

Dec. 8, 1970

M. G. JAWELAK
RESISTOR ASSEMBLY

3,546,653

Filed June 2, 1969

2 Sheets-Sheet 1

Fig. 2

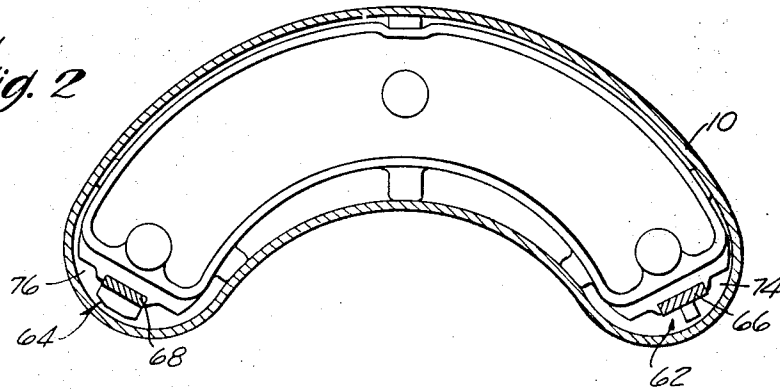
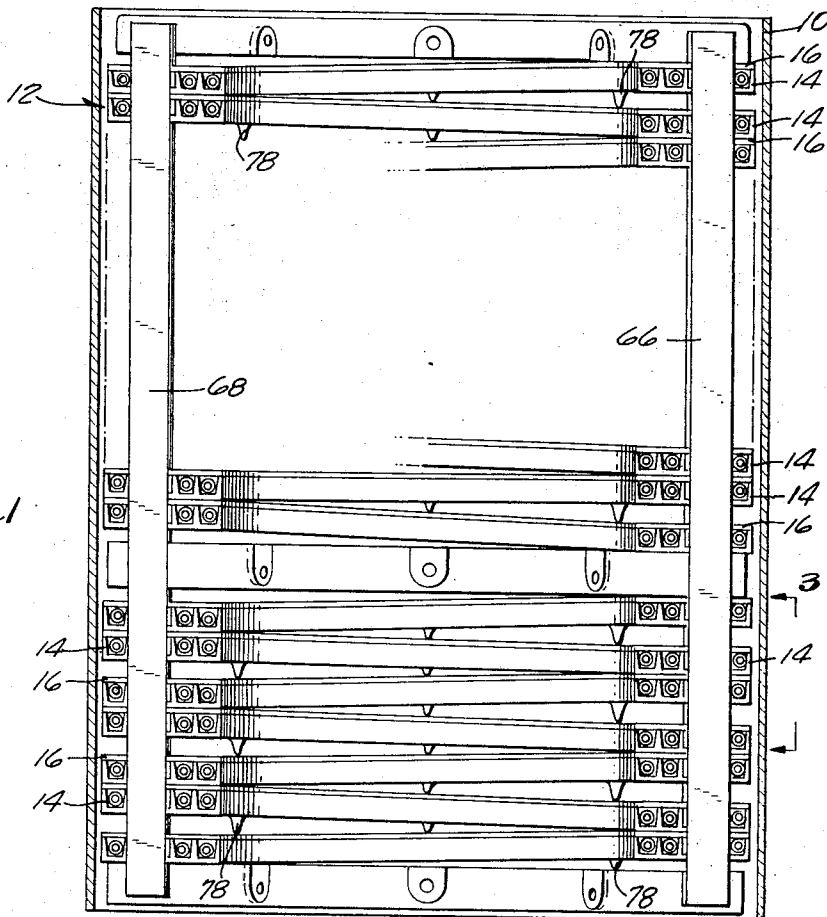


