Sept. 23, 1941. W. W. SLOANE 2,256,727

RESISTOR

Filed May 18, 1939 2 Sheets-Sheet 1

Fig. 1

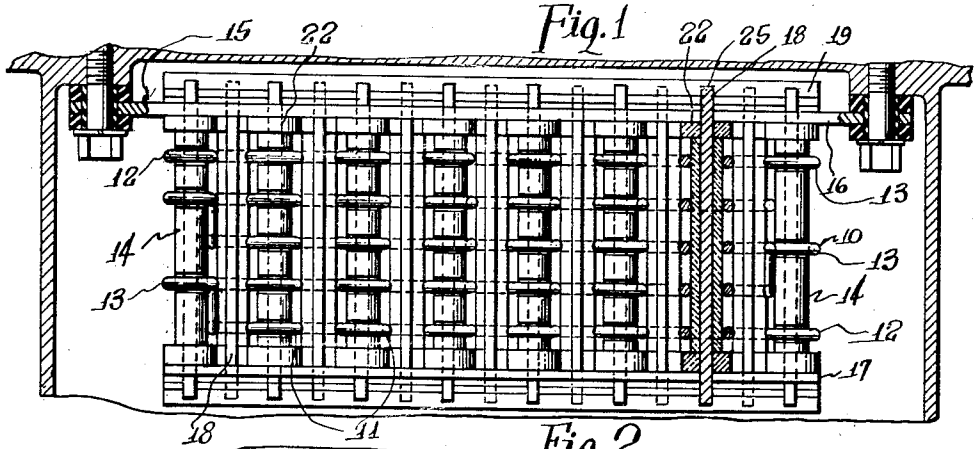



Fig. 2

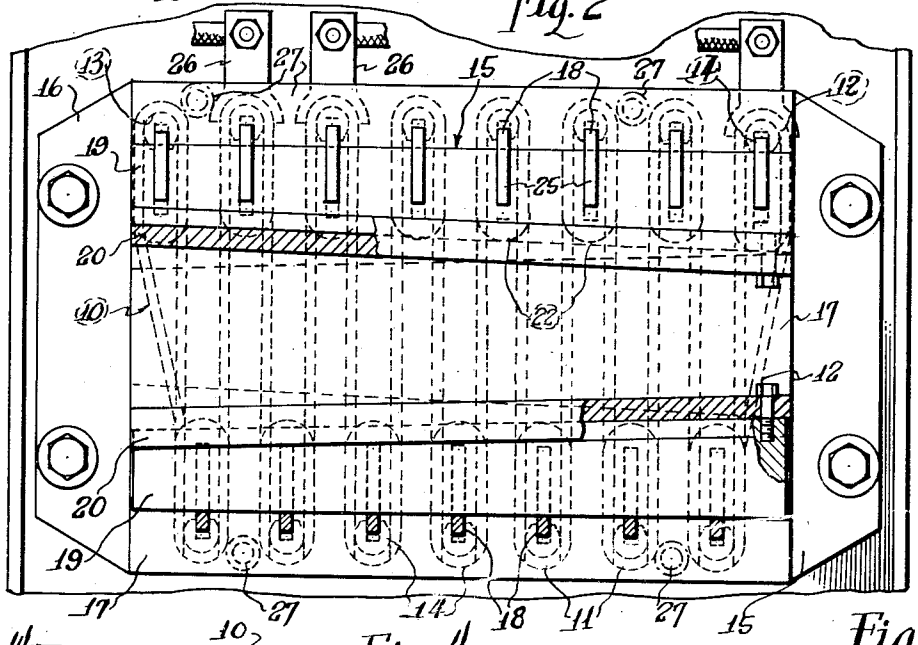



Fig. 4

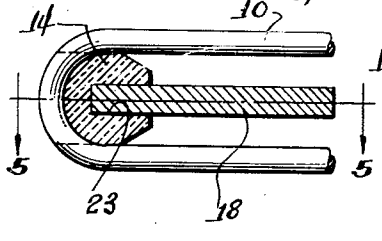
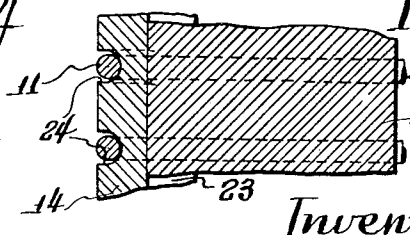



