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A. L. BUNTING
HEATING ELEMENT

3,291,966

Filed April 27, 1964

2 Sheets-Sheet 1

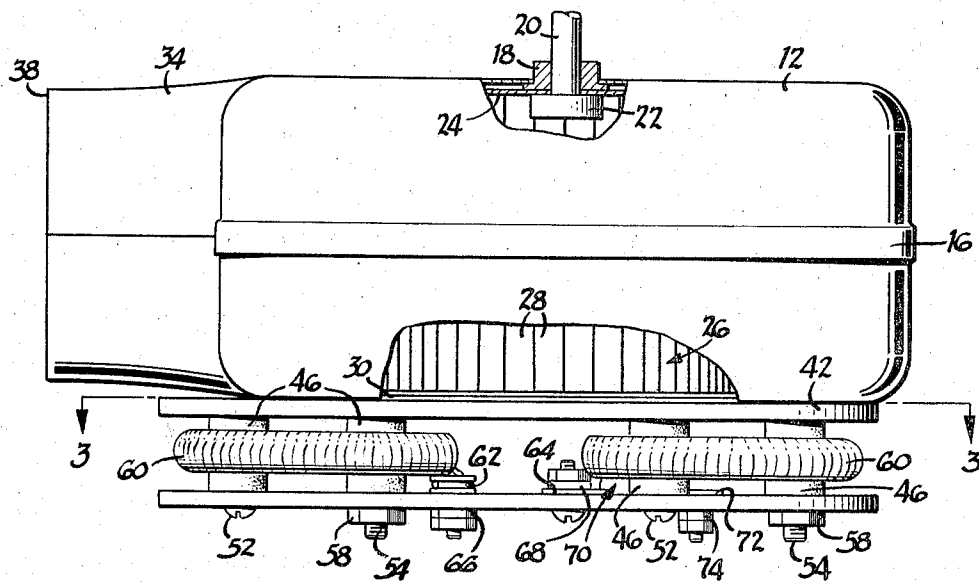
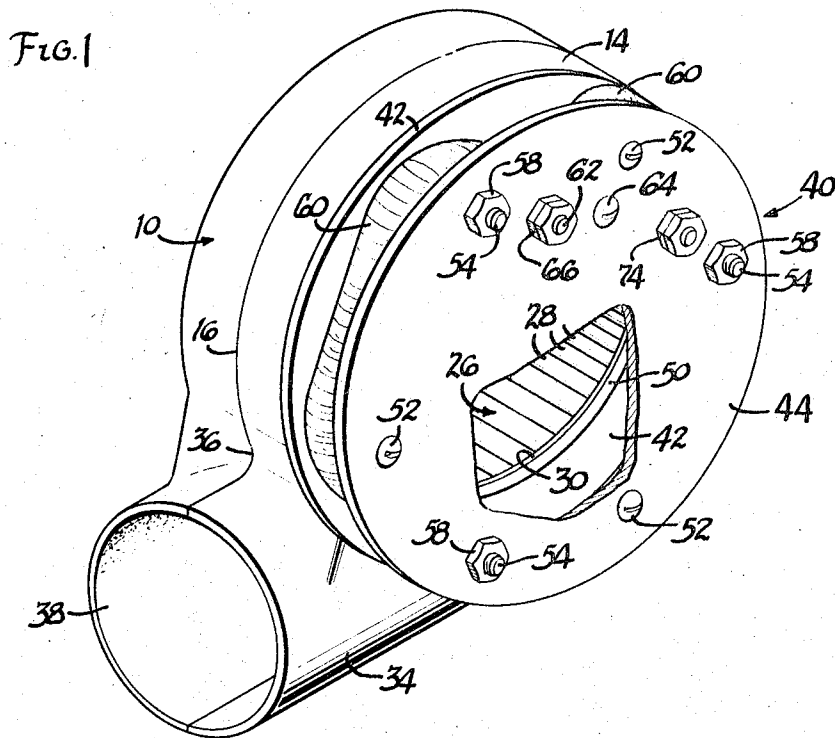


