Oct. 28, 1958 M. W. GRIFFES ET AL 2,858,402

FORCED VENTILATED RESISTOR STACK

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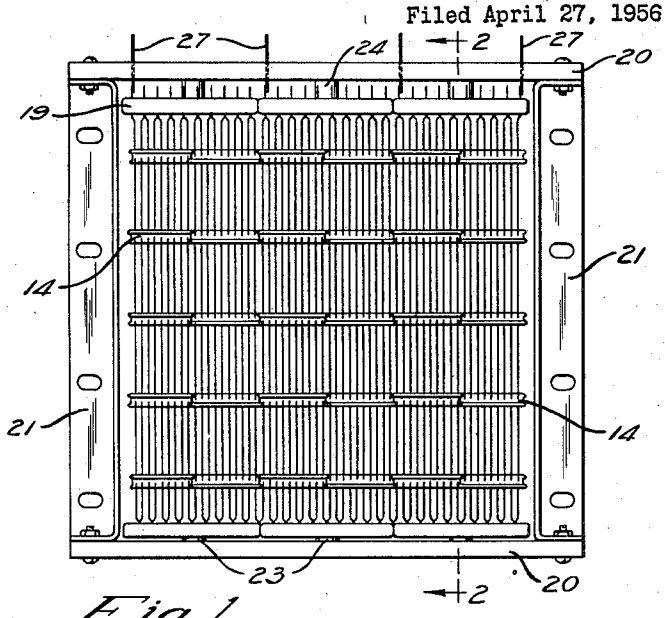



Fig. 1

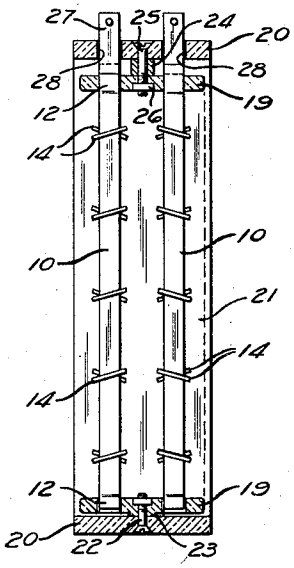



Fig. 2

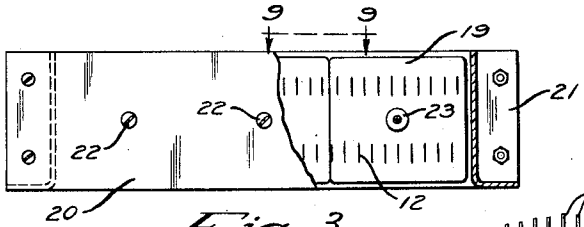



Fig. 3

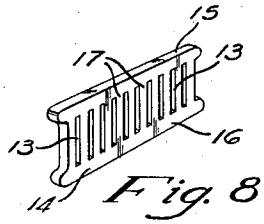



Fig. 8

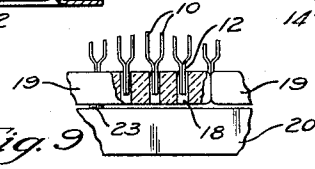



Fig. 9

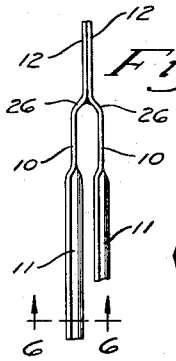



Fig. 5

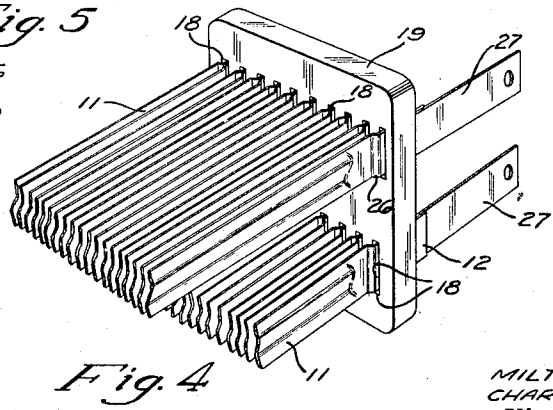



Fig. 4

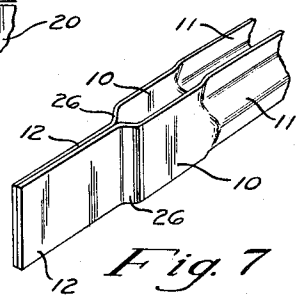



Fig. 7

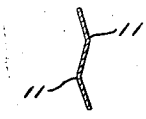



Fig. 6


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# FORCED VENTILATED RESISTOR STACK

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5 Claims. (Cl. 201—69)

This invention relates to the structure and method of manufacture of resistor units for the dynamic braking of electric motors.

