Feb. 24, 1959 G. PEARCE 2,875,309

ELECTRICAL RESISTORS

Filed Aug. 13, 1956

Fig. 1.

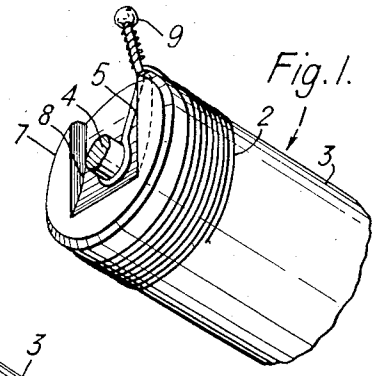


Fig. 2.

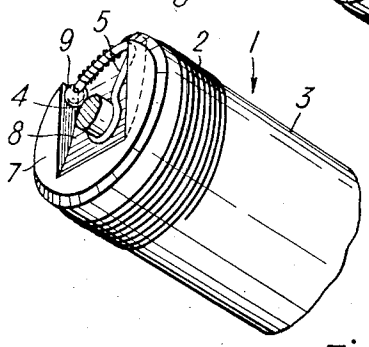


Fig. 3.

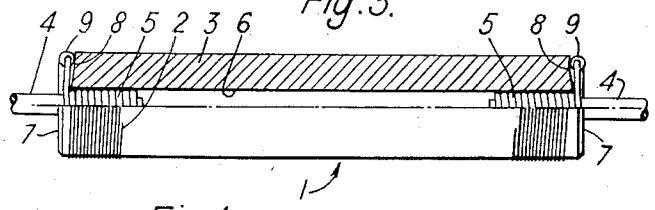


Fig. 4.

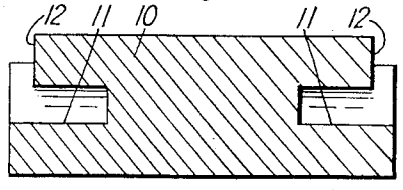


Fig. 5.

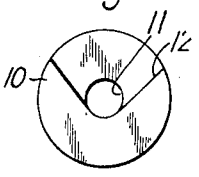


Fig. 6.

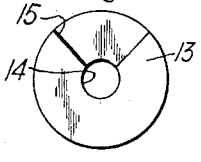
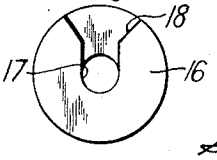


Fig. 7.



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ELECTRICAL RESISTORS

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9 Claims. (Cl. 201—63)

This invention concerns electrical resistors and more particularly relates to relatively small wire wound electrical resistors, e. g. as described in British Patent No. 575,297. In these resistors, a thin conductor of known resistance (hereinafter called a "resistance wire" whether metallic wire or not) is wound upon a former which is usually cylindrical and made of some insulating material such as, for example, a ceramic. This former has an axial bore (or a short axial blind bore at each end) in which is located the end of the terminating lead to the resistor and this terminating lead is connected to the adjacent end of the resistance wire by means of an intermediate conductor.

More especially the invention concerns construction of the core of such resistors and the method of applying terminating leads to the resistors.

In this construction, the resistance wire and intermediate conductor are welded or brazed together and the joint may be laid in a segmental recess in, and extending longitudinally of, the cylindrical surface of the former.

Such resistors are frequently coated with a lacquer or vitreous enamel and, since the joint between the resistance wire and the intermediate conductor stands proud of the surface of the former and there is only a thin coating of glaze at this part, it is sometimes found that the vitreous enamel is liable to crack over the joint; similarly there is danger of cracking where the intermediate conductor passes over the end of the former. The cracking of the vitreous enamel is detrimental in that it may permit the ingress of moisture under tropical conditions and so lower the electrical insulation at these points, thereby contributing to failure of the resistance.

It is therefore an object of this invention to provide an improved electrical resistor, such resistor comprising: an insulating former having an axial bore in each end thereof and also having a recess in each outer end face of the former leading at least from the bore to the periphery of the former; a resistance wire wound on the periphery of the former; a terminating lead located at its end in each said bore in the former; and an intermediate conductor formed separately of said resistance wire and terminating lead and connecting each end of the resistance wire to the adjacent terminating lead, one end of each such intermediate conductor being secured to the terminating lead and being located in said bore whilst the remainder of the intermediate conductor and the joint of the latter with the resistance wire are stowed in said recess in a plane transverse to the axis of the said former, the said recess being of a dimension in said plane sufficient for the reception and stowage of the said remainder of the appropriate intermediate conductor and the joint of the latter with the resistance wire,

whilst being of a depth only sufficient to ensure that no part of the appropriate intermediate conductor and the joint of the latter with the resistance wire will stand clear of the outer end face of the former in which the recess is provided.

It is a further object of this invention to provide a former for such a resistor.