FIG. 2

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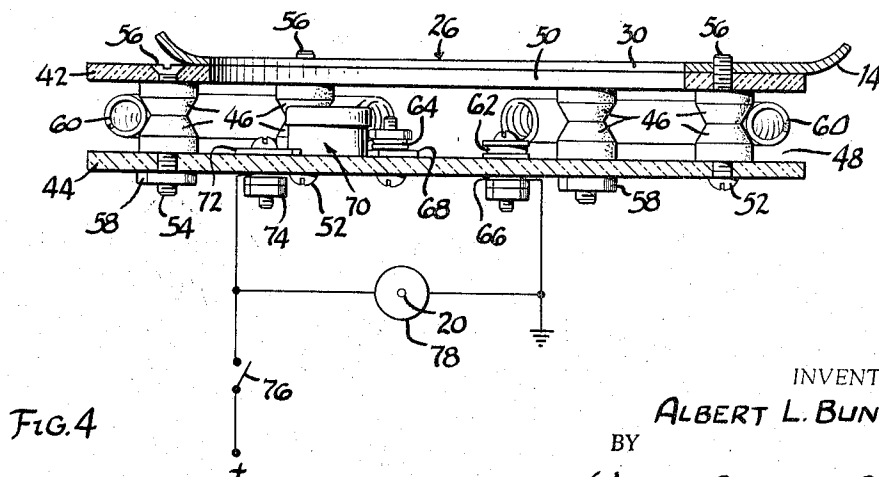
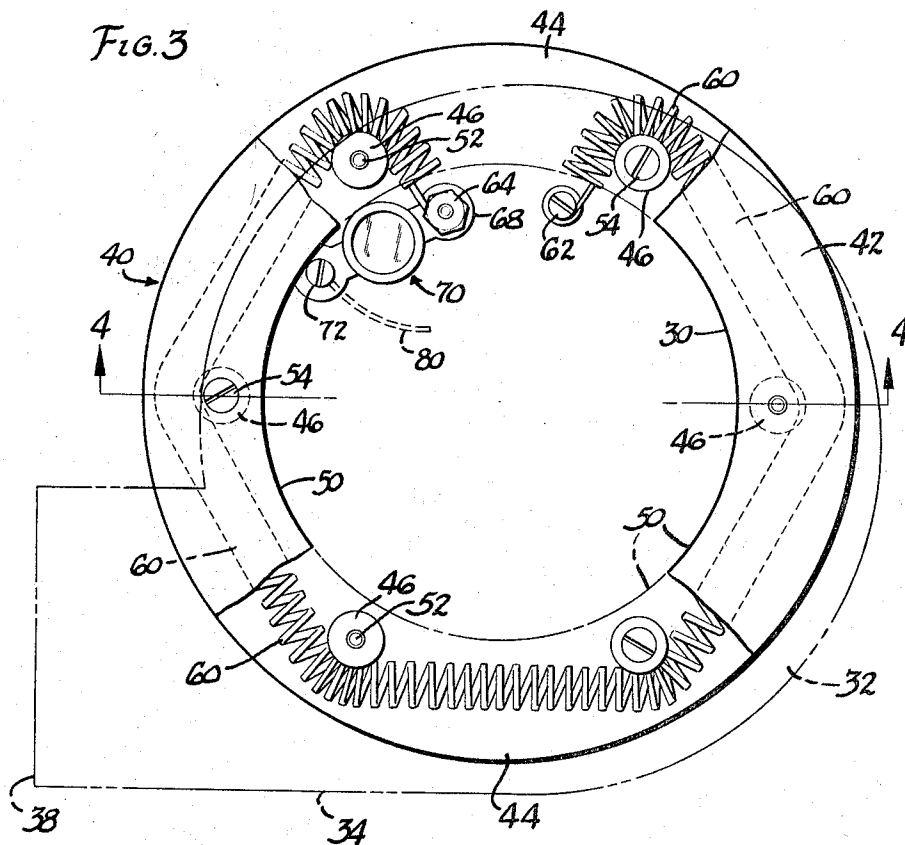
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HEATING ELEMENT

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4 Claims. (Cl. 219—371)

This invention relates to a centrifugal compressor and more particularly to a heater associated with a centrifugal compressor and tending to control the discharge temperature of such a compressor; and with regard to certain of its more specific aspects, to a temperature responsive electrical heating unit for such a compressor.

The invention broadly contemplates an improved, extremely efficient heating unit mountable coaxially of the central inlet of a centrifugal compressor and operable to heat the air or gas passing through the compressor without any substantial impairment of compressor efficiency or increase in driving power requirement. The invention further contemplates an inlet associated heating unit capable of isolating the compressor bearing and driving motor from any destructive heater induced thermal conditions.

The reductions in compressor efficiency and the resultant increases in necessary compressor driving power and the destructive thermal conditions normally attendant previous compressor inlet mounted heating elements have generally precluded any widespread use or commercial acceptance of such heaters, although some remote inlet conduit heaters have been used. In the past, compressor mounted heating elements have generally been located in the discharge chamber on nozzles of such centrifugal compressors. The discharge mounted heating element of the dryer disclosed in United States Patent No. 3,076,887 is illustrative of such past practice. However, the restriction provided to the high velocity discharge flow and the high current loads required for any substantial heating of such compressor discharge flow necessarily complicate the mounting and electrical connections required for such discharge intersecting heaters. These high velocity and heating current requirements also tend to preclude the use of a relatively compact discharge mounted heater and the use of any simple satisfactory means for accurately controlling the compressor discharge temperature within the limits properly required for most blower heating applications.