Fig. 5




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RESISTOR

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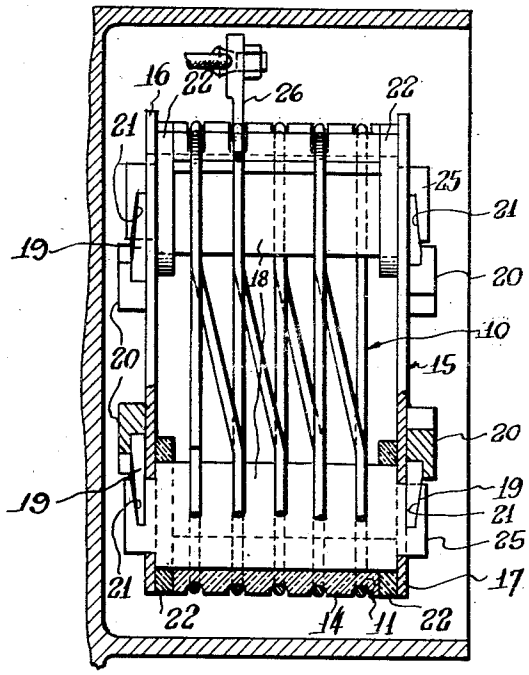
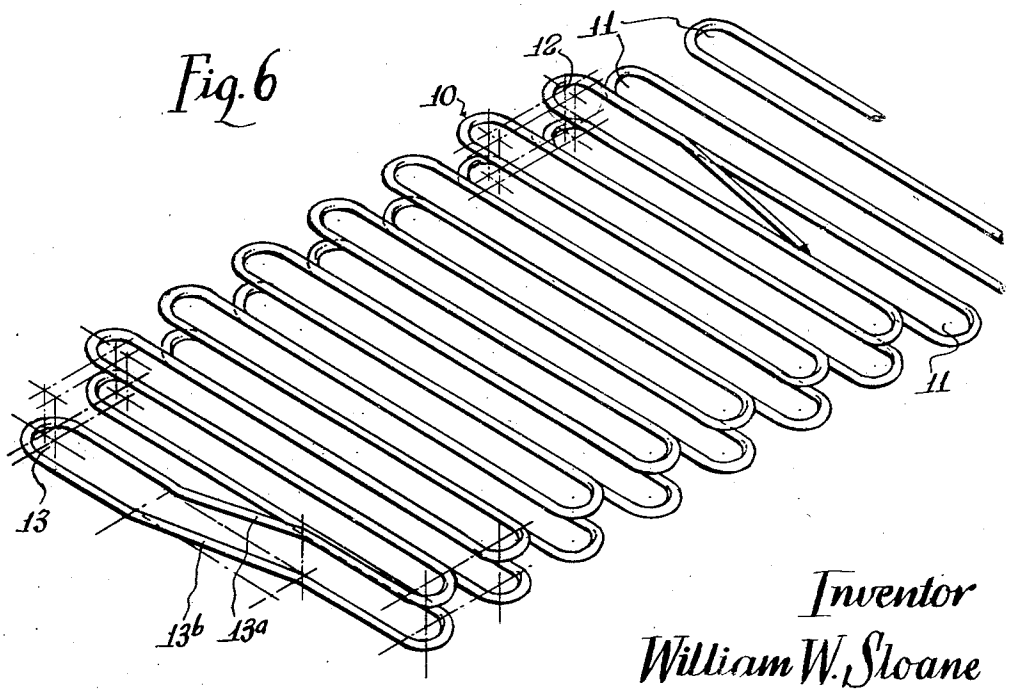



Fig. 3

Fig. 6




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# UNITED STATES PATENT OFFICE

2,256,727

## RESISTOR

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Application May 18, 1939, Serial No. 274,417

2 Claims. (Cl. 201—63)

This invention relates to improvements in resistors of the type particularly adapted for use in the starting circuit of an electric motor.

The principal object of my invention is to provide an improved resistor particularly adapted for use in confined spaces such as are encountered in mining machines or mine locomotives, which resistor consists of a compact arrangement of a plurality of parallel spaced grids adapted to eliminate joints between the grids of the resistor and minimize the possibilities of breakdown of the resistor.

A more specific object of my invention is to provide an improved compact and efficient resistor of the grid type including a plurality of parallel spaced grids formed from a single strip of resistor material.

Still another object of my invention is to provide an improved method of making grid resistors from a single piece of strip material.

My invention may be more clearly understood with reference to the accompanying drawings wherein:

Figure 1 is a plan view of a resistor constructed in accordance with my invention, with certain parts broken away and certain other parts shown in horizontal section;

Figure 2 is a side view of the device shown in Figure 1, with certain parts broken away and certain other parts shown in longitudinal section;

Figure 3 is an end view of the device shown in Figure 1, drawn to substantially the same scale as Figure 1 and showing certain parts in transverse section in order to more clearly illustrate certain details of my invention;

Figure 4 is an enlarged detail view showing one of the loops of the resistor and its insulator in detail;

Figure 5 is a detail sectional view, taken substantially along line 5—5 of Figure 4; and

Figure 6 is a diagrammatic view of a section of a resistor constructed in accordance with my invention, showing the form of the resistor after being bent to a loop form, and illustrating the manner in which the sections of the resistor are folded back and forth over each other for forming a parallel spaced grid resistance.

