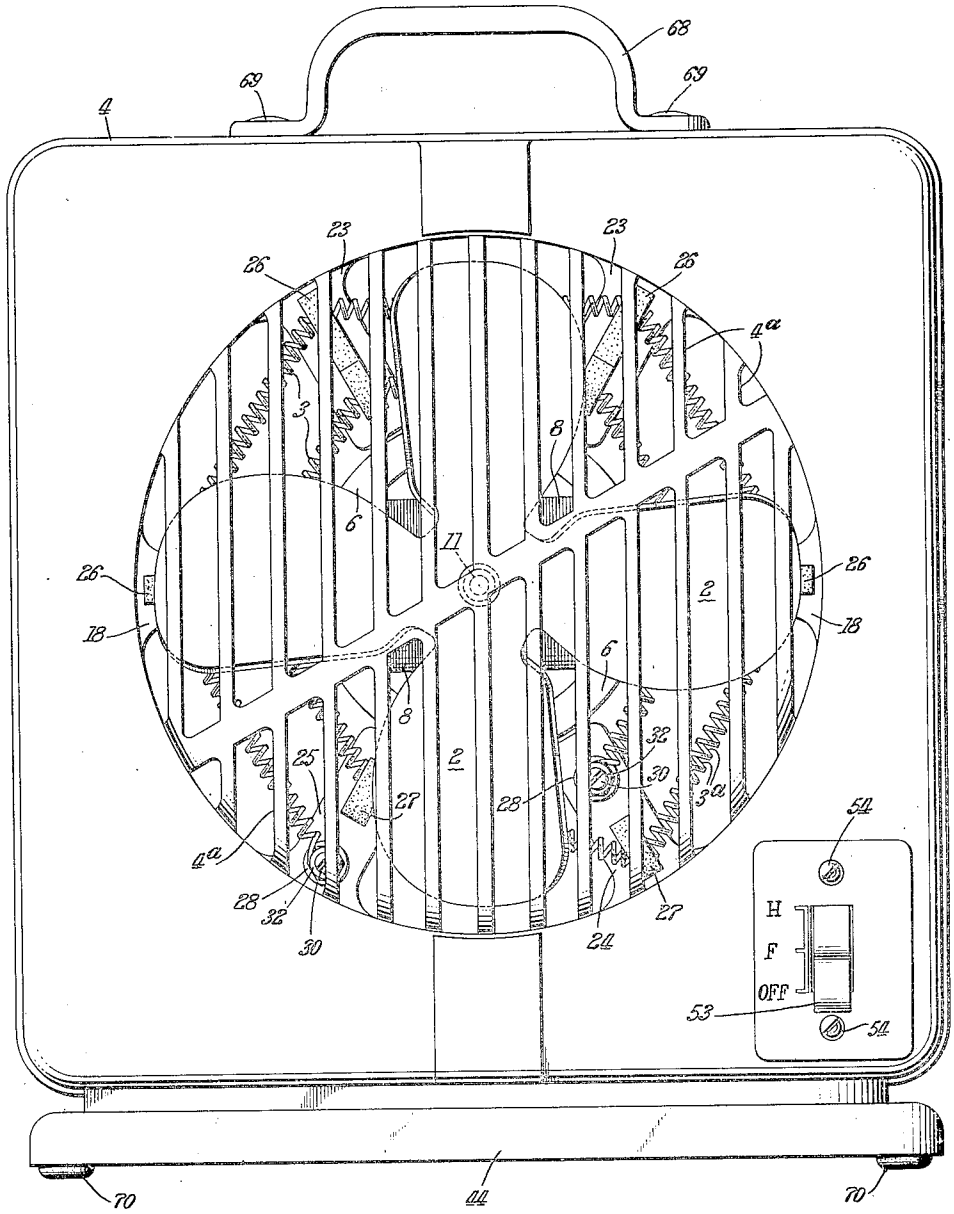


Fig. 2.