Fig. 1



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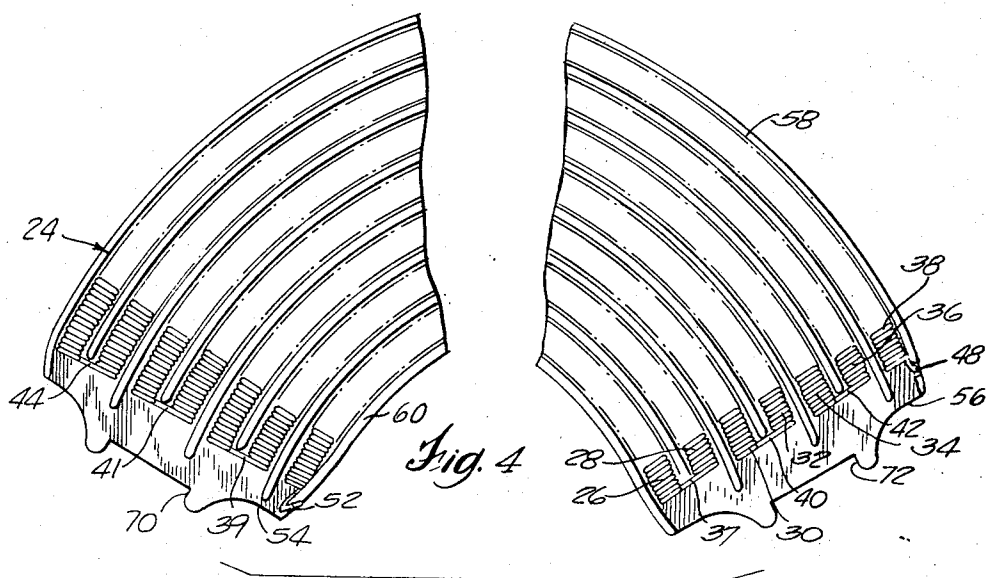
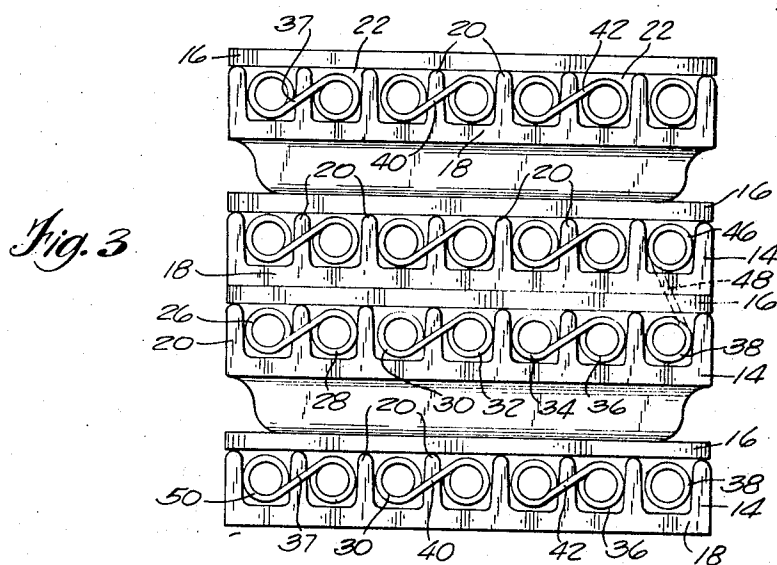
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RESISTOR ASSEMBLY

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12 Claims

ABSTRACT OF THE DISCLOSURE

A number of aligned resistor cards are stacked within a casing. The cards are elongated and each is spaced from an adjacent card and supports a coiled resistance wire. A cover is disposed over each card. Longitudinally extending ribs project from a common side of the card and are relatively staggered so that alternate ribs terminate in ends which are spaced inwardly from the ends of its next adjacent ribs. The resistance wire is generally undulating having sections between each pair of adjacent ribs and portions extending over and engaging the inwardly spaced rib ends. The cover fits over the ribs defining wire channels open only at the longitudinal ends of the cards. The wire sections are held under tension in the wire channels. The longitudinal ends of the cards are spaced from the casing to define oil spaces, when the casing is oil filled extending along and communicating with the open ends of the wire channels.

