

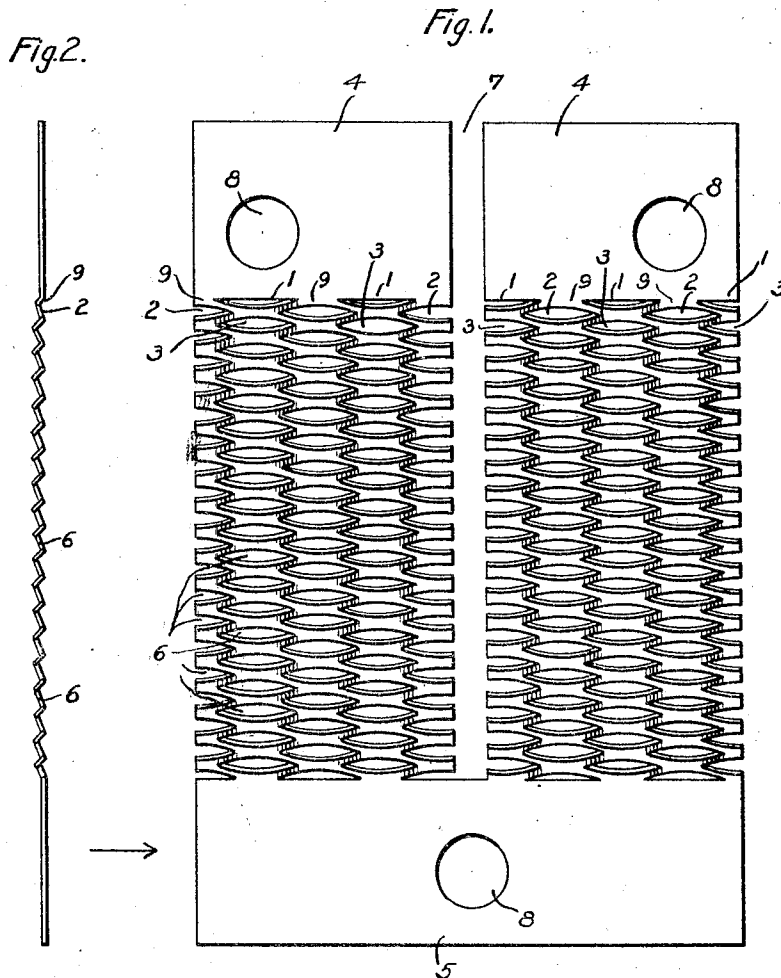
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H. C. NAGEL

METHOD OF MAKING EXPANDED METAL RESISTORS

Original Filed March 7, 1919



WITNESSES:

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METHOD OF MAKING EXPANDED-METAL RESISTORS.

Original application filed March 7, 1919, Serial No. 281,154. Patent No. 1,396,871, dated November 15, 1921. Divided and this application filed June 3, 1921. Serial No. 474,839.

To all whom it may concern:

Be it known that I, HARRY C. NAGEL, a citizen of the United States, and a resident of Wilksburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Methods of Making Expanded-Metal Resistors, of which the following is a specification, this application being a division of my application Serial No. 281,154, filed March 7, 1919, which has matured into Patent No. 1,396,871, dated November 15, 1921.

My invention relates to resistors for electric circuits and particularly to expanded-metal resistors and methods of making the same.

The object of my invention is to provide an improved expanded-metal resistor and a novel method of making the same.

In some cases, as where it is desired to control the circuits of electric motors on board ship, cast-grid resistors are unreliable because of their liability to become broken after repeated shocks, and wire resistors have not the required capacity. Liquid resistors, too, are obviously undesirable. Expanded metal resistors have accordingly been tried.

Ordinary expanded metal, however, is unsatisfactory for such uses because it cannot be obtained commercially with portions unexpanded or in the variety and degree of expansion to make it adaptable for resistor work. A common method of manufacture, which comprises first, slitting the metal sheet and later, pulling the metal apart at the slits, is unsatisfactory because the width of the resulting product is less than that of the original sheet, the walls of some of the slits are pulled apart more than those of others, and, while some of the slit openings may be larger than is necessary for resistor purposes, thus causing the resistor to occupy unnecessary additional space, others of the openings may be so small as to cause short-circuits.