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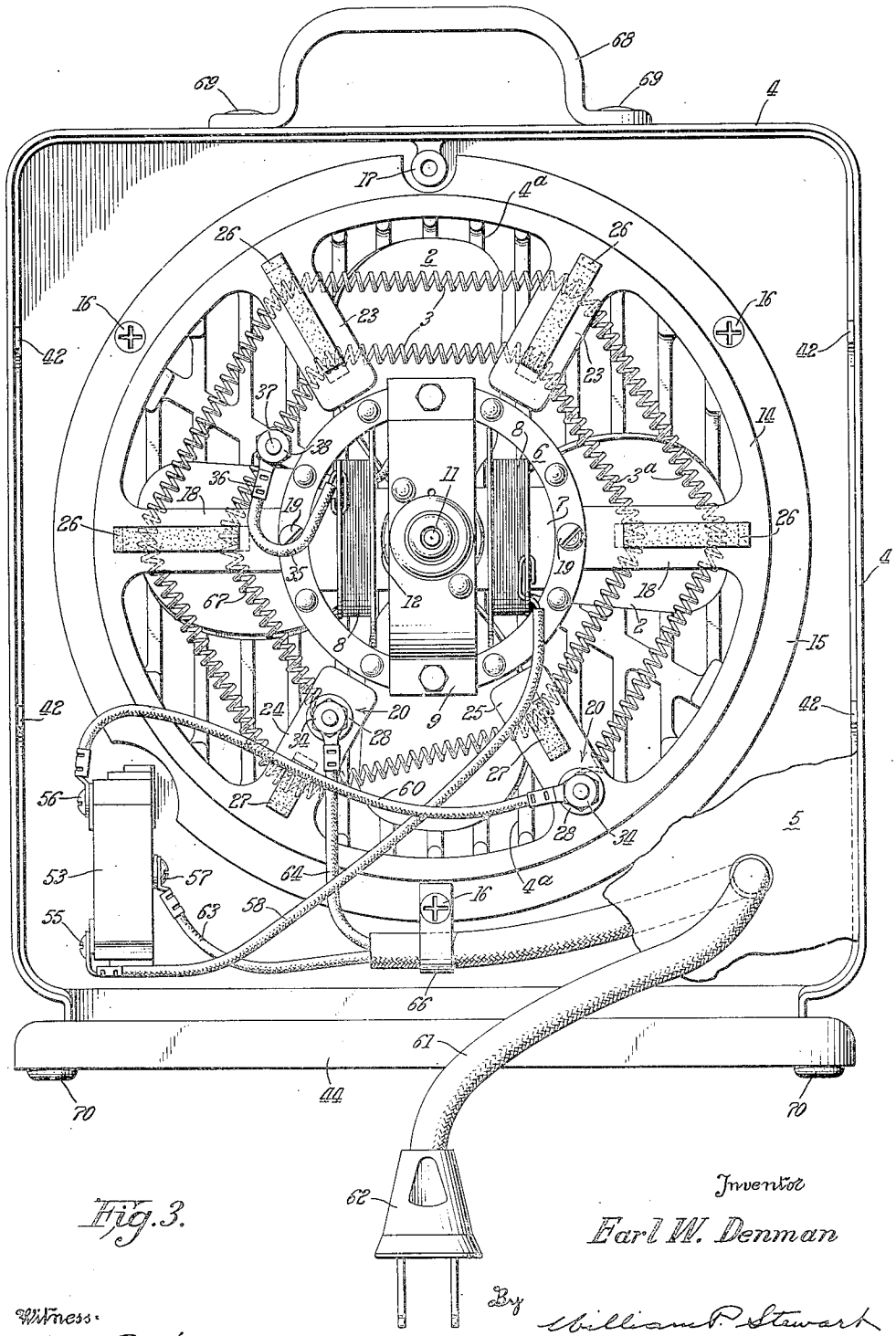


Fig. 3.

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UNITED STATES PATENT OFFICE

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AIR CIRCULATOR

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5 Claims. (Cl. 219—39)

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This invention relates to a combined electric heater and air circulator of the portable domestic type designed to operate from a regular electric convenience outlet.

It is an object of this invention to provide an attractive lightweight, rugged and inexpensive air circulator which may selectively be used either as a cooling fan or as a forced convection heater by the actuation of a switch.

It is a further object of this invention to provide an air circulator in which the air circulation rate is automatically reduced when the heater is turned on in order to obtain a warm air temperature therefrom which is comfortable and does not produce a drafty condition.

It is a still further object of this invention to provide a fan and heater combination of which the assembly shall be simplified by employing a minimum number of fastening elements.

A further object of this invention is to provide, in a convection heater structure, facility in assembling by employing an easily accessible sub-assembly of the essential elements.

With the above and other objects in view as will hereinafter appear, the invention comprises the combination and arrangement of parts hereinafter set forth and illustrated in the accompanying drawings from which the several features of the invention and the advantages attained thereby will be readily understood by those skilled in the art.

In the drawings, Fig. 1 is a section taken through an air circulator embodying the invention, the section being taken in substantially the vertical plane of the fan-axis.

Fig. 2 is a front elevation of the air circulator.

Fig. 3 is a rear elevation of the air circulator, with the rear cover partially broken away.

Fig. 4 is a wiring diagram showing the electrical connections for the air circulator.

Fig. 5 is an enlarged perspective view showing a detail of the air circulator.