The said axial bores at the ends of the former may be provied by a single axial bore extending the whole length of the former, or alternatively, separate blind bores at each end of the former may be provided.

Conveniently, each of said grooves decreases in depth from the periphery of the former towards said bore in the latter, although, if desired, the grooves may be of a constant depth.

The said grooves may be of any convenient shape and may, for example, be parallel-sided grooves of rectangular shape as seen from the end of the former.

Preferably, the intermediate conductors are jointed to the resistance wire by an arc welding process and advantageously, before the former is coated with vitreous enamel, the groove in each end face of the former is filled with a cement or glaze having a higher melting point than the vitreous enamel subsequently used to coat the former.

The former may be made in any suitable way and is conveniently formed by either an extrusion or a pressing process.

It will be appreciated that using this type of technique the shapes have to be relatively simple for complicated pressings cannot be made from the ceramic materials normally used for formers. Indeed it has been found that it is possible to make formers of the above described shape from substantially pure alumina, such as that sold under the registered trademark "Sintox," which, as is well known, is very difficult to work.

The grooves in the said former may be made in any suitable way and are conveniently formed by either a cutting or a grinding operation.

In order that this invention may more readily be understood, reference will now be made to the accompanying drawings in which:

Figure 1 is a fragmentary perspective view illustrating one stage in the manufcture of one embodiment of electrical resistor according to this invention;

Figure 2 is a view similar to Figure 1, but illustrating a second stage in the manufacture of the electrical resistor of Figure 1;

Figure 3 is a side elevation partly in section, of the electrical resistor of Figures 1 and 2;

Figures 4 and 5 are respectively a longitudinal section and an end view of a former for a second embodiment of electrical resistor according to this invention;

Figure 6 is an end view of a former for a third embodiment of electrical resistor according to this invention and

Figure 7 is an end view of a former for a fourth embodiment of electrical resistor according to this invention.

Referring to Figures 1 to 3, the electrical resistor there illustrated is indicated generally by the reference 1 and comprises a resistance wire 2 wound on a cylindrical ceramic former 3, conveniently formed of pure alumina, such as that sold under the registered trademark "Sintox," and connected at each end of the former 3 to a terminating lead 4 by means of an intermediate conductor 5. In accordance with this invention, the former 3 is provided at each end with an axial bore, in this case provided by a single bore 6 extending longitudinally through the

former 3, in which the appropriate terminating lead 4 is received and also provided in each end face 7 with a groove 8 extending at least from the bore 6 to the periphery of the former 3 and serving for the reception of the appropriate intermediate conductor 5 and the joint 9 of the latter with the resistance wire 2.

In the embodiment of Figures 1 to 3, the groove 8 is a parallel sided groove of rectangular shape as seen from the end of the former extending from the periphery of the former 3 to beyond the bore 6 and having a depth which decreases from a maximum at the periphery of the former. The grooves 8 may be formed by a cutting operation using a chisel type of tool or, alternatively, by a grinding operation using a grinding wheel.

The former 3 of this embodiment is advantageously formed by an extrusion process.

To manufacture the electrical resistor of Figures 1 to 3, each terminating lead 4 has the appropriate intermediate conductor 5 wound about the end thereof, and, if desired, welded or soldered thereto in the manner described in British Patent No. 575,297, and such end of each terminating lead is housed in the appropriate end of the bore 6 of the former and secured therein by a suitable vitreous enamel or other cement, each intermediate conductor 5 being arranged to extend radially from the bore and within the groove 8 in the appropriate end of the former. Each end of the resistance wire 2 is then engaged with the appropriate intermediate conductor 5 and secure joints 9 formed between them by an arc welding or like process. Figure 1 illustrates the resistance at this stage of its manufacture.

Each joint 9 is then bent over and located in the groove 8 as shown in Figure 2 so that the bead of the joint 9 is located well below the surface of the former.

Desirably each groove 8 is now filled with a cement or glaze having a higher melting point than the normal vitreous enamel used to coat the former 3 so as to ensure the provision of smooth end faces to the resistor and the adequate protection of the joints 9. Thereafter the usual two or three coats of vitreous enamel are applied to the former.

The former of a resistor according to this invention may be provided with grooves of a form different from that illustrated in Figures 1, 2 and 3 and the former may be provided with a blind bore at each end, instead of a single bore extending therethrough.

Thus Figures 4 and 5 show a former 10, which is conveniently formed by a pressing operation, having a blind bore 11 in each end thereof and a groove 12 in each end face thereof, such groove being of constant depth and of V-shape as seen from the end of the former, the sides of each groove 12 being tangential to the appropriate bore 11.