Referring now to the embodiment of my invention illustrated in the drawings, the resistor element is formed from a single piece of wire 10, which may be of any suitable cross section but which is herein shown as being of a circular cross section bent in a sinuous form, to form a relatively long continuous grid consisting of a plurality of parallel spaced open end loops 11, 11, as is best shown in Figures 1, 2 and 6. The free ends of the metal are bent inwardly towards and are welded to the sides of the next adjacent loop, to form a closed loop, as indicated by reference character 12, which is slightly lower than the other loops of the grid (see Figures 2 and 6). This long grid may be divided into equal sections, the length of which may depend upon the space within which the resistor is to fit. The portion of this long grid which is to be the first section may be folded or bent back over the grid in such a manner that this first section will be parallel to the remainder of the grid and the loops thereof will coincide with the loops of a portion of the long section of the grid. The next section of the long grid may then be folded back in parallel relation with respect to the first and second sections, with the loops thereof coinciding with the loops of said first and second sections, to form a third section of the grid. The remainder of the long section of the grid may then be alternately folded back and forth to form other parallel grids until a resistor is formed from one long grid which consists of a plurality of parallel spaced aligned grids. When folding the sections back and forth to form the parallel spaced grids, the wire at the end loop of each section, as it joins the next parallel spaced grid, is offset in one plane on one side of the loop and in another plane on the other side of the loop, to form an end loop 13 with parallel sides, through which an insulator 14 may pass, to hold said end loop in position and prevent sagging thereof. The two slopes are at similar angles but in different planes, so said slopes will absorb the same amount of wire and the loops and grids will be spaced substantially the same distance apart (see Figures 2 and 6). Said end loop is shown in Figure 6 as being on the level of the lower grid, and in this figure the wire on the side of the loop adjacent the upper grid is shown as being sloped downwardly to the level of the next grid, as indicated by reference character 13*a*. The wire on the other side of the loop is then sloped inwardly to position the next lower loop in alignment with the last loop of the upper grid, as indicated by reference character 13*b*. Said end loop is shorter than the other loops by an amount equal to the difference between the slopes of the wire required to space said end loop on the lower level and space the next loop in alignment with the last loop of the upper grid, and the length of the wire, if said loop were straight and in the

same plane as the other loops of the first grid. This form of bending the end loops and holding them in position thus eliminates all loose end loops and sagging of the grids of the resistor, and forms a simple means for forming a grid resistor from a single piece of wire, so that all of the loops may be held in position by insulators, and also reduces the amount of twist required for a single section of wire in forming the grids of the resistor.

When the successive sections of the long grid have been folded back and forth over each other and the resistor has been formed in the form of a plurality of parallel spaced grids, the insulators 14 may be inserted through the open ends of each loop, preferably before assembly of the resistor in its resistor frame, to form an insulated support for each strand of wire and to insulate the loops 11, 11 from the supporting frame of the resistor, and also to prevent sagging of individual loops of the resistor.

A frame 15 forms a mounting for the resistor. Said frame may be mounted in a suitable resistance box or case, a portion only of which box is herein shown and which need not be described since it is no portion of my present invention. Said frame is herein shown as being bolted to the side of said box and insulated therefrom, and includes a side plate 16 and another parallel spaced side plate 17 (see Figure 2). Said plates are held in spaced relation with respect to each other by a plurality of spacing members 18, 18, interposed therebetween and having the insulators 14, 14 mounted on the outer edges thereof. One of said spacing members is provided for each set of aligned loops of the grid. Each of said spacing members is provided with opposite projecting ends 25, 25, of a smaller cross section than the major portion of said spacing members, thus forming shouldered portions engaging the inner sides of the plates 16 and 17. Said spacing members may be held in engagement with said plates by spot welding or by twisting the ends thereof, but are herein shown as being held in engagement with said plates by means of wedge shaped locking members 19, 19, guided in oppositely inclined guides 20, 20, formed on the outsides of the plates 16 and 17 and engaging grooves 21, 21 formed in the projecting ends 25, 25 of said spacing members.