The air circulator comprises a motor 1, a fan 2 driven by said motor, a heater element 3 located on the upstream side of the fan, all disposed within an enclosure formed by a front cover 4 and a rear cover 5 formed preferably of die cast material. The covers 4 and 5 are formed with grilled apertured portions 4^a and 5^a which provide for free flow of the air circulated by the fan 2 as shown by the arrows and minimize introduction of foreign elements within the case formed by said covers. The motor 1 is of the shaded-pole induction type and comprises a stator core ring 6 within which is pressed a stator core 7 carrying a current-conducting winding 8. Bearing brackets 9—9 contain bearing bushings 10—10 within which is journaled a rotor shaft 11 carrying a rotor 12 having thereon a die-cast squirrel-cage 13. It will be noted that the motor 1 is of the skeleton type of construction which affords the best ventilation by exposing the heat generating parts directly to the air stream.

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A motor-supporting annular band 14 has a flanged rim-portion 15 which is secured by means of self-tapping screws 16 to bosses 17, formed at the inner side of the front cover 4. The band 14 is formed with radial opposed arm portions 18—18 which are apertured to receive bolts 19—19 which extend through the motor stator core ring 6. This construction supports and positions the motor 1 centrally relative to the covers 4 and 5. Secured to the rotor shaft 11 by a set screw 21, is the four-bladed fan 2.

The band 14 is formed with other radial arms 23, 24 and 25 which extend inwardly toward the motor stator core ring 6 but terminate just outside said ring. These arms are apertured to receive ceramic insulators 26 and 27 upon which are strung convolutions of the wire 3^a of the heater 3 as shown clearly in Fig. 3. The ceramic insulators may be secured to the arms by means of a ceramic bonding cement. The motor-supporting arms 18—18 are also apertured and receive therein insulators 26 on which are strung the wire convolutions 3^a of heater 3. This provides a spiralling hexagonal configuration for the heater which includes nearly two complete turns. At each end of the heater, electrical terminals 20—20 are provided and each comprises an insulating bushing 28 secured to its respective arm 24 or 25 by being retained in an aperture therein by means of a snap ring 29, as shown most clearly in Fig. 1. A conducting screw 30 traverses the insulating bushing 28, the heater wire 3^a being secured between a washer 31 and a nut 32. The screw is tightened in the bushing by taking up on a nut 33 and an extra nut 34 provides means for making connection to an external circuit as will be described presently.

A permanent connection is made between one end of the motor winding 8 and a point near one end of the heater 3. To that end, a motor lead 35 is formed with a terminal 36 which is joined to the heater wire 3^a by means of screw 37, and nut 38 as seen most clearly in Fig. 3.

The annular band 14, together with the heater 3, motor 1 and fan 2 secured thereto, form a subassembly of the essential elements, which as-

sembly is secured to the front cover 4 by means of the three self-tapping screws 16 which extend through apertures in the flange portion 15 and are tapped into the bosses 17 located on the inside of the front cover 4. As illustrated in Fig. 5, the front cover 4 is formed with internal spacing bosses 42 against which the edge portion 43 of the back cover 5 may seat in edge-overlapped condition to position said covers in proper relative spaced position to form an enclosure.

A base element 44 is formed as a ring having a depressed saddle portion 45 in which are seated the covers 4 and 5 in assembled edge-overlapped condition, said covers and said base having connecting apertured portions 46, 47 and 48 which permit additional inflow and outflow of air to and from the housing formed by the covers 4 and 5. A fiber shield 49, provided with apertures 50, is secured between the bottom portions of the covers and said base as shown clearly in Fig. 1. Screws 51—51, extending through the base, are tapped into the respective covers to secure the parts and a single screw 52 passes through an aperture in the rear cover 5 and is tapped into the front cover 4. Thus, only three screws (51—51, 52) are employed to hold the covers and the base in completely assembled condition.

A three-position switch 53 is secured to the inside of the front cover by means of screws 54—54 and is provided with three terminals 55, 56 and 57. Motor lead 58 is connected to terminal 55. One end of the heater, is connected to terminal 56 of the switch by lead 60. A line cord 61 having a regular two-prong plug 62 terminates within the unit in leads 63 and 64, one of which connects to the switch terminal 57, and the other of which connects to a heater terminal. A wire clamp 66, secured under one of the screws 16, anchors the cord 61 to prevent detrimental mechanical pull at the heater terminals. These electrical connections are shown schematically in the wiring diagram of Fig. 4.