Accordingly to the present invention, a strip of uncut metal is operated upon in such fashion as to simultaneously cut and stretch the metal, whereby the resulting product is of the same width as the original, uncut sheet. The metal is stretched in a direction oblique to the plane of the sheet so as to obtain comparatively large openings

between the walls of the slits without the necessity of taking up a great deal of room in the plane of the grid. The openings are provided of just the proper size so that the maximum amount of resistor material is crowded into the minimum amount of space, without danger of short circuits. The openings are further of symmetrical form to provide for the parallel resistance paths being of equal length. Uncut portions of the metal are left at the ends to serve as terminals. To lengthen the electrical, series path, the expanded metal is longitudinally slotted. If a steel or similar alloy is employed, the metal is sherardized or otherwise protected against the weather.

Figure 1 of the accompanying drawing is a front view of an improved form of my expanded metal resistor and Fig. 2 is a side view thereof, looking in the direction of the arrows.

In forming my expanded-metal resistor, a sheet of metal having the requisite electrical conductivity is first cut along slits 1 to form a lengthened path for the electric current. The sheet is then moved longitudinally and to one side. The sheet is then cut at slits 2, opposite portions 9 that are not cut at the previous operation. The sheet is then moved longitudinally in the same direction, and to the other side, and is cut at slits 3 opposite the slits first made, and so on until as much of the sheet has been cut as is desired. Portions of the metal are left uncut at the ends, as shown at 4 and 5. Uncut portions may also, if desired, be left at the center and at other securing places.

Simultaneously with the slitting operation, the metal is stretched in a direction oblique to the plane of the sheet, by reason of the shape of the cutting tool, to produce openings 6 which shall be inclined to the plane of the sheet whereby the walls of the openings shall be separated from each other to an appreciable extent, thereby avoiding short-circuits, but without occupying an unduly large amount of room in the plane of the sheet. Oblique stretching is obviously better for this purpose than stretching either in the plane of the sheet or at right angles thereto. The simultaneous slitting and stretching is effected in such fashion that the portions of the openings 6 on each side of the metal portions 9 are of

the same size and width. The parallel paths of the current are thereby rendered equal in length.

By means of the simultaneous operations of slitting and stretching, there can be no contraction in the width of the metal, because the stretching operation is effected at a time when the metal that is being stretched is contiguous to unstretched metal. The resulting product is therefore of the same width as the unexpanded metal and is stiffer than ordinary expanded metal.

The metal is then slotted as at 7 to increase the electrical series path from one of the terminals 4, longitudinally through the grid to the terminal 5, and then back through the other portion of the grid to the other terminal 4, and openings 8 are punched, one in the terminal portion 5 and one in each of the terminal portions 4 so as to provide for easily securing the resistor in position in a frame or box by means of bolts or similar securing means. The metal may then be sherardized or otherwise treated to preserve it from the destructive effects of the air. Such treatment is particularly desirable if the resistor is to be employed on board ship.

I have found that, in this manner, a very serviceable grid may be produced, which is entirely satisfactory where cast metal grids and other resistors are undesirable, which is of uniform quality, having the requisite stiffness, and which is not subject to the defects of ordinary expanded-metal resistors.

I claim as my invention:

1. The method of making expanded-metal resistors which comprises slitting an interior portion of a plane metal sheet between two uncut end portions, simultaneously expanding said slitted portion, then actuating said sheet in the plane thereof and repeating said operation, and finally cutting

through one of said end portions and said interior portion.

2. The method of making expanded-metal resistors which comprises slitting a plane metal sheet, simultaneously with the slitting operation stretching the metal obliquely to the plane of said sheet, then so actuating said sheet that upon repetition of said operation, the slits formed thereby in said sheet are in staggered relation to the slits formed by said first operation.

3. The method of forming an expanded-metal resistor which comprises simultaneously cutting and stretching an interior portion of a metal sheet between two uncut end portions, and slitting the resulting product through one of said end portions and said interior portion.

4. The method of forming an expanded-metal resistor which comprises simultaneously cutting and stretching an interior portion of a metal sheet between two uncut end portions, slitting the resulting product through one of said end portions and said interior portion, punching an opening in each of the slitted end portions and the said other end portion, and treating the resultant product to render it weatherproof.

5. The method of making an expanded-metal resistor which comprises slitting an interior portion of a plane metal sheet between two uncut end portions, simultaneously expanding said slitted portion, then actuating said sheet longitudinally and to one side and repeating said operation, then actuating said sheet longitudinally and toward the opposite side and repeating said operation, and finally cutting through one of said end portions and said interior portion.

In testimony whereof, I have hereunto subscribed my name this 26th day of May, 1921.

HARRY C. NAGEL.