More specifically the invention contemplates a resistor unit which is formed to facilitate the ventilation of the entire area of a sinuous grid including, particularly, the return end portions thereof.

Heretofore, it has been the practice to construct the resistor grid from a reflexed resistance ribbon element supported by the imbedded looped end portions thereof in opposed insulators. Such structure has been found unsatisfactory since the ceramic insulators blocked the circulation of air through the cavities formed by the looped ends of the resistor ribbon and thus, not only impaired the ventilation of the grid, but also produced deleterious hot spots in the areas of support.

In the present invention, the grid, or heat exchanger is formed from separate strands of a high chrome steel alloy which are die struck to provide a tortuous central body portion with right and left offset ends or tangs. These tangs are united in pairs by silver soldering, welding, or otherwise bonding the parts together to form a serpentine grid embodying parallel lineal strips of a tortuous central section, bonded end portions, and transaxial end walls adjacent the merged tang portions of the strips. These end walls are disposed, upon assembly, in spaced relation with the inner walls of the supporting insulators and thus accommodate the free passage of air therethrough and about the supporting ends of the grid.

In addition to the foregoing advantage of the improved resistor unit, a further object of the invention resides in the provision of a plurality of ceramic separators disposed between the resistor strands to inhibit untoward flexure and/or deformation thereof, yet afford lineal movement of the resistor strands as the metal expands or contracts.

Another object of the invention is to provide a novel process of manufacture and assembly of the resistor elements forming the grid.

Another object of the invention is to provide insulator end block units of a uniform design which may be assembled in multiple transverse rows or vertical columns to form a unit of the requisite size and capacity for the current anticipated for use therewith.

Further objects of the invention reside in the provision of a resistor unit which is rigid of structure, capable of resisting vibrational strains imposed thereon, and designed to facilitate renewal of a sub-assembly thereof, should failure occur, without dismantling the entire resistor unit.

Another object of the invention is to provide a resistor unit in which the bonded joint connecting the resistor strands is disposed in the path of the air stream circulated thereover. Such structure is particularly desirable in units subjected to relatively high air velocity since the air swept portions of the resistor will be effectively cooled while the unventilated ends thereof will become overheated.



Other objects and advantages more or less ancillary to the foregoing, and the manner in which all the various objects are realized, will appear in the following description, which considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a plan view of a resistor unit embodying the present invention;

Fig. 2 is a transverse sectional view of the resistor assembly shown in Fig. 1, the section being taken on a plane indicated by the line 2—2 in Fig. 1;

Fig. 3 is an end elevational view of the resistor assembly of Fig. 1, portions thereof being broken away and shown in section;

Fig. 4 is a view in perspective of a fragmentary portion of one of the resistor elements and the ceramic insulator therefore;

Fig. 5 is a plan view of a pair of resistor strips illustrated in their assembled relation;

Fig. 6 is a transverse sectional view of a resistor strand or ribbon of the form shown in Fig. 5, a section being taken on a plane indicated in line 6—6 in Fig. 5;

Fig. 7 is a view in perspective of a fragmentary portion of a pair of resistor strands with the end portions thereof in their assembled relation;

Fig. 8 is a view in perspective of one of the resistor strand separators; and

Fig. 9 is a plan view, partially in section, of a fragmentary portion of one end of the grid assembly, the illustrated area being indicated by the section 9—9 in Fig. 3.

Referring first to Figs. 5, 6 and 7, the resistor strands 10 are die struck from a continuous roll of steel ribbon having a high chrome content. The die is formed to cut the strips to their requisite length and form a tortuous center section 11 with right and left hand offset end portions or tangs 12 thereon. Each strip is then laced through the rectangular slots 13 in ceramic separators or spreader plates 14, the number of the plates 14 depending upon the length of the resistor under construction. The separator plates are formed of a fired ceramic insulating material, and comprise top and bottom portions 15 and 16, and a plurality of homogeneous center strips 17 spaced to define the slots 13. The openings are of a sufficient width to receive the tortuous central portions of the strips without impingement thereof in order to facilitate expansion and contraction of the metallic strips. One of each pair of the resistor strips 10, prior to the assembly, is rotated about its medial axis so the right offset tang 12 thereof is disposed in planar contiguous relation with the left tang. The mated tangs are then tack welded together to facilitate the temporary support thereof while tangs are silver soldered or otherwise secured together. The assembly, as thus formed, is then fluxed, sufficient silver solder or brazing compounds being applied to the merged end portions 12 to form a fillet at the junction of the tangs. The parts may be either flame or electrically heated to the melting point of the bonding material, or may, if desired, be resistance welded to form a permanent joint. The ends or tangs of the sections thus united are then inserted into slots 18 in rectangular supporting insulator blocks 19, the slots being spaced in aligned relation with the medial axis of the respective strand in the sinuous resistor unit. The resistor elements including the assembled resistor strips 10, spacers 14, and end supporting insulator blocks 19 are then mounted upon end insulating panels 20 which in turn are retained by fabricated steel frame side rails 21.