With regard to certain of its more specific aspects, the invention further contemplates and features a heater supporting means or structure of electrical and heat insulating material defining an annular relatively unrestricted inlet passage mountable coaxially of and opening inwardly adjacent the central inlet of centrifugal blower or compressor and outwardly mounting a compressor inlet temperature controlled heating element with electrical terminal connections mounted by the insulating passage defining structure.

The foregoing and other objects, advantages and features of the invention will be apparent from the following description of an illustrative embodiment, having reference to the accompanying drawing, in which:

FIGURE 1 is a perspective view of a centrifugal compressor or blower having an inlet heater constructed in accordance with the invention mounted thereon coaxially of the compressor inlet;

FIGURE 2 is a plan elevational view of the compressor and inlet heater shown in FIGURE 1 with portions of the compressor broken away and shown in partial section;

FIGURE 3 is a view further illustrating the inlet heater and is taken substantially in the plane of the line indicated at 3—3 in FIGURE 2 with certain portions broken away to show additional details of the inlet heater; and

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FIGURE 4 is a fragmentary sectional view taken substantially in the plane indicated at 4—4 in FIGURE 3 and schematically indicates an illustrative connection of the blower inlet heating unit of the invention to a suitable power source or supply in parallel with the blower driving motor.

Referring more particularly to the drawings, a centrifugal compressor or blower of the type and size adapted to be used in a hand and face warm air dryer is indicated by the reference numeral 10. This blower is merely illustrative of an intended operational environment or specific application of the invention which is applicable to centrifugal compressors generally. A blower housing or casing is formed by two cooperating stamped housing members 12 and 14 suitably joined in a median plane as indicated at 16. The blower casing may be independently supported but is often mounted or attached to the casing or frame of an associated blower driving motor.

The end wall of the casing member 12 is centrally perforated and supports a bearing 18 journalling the blower driving end of a motor driven shaft 20. The end of the shaft 20 projecting into the blower casing is drivingly secured to a hub 22 mounted coaxially of the end wall 24 of an impeller or compressor wheel 26 of known form having a perforated axial flange forming a plurality of compressor blades 28.

The end wall of the casing member 14 has free rotative clearance with the adjacent end of the compressor wheel and is perforated to define a blower inlet 30 opening coaxially and inwardly adjacent the inner radial edges of the compressor blades. The compressor wheel thus divides the casing into a central inlet chamber and an outer discharge chamber 32. The joined outer walls of the casing members cooperate to form a discharge chamber defining scroll 34 of generally involute spiral form, increasing in radial dimension from a point of minimum wheel clearance at 36 and terminating in a discharge nozzle opening at 38. As the several blades of the compressor are rotated through the discharge nozzle region or zone past the point of minimum casing clearance, they pass through a subsequent zone or region of minimum draw or suction.

An electrically and heat insulated heater constructed in accordance with certain aspects of the invention is indicated generally by the reference numeral 40. This heater is mounted on the casing member 14 coaxially of the blower inlet 30 and oriented with respect to the minimum radius or clearance portion of the casing and consequently the minimum draw zone of the compressor unit.

In the illustrative embodiment, the blower inlet heater 40 includes an annular plate or ring 42 of suitable electrical and heat insulating material mounted on the casing member coaxially and radially outwardly of the blower inlet. A circular plate 44 of similar electrical and heat insulating material is supported in spaced parallel, coaxial relation to the blower inlet and to the insulating ring 42. As best seen in FIGURES 3 and 4, a plurality of chamfered cylindrical insulators 46 are angularly spaced and secured in coaxially aligned pairs between the ring 42 and the plate 44. The adjacent chamfered ends of these paired insulators form shallow V-grooves intermediate the insulator spaced, parallel ring 42 and plate 44. The insulating ring and plate thus cooperate to define an annular air inlet passage 48 intersected or bridged at angularly spaced intervals by the paired insulators 46. This annular inlet passage opens inwardly through the central opening 50 of the insulating ring and the blower inlet 30 to the adjacent inner periphery of the perforated blade forming cylindrical flange 28 of the compressor wheel 26.

In assembly, the insulating ring and plate 42 and 44 and the paired insulators 46 are rigidly secured together

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and to the casing member 14 by screws 52 and bolts 54 which extend through alternate sets of the angularly spaced insulators. The screws 52 are preferably self-tapping and threadably engage cooperating angularly spaced holes 56 provided in the inlet adjacent flange of the casing member. The heads of the alternate bolts 54 are countersunk in the insulating ring 42 and are secured by nuts 58 threadable thereon into engagement with the opposite face of the insulating plate 44. The insulating elements 42, 44 and 46 thus cooperate to form both a heat insulated inlet passage and an electrically insulated frame. The paired shallow groove forming insulators of this frame outwardly support a resistance type heating element 60 intermediate the opposed inlet passage defining faces of the insulating ring and plate.