Figure 6 shows one end face of a former 13 having a blind bore 14 in each end thereof and a groove 15 in each end face thereof, each groove in this former being similar to the grooves 12 of Figures 4 and 5, but being of a truncated V-shape as seen from the end of the former, the sides of each groove being radial to the appropriate bore 14, while Figure 7 shows one end face of a former 16 having a blind bore 17 in each end thereof, each groove in this former being similar to the grooves 12 of Figures 4 and 5, but being of a Y-shape as seen from the end of the former.

I claim:

1. For an electrical resistor of the type in which the resistance wire is wound on a former and is connected at each end of the latter to a terminating lead by means of an intermediate conductor formed separately of said resistance wire and terminating lead, a former provided with an axial bore at each end for the reception of the appropriate terminating lead and also provided with a recess in each outer end face, each recess extending at least from the said bore to the periphery of the former and being of a dimension in a plane transverse to the axis of the former sufficient for the reception and stowage of the appropriate intermediate conductor and the joint of the latter with the resistance wire in a plane transverse to the axis of the said former, whilst being of a depth only sufficient to ensure that no part of the appropriate intermediate conductor and the joint of the latter with the resistance wire will, when stowed in such recess, project from the outer end face of the former in which the recess is provided.

2. An electrical resistor comprising: an insulating former having an axial bore in each end thereof and also having a recess in each outer end face of the former leading at least from the bore to the periphery of the former; a resistance wire wound on the periphery of the former; a terminating lead located at its end in each said bore in the former; and an intermediate conductor formed separately of said resistance wire and terminating lead and connecting each end of the resistance wire to the adjacent terminating lead, one end of each such intermediate conductor being secured to the terminating lead and being located in said bore whilst the remainder of the intermediate conductor and the joint of the latter with the resistance wire are stowed in said recess in a plane transverse to the axis of the said former, the said recess being of a dimension in a plane transverse to the axis of the former sufficient for the reception and stowage of the said remainder of the appropriate intermediate conductor and the joint of the latter with the resistance wire, whilst being of a depth only sufficient to ensure that no part of the appropriate intermediate conductor and the joint of the latter with the resistance wire will project from the outer end face of the former in which the recess is provided.

3. For an electrical resistor of the type in which the resistance wire is wound on a former and is connected at each end of the latter to a terminating lead by means of an intermediate conductor formed separately of said resistance wire and terminating lead, a cylindrical former provided with an axial bore at each end for the complete reception of the appropriate terminating lead and also provided in each outer end face with a groove of a V-shape as seen from the end of the former, each groove extending from the said bore to the periphery of the former and being of a dimension in a plane transverse to the axis of the former sufficient for the reception and stowage of the appropriate intermediate conductor and the joint of the latter with the resistance wire, whilst being of a depth only sufficient to ensure that no part of the appropriate intermediate conductor and the joint of the latter with the resistance wire will, when stowed in such groove, stand proud of the outer end face of the former in which the groove is provided.

4. For an electrical resistor of the type in which the resistance wire is wound on a former and is connected at each end of the latter to a terminating lead by means of an intermediate conductor formed separately of said resistance wire and terminating lead, a cylindrical former provided with an axial bore extending completely therethrough for the reception of the terminating leads and also provided with a recess in each outer end face, each groove extending at least from the said bore to the periphery of the former and decreasing in depth from the periphery of the former towards the said bore and being of a dimension in a plane transverse to the axis of the former sufficient for the reception and stowage of the appropriate intermediate conductor and the joint of the latter with the resistance wire in a plane transverse to the axis of the said former whilst being of a depth at the periphery of the former only sufficient to ensure that no part of the joint of the appropriate intermediate conductor with the resistance wire will, when stowed in such recess, project from the outer end face of the former in which the recess is provided and being of a depth at the said bore sufficient to ensure that no part of the said

intermediate conductor will, when stowed in the groove, stand proud of the said outer end face.

5. An electrical resistor comprising: an insulating former having an axial bore in each end thereof and also having a recess in each outer end face of the former leading at least from the bore to the periphery of the former and decreasing in depth from the periphery of the former towards the said bore; a resistance wire wound on the periphery of the former; a terminating lead located at its end in each said bore in the former; and an intermediate conductor formed separately of said resistance wire and terminating lead and connecting each end of the resistance wire to the adjacent terminating lead, one end of each such intermediate conductor being secured to the terminating lead and being located in said bore whilst the remainder of the intermediate conductor and the joint of the latter with the resistance wire are located in said recess in a plane transverse to the axis of the said former, the said recess being of a dimension in a plane transverse to the axis of the former sufficient for the reception and stowage of the remainder of the appropriate intermediate conductor and the joint of the latter with the resistance wire, whilst being of a depth at the periphery of the former only sufficient to ensure that no part of the joint of the appropriate intermediate conductor with the resistance wire will project from the outer end face of the former in which the recess is provided and being of a depth at the said bore sufficient ot ensure that no part of the said intermediate conductor will project from the said outer end face.