The insulator blocks 19 in one end of the grid assembly are secured to the adjacent panel 20 by bolts 22 and are held in spaced relation therewith by bosses 23 formed

in the face of the block. The opposed insulator blocks **19** are supported in spaced relation with the adjacent panel **20** by spacer sleeves **24** and bolts **25** engaged with nuts **26** imbedded in the blocks **19**.

The tortuous form of the central body of the resistor strands stiffens the structure of the resistor and prevents undue warpage thereof when subjected to the influence of the heat. The tortuous or corrugated form of the strand also increases the effective area thereof.

As illustrated in Fig. 5, the merged ends of the resistor strips form closed end walls **26** in the sinuous or suspension strip assembly, and these end walls are disposed, as shown under Fig. 4, in spaced relation with the inner faces of the insulator supporting blocks **19**. Thus as air is forced through the grid, it will flow through the voids defined by the closed end walls **26** over the bonded inner ends of the tangs, through the openings between the strips, and thus carry the heat therefrom.

The separator plates **14** are preferably adjusted in staggered relation in adjacent sets of strands in order to facilitate free movement of the strands during contraction and expansion of the resistor material.

As shown in Fig. 9, the tangs **12** terminate within the slots **18** in the insulator blocks **19**, the clearance thus afforded accommodating expansive distention of the resistance element.

The tangs **12** of certain of the resistor elements are provided with tap terminals **27** bonded thereto and protruding through openings **28** in one of the end panels **20**.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

What is claimed is:

1. A grid for a resistor comprising a plurality of strands of resistance material, each strand having right and left offset ends arranged and bonded in the form of a homogeneous sinuous grid unit, and opposed insulator blocks having slots therein for the slidable support of the bonded ends of the strips in spaced relation with each other, the merged portions of the strands being spaced from the inner faces of said insulator blocks whereby the electric current passing through said strands will be shunted around the merged portions of the strands, and the central portions of the strands are cooled by the air current flowing thereover.

2. A grid for a resistor comprising a plurality of strands of equal length, each embodying right and left offset planar end portions, said ends being bonded together and defining a sinuous grid, the bonded ends of the resistor elements constituting tangs for the support of said grid, insulator blocks having slots therein slidably engaged with said tangs, and a frame encasing the grid and block assembly whereby the electric current will flow around said tangs, and the central portions of said strands will be cooled by the uninterrupted current forced thereover.

3. The method of forming a resistor comprising cutting resistor strips to a uniform length, die forming a tortuous central body therein and a flat right hand tang on one end thereof, and a flat left hand tang on the opposed end, arranging said tangs in intimate confronting relation with the strands in a sinuous pattern defining a grid, bonding the tangs together and then mounting the bonded tangs in openings in the ceramic blocks for sliding engagement therewith and with the merged portions of the strands in spaced relation with the inner faces of said blocks to provide for the free passage of air thereover.



4. A grid for a resistor comprising a plurality of strands of equal length, each embodying right and left offset planar end portions, said ends being bonded together and defining a sinuous grid, the bonded ends of the resistor elements constituting tangs for the support of said grid, insulator blocks having slots therein engaged with said tangs for lineal sliding movement, a frame encasing the grid and block assembly, insulator end panels therein disposed in spaced relation with said blocks, the tangs in the slots in one end of said frame terminating within the slots, and the tangs in the blocks in the other end of the frame protruding through the slots therein and terminating adjacent the contiguous face of said panel whereby the electric current will be shunted around said tangs, and the central portions of the strands will be disposed in the current of air flowing through the grid.

5. A grid for a resistor comprising a plurality of strands of equal length, each embodying right and left offset planar end portions, said ends being bonded together and defining a sinuous grid, the bonded ends of the resistor elements constituting tangs for the support of said grid, insulator blocks having slots therein slidably engaged with said tangs, a frame encasing the grid and block assembly, insulator end panels therein disposed in spaced relation with said blocks, the tangs in the slots in one end of said frame terminating within the slots, the tangs in the blocks in the other end of the frame protruding through the slots therein and terminating adjacent the contiguous face of said panel, tap terminals connected to certain of the strands and protruding through openings in said panels the insulating blocks and tangs forming an unrestricted passageway for the air passing through the grid, and the portions of the strip adjacent the merged portions thereof with the tangs being disposed within the air current forced through the grid.


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