The heating element 60 of the illustrative embodiment is formed from a suitable length of coiled resistance wire and tangentially supported by the chamfer-formed grooves of the insulators which tend to independently compensate for the imposed thermal loads. As best shown in FIGURE 3, the opposite ends of the coiled heating element are deflected inwardly over adjacent angularly spaced paired insulators to form a circumferential gap in the heating element. These inwardly extending ends of the heating element are connected at 62 and 64 to circumferentially spaced terminal posts or bolts spacedly secured to the insulating plate 44. As shown schematically in FIGURE 4, the terminal post 62 is connected outwardly of the plate at 66 to one wire of a suitable electrical power source. The opposite post 64 is connected at 68 to one terminal of a self-contained temperature responsive circuit opening switch 70. The other terminal of the switch 70 is connected at 72 to a third terminal post secured to the insulating plate 44. The terminal post 72 is connectable outwardly of the plate at 74 to the other wire of the power source through a suitable switch 76 adapted to simultaneously energize the blower inlet heating element 60 and the blower driving motor 78.

By varying the location of the terminal post 72 on a radius about the terminal post 64, as indicated by the arcuated broken line 80, the position of the temperature responsive switch 70 may be varied with respect to the relatively cooler air drawn through the circumferential gap in the heating element between the spaced ends of the heating element. Additional control variation may be achieved by connecting and similarly locating the thermal cut-off switch with respect to the other heater terminal 62. A single thermal switch having a fixed cut-off temperature may thus be used in a number of different blower heat applications to provide a relatively accurate range of desired blower discharge temperatures simply by varying the position of the thermal switch. Where wide variations in the blower discharge temperature are desired, as in certain drying applications, a variable temperature control switch may be used in place of the fixed temperature cut-off switch of the illustrative embodiment.

The radially induced flow of air or gas through the heater is reversed immediately upon passing through the compressor inlet by the centrifugal action of the inlet adjacent blades of the compressor wheel. This reversal in air flow has been found to result in a cone of relatively cooler air extending coaxially and outwardly from the motor shaft driven endwall 24 of the compressor wheel toward the compressor inlet. This cone of cooler air cooperates with the remote, insulated mounting of the inlet heating element to further isolate the compressor bearing and driving motor from destructive heater induced thermal conditions.

From the foregoing description, it will be apparent that the illustrative embodiment provides a relatively simple, economical, easily assembled inlet heater for a centrifugal blower or compressor capable of wide application and fur-

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nishing the several stated objects, advantages and features of the invention. It will be further apparent that various changes and departures might be made in and from the structure of the illustrative embodiment without departing from the spirit and scope of the following claims.

I claim:

1. In combination with a blower having a casing, and means defining a blower inlet opening in said casing; a heating assembly comprising a circular plate having an area greater than the area of said inlet opening, a plurality of insulating posts supported upon said casing around the periphery of said inlet opening and fixedly secured to said plate to support said plate in spaced relationship from said casing to define an annular inlet passage between said plate and said casing coaxial with said inlet opening, an electrical heating element supported upon said posts within said inlet passage extending substantially entirely around the periphery of said inlet opening with opposite ends of said heating elements circumferentially spaced from each other to form a circumferential gap in said heating element, and temperature responsive means for controlling operation of said heating element connected to one of said opposite ends of said heating element and located within said inlet passage adjacent said gap.

2. The invention defined in claim 1 further comprising means for adjustably locating said temperature responsive means relative to said gap to select the degree of exposure of said temperature responsive means to air flowing through said gap into said inlet opening.

3. For use in combination with a blower having a casing, and means defining a circular blower inlet opening in said casing; a heating element comprising a pair of circular plates, one of said plates having a central opening therein of substantially the same size as said inlet opening of said blower, a plurality of insulating posts fixedly secured to said plates about the periphery of said central opening to support said plates in axially spaced coaxial relationship with each other, means for mounting said one of said plates upon said blower casing with said central opening in said one of said plates in communication with said inlet opening of said blower whereby said axially spaced plates define an annular inlet passage therebetween communicating with said blower inlet opening, an electric heating coil supported upon said insulating posts between said plates and extending circumferentially of said central opening from a first terminal adjacent one of said insulating posts circumferentially around said central opening to a second terminal located adjacent the insulating posts adjacent to said first insulating post, a temperature responsive means mounted upon one of said terminals radially inwardly of said heating coil for pivotal movement toward and away from the space between said terminals, and means for adjustably locking said temperature responsive means at selected pivotal positions.

4. The invention defined in claim 3 wherein said one of said plates is of a material having both heat and electrical insulating characteristics.

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