6. An electrical resistor comprising: a cylindrical insulating former having an axial bore extending completely therethrough and also having in each outer end face a parallel-sided recess of rectangular shape as seen from the end of the former leading from the bore to the periphery of the former and decreasing in depth from the periphery of the former towards the said bore; a resistance wire wound on the periphery of the former; a terminating lead located at its end in each said bore in the former; and an intermediate conductor formed separately of said resistance wire and terminating lead and connecting each end of the resistance wire to the adjacent terminating lead, one end of each such intermediate conductor being secured to the terminating lead and being located in said bore whilst the remainder of the intermediate conductor and the joint of the latter with the resistance wire are located in said recess in a plane transverse to the axis of the said former, the said recess being of a dimension in a plane transverse to the axis of the former sufficient for the reception and stowage of the remainder of the appropriate terminating lead and the joint of the latter with the resistance wire, whilst being of a depth at the periphery of the former only sufficient to ensure that no part of the joint of the appropriate intermediate conductor with the resistance wire will project from the outer end face of the former in which the recess is provided and being of a depth at the said bore sufficient to ensure that no part of the intermediate conductor will project from the said outer end face, the space within the said recess which is not occupied by the appropriate intermediate conductor and the joint of the latter with the resistance wire being filled with a suitable vitreous enamel cement.

7. An electrical resistor comprising: an insulating former made of sintered alumina and having an axial bore in each end thereof and also having a groove in each outer end face of the former leading from the bore to the periphery of the former and of a V-shape as seen from the end of the former; a resistance wire wound on the periphery of the former; a terminating lead located at its end in each said bore in the former; an intermediate conductor formed separately of said resistance wire and terminating lead and connecting each end of the resistance wire to the adjacent terminating lead, one end of each such intermediate conductor being secured to the terminating lead and being

located in said bore whilst the remainder of the intermediate conductor and the joint of the latter with the resistance wire are located on said groove, the said V-shaped groove being of a dimension sufficient for the reception and stowage of the remainder of the appropriate terminating lead and the joint of the latter with the resistance wire, whilst being of a depth only sufficient to ensure that no part of the appropriate intermediate conductor and the joint of the latter with the resistance wire will stand proud of the outer end face of the former on which the groove is provided; and a vitreous enamel cement filling in the space within the said groove which is not occupied by the appropriate intermediate conductor and the joint of the latter with the resistance wire.

8. An electrical resistor comprising an insulating former having an axial bore in each end thereof and also having a groove in each outer end face of the former leading from the bore to the periphery of the former and of a V-shape as seen from the end of the former; a resistance wire wound on the periphery of the former; a terminating lead located at its end in each said bore in the former; an intermediate conductor formed separately of said resistance wire and terminating lead and connecting each end of the resistance wire to the adjacent terminating lead, one end of each such intermediate conductor being secured to the terminating lead and being located in said bore whilst the remainder of the intermediate conductor and the joint of the latter with the resistance wire are located in the said groove, the said V-shaped groove being of a dimension sufficient for the reception and stowage of the remainder of the appropriate terminating lead and the joint of the latter with the resistance wire, whilst being of a depth only sufficient to ensure that no part of the appropriate intermediate conductor and the joint of the latter with the resistance wire will stand proud of the outer end face of the former in which the groove is provided; and a vitreous enamel cement filling in the space within the said groove which is not occupied by the appropriate intermediate conductor and the joint of the latter with the resistance wire; and a vitreous enamel coating to the resistor covering the said resistance wire and outer end faces of the said former, said coating having a lower melting point than the said cement filling.

9. An electrical resistor comprising an insulating former made of sintered alumina and having an axial bore in each end thereof and also having a recess in each outer end face of the former leading from the bore to the periphery of the former; a resistance wire wound on the periphery of the former; a terminating lead located at its end in each said bore in the former; and an intermediate conductor formed separately of said resistance wire and terminating lead and connecting each end of the resistance wire to the adjacent terminating lead, one end of each such intermediate conductor being secured to the terminating lead and being located in said bore whilst the remainder of the intermediate conductor and the joint of the latter with the resistance wire are stowed in said recess in a plane transverse to the axis of the said former, the said recess being of a dimension in a plane transverse to the axis of the former sufficient for the reception and stowage of the said remainder of the appropriate intermediate conductor and the joint of the latter with the resistance wire, whilst being of a depth only sufficient to ensure that no part of the appropriate intermediate conductor and the joint of the latter with the resistance wire will project from the outer end face of the former in which the recess is provided; a vitreous enamel cement filling in the space within the said recess which is not occupied by the appropriate intermediate conductor and the joint of the latter with the resistance wire; and a vitreous enamel coating to the resistor covering the said resistance wire and outer end faces of the said former, said coating having a lower melting point than the said cement filling.

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