The insulators 14, 14 may be made from a suitable insulating material, such as porcelain, and are herein shown as being provided with slots 23, 23 formed in the inner sides thereof, which engage the edges of the spacing members 18, 18. The outer sides of said insulators are grooved as indicated at 24 in Figure 5, to receive and support the loops 11 of the wire 10. Said insulators are mounted on the outer edge of said spacing members, between end insulators 22, 22, which are apertured to fit around the ends of said spacing members adjacent the plates 16 and 17.

In assembling the resistor, the insulators 14, 14 are inserted through the open ends of each loop and the grooved outer portions thereof are engaged with the inner sides of the closed ends of the loops 11, 11 of the grids.

The spacing members 18, 18, with the insulators 22, 22 on the ends thereof, may then be inserted through the open ends of the loops 11, 11, and engaged with the slots 23, 23 formed in the inner sides of the insulators 14, 14, for maintaining said insulators in the proper position with respect to said loops. The ends 25, 25 of said spacing members may then be inserted in slots formed in the plates 16 and 17 and said plates may then be held together by tie rods 27, 27. Each of said tie rods is indicated generally by dotted lines in Figure 2 and may have a head on one end thereof, and may be threaded at its opposite ends in the plate 16. Said tie rods are removed after assembly of the resistor.

The wedges 19, 19 may then be inserted in the guides 20, 20 and engaged with the grooves 21, 21, formed in the ends of the spacing members 18, 18, for holding the resistors together. The tie rods 27, 27 are removed upon insertion and tightening of said wedges.

Connectors 26, 26 may be secured to certain of the loops of the resistor, to permit certain grids thereof to be cut in or out of the motor circuit step by step in the usual manner. Said connectors are herein shown as being formed to fit over a loop of the resistor and be welded thereto.

It may be seen from the foregoing that a simplified form and method of making a resistance has been provided, which uniformly forms the resistor from a continuous strip of wire and eliminates joints or connectors between adjacent grids, and also does away with excessive twisting of the wire. It may likewise be seen that said resistor may be formed and assembled in a simpler manner than grid resistors of the common type, and is compactly arranged in such a manner as to prevent sagging of the grids and eliminate any loose end loops which might sag or otherwise come into engagement with other loops of the resistor.

While I have herein shown and described one form in which my invention may be embodied, it will be understood that the construction thereof and the arrangement of the various parts may be altered without departing from the spirit and scope thereof. Furthermore, I do not wish to be construed as limiting myself to the specific embodiment illustrated, excepting as it may be limited in the appended claims.

I claim as my invention:

1. A resistor of the class described including a single wire formed in a long grid consisting of a plurality of parallel spaced oppositely facing open loops, an end section of said grid being folded over the remainder of said grid in spaced relation with respect thereto and the remainder of said long grid being alternately and successively folded back and forth over said end section in parallel spaced relation with respect thereto, to form a continuous parallel spaced multiple grid resistor from a single long grid, with the loops thereof in aligned relationship with respect to each other, the wire on the side of the loop of the end loop of one grid where two adjacent parallel grids join each other, being sloped in one plane to the plane of the next grid and the wire on the other side of this loop being sloped inwardly in another plane at substantially the same angle as the angle of slope of said first mentioned slope, to form an end loop with the looped portion in alignment with the other loops of the grid, to permit a supporting insulator to pass therethrough, and so arranged that the slopes of the wire at the end of each grid section as it joins the next succeeding grid section will be at similar angles but in different planes and absorb the same amount of wire, to space the loops and grids of the resistor substantially the same distance apart, with similar loops in alignment with each other.

2. A resistor of the class described including a

single wire formed in a long grid consisting of a plurality of parallel spaced oppositely facing open loops, an end section of said grid being folded over the remainder of said grid in spaced relation with respect thereto and the remainder of said long grid being alternately and successively folded back and forth over said end section in parallel spaced relation with respect thereto, to form a continuous parallel spaced multiple grid resistor formed from a single grid, with the loops thereof in aligned relationship with respect to each other, to permit supporting insulators to pass therethrough, the wire on the side of the loop of the end loop of one grid, where two adjacent parallel grids join each other, being sloped in one plane to the plane of the next grid and the wire on the other side of this loop being sloped inwardly in another plane at substantially the same angle as the angle of slope of said first mentioned slope, to form an end loop with the looped portion in alignment with the other loops of the grid, to permit an insulator to pass therethrough, and so arranged that the slopes of the wire at the end of each grid section, as it joins the next succeeding grid section, will be at similar angles but in different planes to absorb the same amount of wire and space the loops and grids substantially the same distance apart, and insulators insertable through the open portions of the loops of said grids and engaging the insides of said loops, for supporting said grids and preventing sagging thereof.

WILLIAM W. SLOANE.