It will be seen that a small portion 67 of the heater 3 is permanently in series with the motor winding 8 and the supply line when the plug 62 is inserted in a convenience outlet. If the switch 53 is in the "fan" position, (denoted by F), only the relatively small motor current traverses this portion 67 of the heater. Thus, the voltage drop in series with the motor created thereby is small and substantially the full line voltage is impressed on the motor. However, when the switch is in the "heater" position, (denoted by H), the heater is placed across the line and draws a relatively heavy current. Thus the voltage drop in the portion 67 thereof in series with the motor is increased and the motor voltage is accordingly decreased with resultant decrease in speed. This decreased motor speed enables the air passing the heater to absorb enough heat to raise its temperature so that a comfortable flow of warm air results.

A carrying handle 68 is secured to the top of the front cover by means of screws 69—69. Rubber feet 70 are secured to each of the four corners of the base 44 by self-tapping screws 71 and this completes the assembly.

It will be seen that the construction is such that the rear cover 5 may be readily removed (Fig. 3) without disturbing the essential parts and is important in providing access to and inspection of those parts during actual operation. This is brought about by the fact that the complete subassembly of annular band 14, motor 1, fan 2 and heater 3 is first secured directly to the front cover 4 only, the covers 4 and 5 being subsequently secured together by the screw 52 and by the bridging function of the base 44. It will be noted from Fig. 1 that the motor is placed on the upstream side of the fan so that the air flowing over it is the relatively cool entering air. This assists in reducing the motor size and, by thus reducing its obstruction to the air flow, makes the entire unit more efficient as an air circulator.

It is to be understood that the tap at 36 on the heater winding 3 is so chosen as to provide a fan speed (with the heater turned on) producing an air flow which will just prevent the heater from attaining a visible glow. This is done to prevent temperature radiation from the heater which would detrimentally heat the motor and the case formed by the covers and the base. The latter condition would be most undesirable, especially with a portable device for domestic use which requires a low case temperature to facilitate handling. Baffles have been used in the prior art to shield the motor and the case from the undesirable heating effects of this radiation, but these provisions make the structure more complicated and the assembly more difficult. Thus, according to the invention, the heater temperature is controlled by the air flow rate so that its loss of heat by radiation is negligible and substantially all of the heat generated is transferred directly to the air stream by conduction and convection.

The dished shape of the grilled apertured portions of the end-covers makes it difficult to effect a complete air flow stoppage in the event that the heater should be turned over accidentally on its back or front. This, together with the fact that the heater is placed as remote as possible from either cover, assures that no external scorching will occur by radiation from the heater.

From the foregoing, it will be perceived that I have provided a portable, rugged and inexpensive air circulator which may be readily converted from a cooling fan to a convection heater use and which may be easily assembled with a minimum number of fastening elements.

Having thus set forth the nature of the invention, what I claim herein is:

1. A unitary assembly for air-circulators comprising, a continuous annular shell having an outturned flanged edge and formed with integral inwardly extending radial arms, a motor secured to a diametrical pair of said arms, insulators secured to each of said arms and radially spaced from said motor, a heater supported by said insulators, and a fan driven by said motor and located on the downstream side of said heater and motor.

2. A combination electric fan and heater having separable front and back apertured covers complemental to each other in forming a housing, a continuous annular band formed with an outturned flanged portion removably secured to one of said covers within said housing, said band having integral inwardly extending radial arms, a motor secured to a diametrical pair of said arms, a heater surrounding said motor and secured to said arms including said diametrical pair, and a fan secured for rotation to said motor on the downstream side of said motor and heater.

3. An electric heater comprising a case formed by two apertured covers placed in back-to-back position, a completely operative subassembly formed by a single continuous annular band having an outturned integral flanged portion for securing said band to one of said covers, integral

inturned radial arms formed on said band, a motor secured to a diametrical pair of said arms, a heater secured to said arms in radially spaced relation to said motor, and means for securing both of said covers in back-to-back assembled position to form an enclosure for said subassembly.

4. An electric heater comprising a case formed by two apertured covers placed in back-to-back position, a continuous cylindrical band having, at one peripheral edge, an integral outturned flanged portion and, at the opposite peripheral edge, a series of integral inturned radial arms, an electric motor secured to a diametrical pair of said arms, a heater secured to said arms including said diametrical arms, a fan mounted for rotation on said motor on the downstream side of said motor and said heater, and means for securing said flanged portion to one of said covers.

5. A self-supporting subassembly for an electric convection heater comprising a single continuous cylindrical band formed with an integral outturned mounting flange at one edge and a series of integral inturned radial arms at the opposite edge, a motor secured to a diametrical pair of said arms, insulators secured to said arms in the region surrounding said motor, heater coils carried by said insulators, and a fan mounted for rotation with said motor on the downstream side of said motor and heater.

EARL W. DENMAN.

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