BACKGROUND OF THE INVENTION

This invention relates to resistor assemblies and, more particularly, to resistor assemblies of the type which are used in combination with circuit breakers or the like.

It is generally common practice to use a resistor arrangement in combination with a circuit breaker. Such resistors are generally connected in parallel with the switching contacts of the circuit breaker and are used, for example, to divide voltage evenly over a number of individual contact breakers.

Among the general objects of this invention is to provide an improved resistor arrangement of this type which is of relatively simple construction, is readily assembled, affords increased thermal and dielectric ability, and is generally self-cooling.

SUMMARY OF INVENTION

In accordance with this invention a plurality of resistor card assemblies are supported in stacked relationship. Each card assembly includes a number of wire channels preferably formed by a base and spaced ribs extending along and projecting at an angle with respect to the base. An electrical resistance wire has an undulating configuration to define wire sections adjacent ones of which have one of the ribs positioned therebetween. The wire sections are held in the wire channels under tension and with the opposite ends of each of said wire sections spaced inwardly from the edges of the card base.

In addition, it is contemplated that the wire channels defined between the ribs will be closed except for their opposite ends so that, for example, in an oil filled environment a self-induced flow through the channels results to expel any generated gases and to draw in fresh cooling oil. These closed channels may be formed by using a separate cover with each base and rib combination. In furtherance of the provision of this self-induced flow, the resistor cards may be arranged within a casing such that they are aligned and spaced from the casing wall in the area of the open ends of the channels to define oil spaces communicating with the channels.

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Also, the resistance wire sections can be effectively and simply located on the base and held in tension by staggering the ribs so that at both ends of the base the ends of alternate ribs are spaced inwardly from adjacent rib ends. The connecting wire portions between adjacent wire sections then extend over and engage these inwardly spaced rib ends to hold the wire sections under tension.

DESCRIPTION OF DRAWINGS

FIG. 1 is a front elevation of an embodiment of this invention with a portion of the casing removed to expose the stacked cards;

FIG. 2 is a top plan view;

FIG. 3 is an enlarged end view of a portion of the card stack; and

FIG. 4 is an enlarged plan view of one of the cards with the cover removed.

DESCRIPTION OF PREFERRED EMBODIMENT

With reference to the drawing, only the resistor assembly is illustrated. Its connection to the electrical equipment with which it is used (e.g. a circuit breaker) and the equipment itself have not been shown and will not be described as they are conventional. The resistor assembly includes an outer casing 10, which can be oil filled, and a stack 12 of resistor cards arranged within the casing.

Each of the illustrated resistor card assemblies includes a card 14 and a cover 16 both made of electrical insulating material. The cards are generally elongated, as illustrated they are kidney shaped having a major dimension along the longitudinal axis and a minor dimension. The casing and cover have a shape generally conforming to that of the card. The card also includes integrally formed base 18 and ribs 20. The ribs are arranged in relative spaced parallel relation along the longitudinal axis of the card and project from the base into engagement with the underside of cover 16. In this manner, a number of wire channels 22 are provided in the card assemblies, the channels being generally closed except for their opposite ends which are open.

A continuous resistance wire 24 in coil form is supported on each of the cards 14. The wire is bent so that it has a generally undulating configuration or, more specifically, is made up of a plurality of wire sections 26, 28, 30, 32, 34, 36 and 38 which have been turned back on each other. The wire sections are joined by connecting portions 37, 39, 40, 41, 42 and 44, which are formed when the wire 24 is bent. The details of the resistance wire of only one card assembly have been illustrated (FIG. 4) and that should be sufficient for all as all are generally the same.

The bends in wire 24 to form sections 26-36 are generally 180° so that the sections are generally parallel to each other. Furthermore, each of the individual wire sections is positioned in one of the wire channels and a rib 20 is positioned between adjacent wire sections. The ribs provide positive electrical separation between the wire sections.

A continuous wire runs through the assembly of cards so that one end of resistance wire 24 on each card is connected to an end of the resistance wire on the next adjacent card. With reference to FIGS. 3 and 4, wire section 38 is connected to wire section 46 of the card assembly above it by connecting portion 48 and wire section 26 is connected to wire section 50 of the card assembly below it by connecting portion 52. This ties the assembly of cards together electrically. In a conventional manner the resistance wire, or wires, can be connected to suitable terminals (not shown) to permit the resistance wire of the resistor assembly to be connected in circuit using the entire length and/or selected portions thereof.

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To insure physical and electrical separation between wire sections of adjacent card assemblies a further consideration is involved in arranging the resistance wire on each card. More particularly, the wire sections are supported such that the ends thereof (i.e. those at connecting portions 37, 39, 40, 41, 42 and 44) are spaced inwardly of the longitudinal end edges of the card, e.g. 54 and 56 of card 14. Furthermore, the support of the wire sections is such that the sections are held under tension and hence hold their desired relative position on the card. Structurally this is accomplished in the illustrated embodiment by direct support of the wire sections on the ribs and by the arrangement of the ribs on the card. More specifically and with reference to FIG. 4, alternate ones of the ribs terminate in ends which are spaced inwardly of adjacent ribs. This is accomplished simply and effectively by staggering, or offsetting, the ribs so that the rib which at card end 54 has the inwardly spaced rib and is the rib card end 56 which projects beyond the inwardly spaced rib end. The wire is then positioned so that the connecting portions 37, 39, 40, 41, 42 and 44 thereof extend over and engage the inwardly spaced rib ends at both longitudinal ends of the card. The relaxed lengths of the wire sections are less than the distance between the rib ends between which they are to extend. Thus when engaged as discussed above, the wire sections are stretched, separating the adjacent coils thereof, and are held under tension so that they do not shift in service. The separation of the coils provides a generally open structure the advantage of which will be described later. To complete the electrical separation of the resistance wires, each card is also provided with side ribs 58 and 60 along the side edges thereof and extending beyond the end of the wires.

In the casing the cards are stacked in general alignment so that the longitudinal ends and the open ends of the wire channels thereof are aligned as between adjacent cards. The connection of the cards in the casing and this alignment are accomplished with the use of bracket assemblies 62 and 64 which include braces 66 and 68. The braces fit into, for example, notches 70 and 72 in the longitudinal ends 54 and 56 of the card base.

In the illustrated embodiment the longitudinal end edges of the cards terminate in spaced relation from the casing end to define open spaces 74 and 76. The open spaces 74 and 76 extend the length of the casing and communicate with the open ends of the wire channels at both longitudinal ends of the cards. In operation, the resistance wire may become hot even to the point of creating gases within the casing. Initially these gases may build within the generally closed wire channels and be expelled from both ends thereof, in some instances with considerable force. As gas expulsion continues it will generally be greater at one end of the channel, or channels, than the other and this will eventually result in gas being expelled only from one end while relatively cooler, clean oil is drawn into the other end. Thus, by providing a wire channel closed except for its opposite ends a self-induced flow is created through the channel expelling gases and the like and relatively warm oil from one end while drawing in cooler oil through the other end. Spaces 74 and 76 provide this flow throughout the entire length of the stacked assembly. In this respect the open nature of the wire coils as a result of being stretched enhances cooling by better accommodating flow through the coils.

It should be noted that closure of wire sections in the cards by covers 16 is preferred but other closure arrangements are possible.

Also, it will be noted that cards 14 are provided with projections 78 which engage the covers of the adjacent card assemblies. These projections maintain a space between card assemblies to permit oil flow therein and increased cooling.

The individual cards each include wire sections as illustrated. The wire sections vary in length, increasing

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from inner section 26 to outer section 36, this increase being achieved simply with the kidney shape. Furthermore, the stacked cards can be divided into several sections each including more than one card assembly. For example, twenty-one cards may be stacked and divided into three sections of seven cards each and, thus, a voltage gradient with seven divisions per section can be achieved with conventional wiring. In such an arrangement a continuous resistance wire with suitable tap terminals can be used or separate resistance wires for each of the three sections and each with their own terminals can be used.

I claim:

1. A resistor assembly comprising, in combination, means defining a casing, a plurality of resistor card assemblies in said casing, each card assembly comprising
 - a base,
 - a plurality of spaced ribs extending along and projecting at an angle to said base and defining therewith a plurality of wire channels,
 - an electrical resistance wire having a generally undulating configuration defining a plurality of adjacent wire sections arranged with one of said ribs between each pair of adjacent wire sections,
 - and means connecting said resistance wire in said wire channels under tension and with the opposite ends of each of said wire sections spaced inwardly from the edges of said base,
 - and means supporting said card assemblies in stacked relationship in said casing.
2. The resistor assembly of claim 1 including means engaging said ribs and, with said ribs and base, closing said channels except for opposite ends thereof.
3. The resistor assembly of claim 2 wherein said ribs include terminal ends spaced inwardly from the edges of said base position and adjacent wire sections are connected by wire portions connecting the ends thereof and extending over and engaging said rib terminal ends, said wire portions and rib terminal ends providing the means connecting said wire sections under tension on said card.
4. The resistor assembly of claim 2 wherein said cards are generally elongated and said ribs and wire sections extend generally parallel to the longitudinal axis thereof.
5. The resistor assembly of claim 4 wherein
 - each of said wire sections is disposed between two adjacent ribs,
 - said open ends of said wire channels open at the opposite longitudinal ends of said cards,
 - and said longitudinal ends of said cards are relatively aligned and spaced from said casing defining spaces extending long and communicating with the open ends of said wire channels.
6. The resistor assembly of claim 5 wherein said cards are generally kidney shaped having major and minor axes and said ribs and wire sections extend generally along said major axes.
7. The resistor assembly of claim 2 wherein the opposite open ends of said wire channels are relatively aligned and are spaced from said casing defining spaces extending along and communicating with the open ends of said wire channels.
8. The resistor assembly of claim 2 wherein
 - each of said cards is generally elongated,
 - said ribs are parallel to each other and extend generally along the longitudinal axes of said cards, said ribs being relatively staggered so that alternate ribs at both longitudinal ends of each of said cards terminate in ends spaced inwardly from the ends of the next adjacent rib,
 - said resistance wire is in the form of a wire coil, adjacent wire sections being connected by wire portions connecting the ends of said wire sections and extending over and engaging said inwardly spaced rib ends,

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and the relaxed length of said wire sections being less than the distance between the rib ends between which the wire sections extend so that said wire sections are held under tension and the coils thereof are separated.

9. The resistor assembly of claim 8 wherein said cards also include side edge ribs extending along the outer wire sections and beyond the ends of said wire sections.

10. The resistor assembly of claim 8 wherein said cards are generally aligned within said casing and the open ends of said wire channels are open at both of the longitudinal ends of said cards.

said casing is oil filled, and said longitudinal ends of said cards are spaced from said casing defining oil spaces extending along and communicating with the open ends of said wire channels.

11. The resistor assembly of claim 10 including means engaged between adjacent card assemblies for spacing

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one card assembly from an adjacent card assembly so that said card assemblies are stacked with an oil space between adjacent card assemblies.

12. The resistor assembly of claim 2 including means engaged between adjacent card assemblies for spacing one card assembly from an adjacent card assembly so that said card assemblies are stacked with a space between adjacent card assemblies.

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E. A. GOLDBERG, Primary Examiner

U.S. Cl. X.R.

338—252, 261, 285, 319