A. H. CANDEE.

RESISTOR.

APPLICATION FILED FEB. 15, 1919.

1,433,697. **Patented Oct. 31, 1922.**

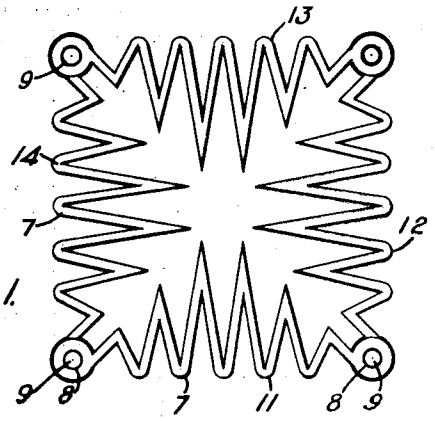

Fig. 1.

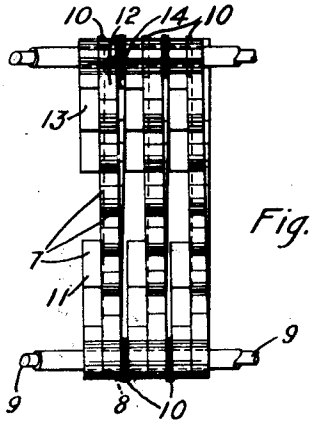

Fig. 2.

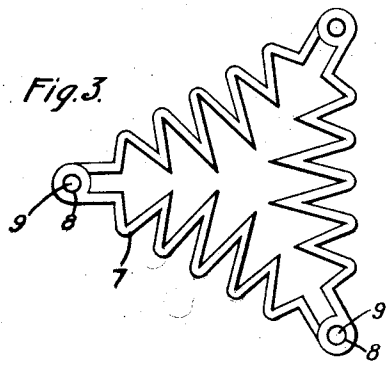

Fig. 3.

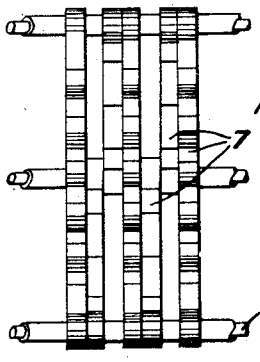

Fig. 4.

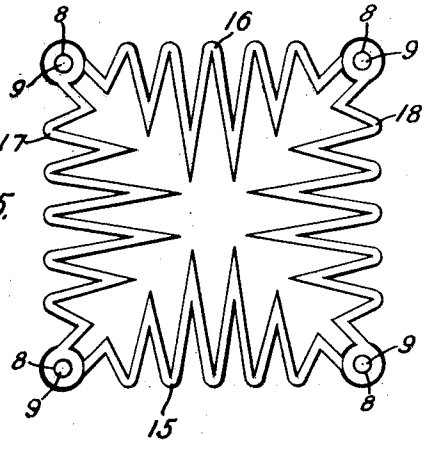

Fig. 5.

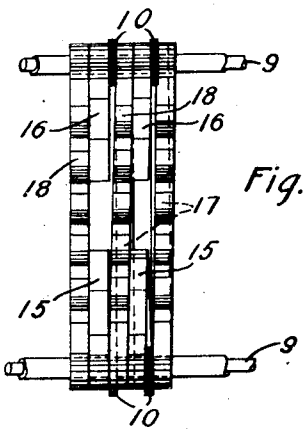

Fig. 6.

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UNITED STATES PATENT OFFICE.

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RESISTOR.

Application filed February 15, 1919. Serial No. 277,224.

To all whom it may concern:

Be it known that I, ANDREW H. CANDEE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Resistors, of which the following is a specification.

My invention relates to resistors of the grid type and it has particular relation to the arrangement for mounting such apparatus.

The object of my invention is to provide an arrangement by which the grids may be properly spaced apart without occupying an unnecessarily large amount of space and in which the employment of separate spacing collars may be reduced to a minimum.

In the accompanying drawing, Fig. 1 is an end elevational view of a resistor constructed in accordance with my invention, and Fig. 2 is a side elevational view thereof; Fig. 3 is an end elevational view of a slight modification of my invention; and Fig. 4 is a side elevational view thereof; Fig. 5 is an end elevational view of a resistor constructed in accordance with my invention and having its grids connected in multiple; and Fig. 6 is a side elevational view thereof.

Heretofore, it has been customary, in manufacturing grid resistors, to employ conducting spacing members intermediate the grids to be electrically connected. In cast grids, the spacing members are lugs cast integral therewith. In pressed and punched-metal grids, however, the spacing means usually comprises separate collar members mounted on insulated tie rods intermediate the grids, the electrically connected grids being spaced apart by metallic collars and the others by insulating collars. Thus, it will be apparent that, between each two connected grids, are two contacts made between abutting surfaces. It is highly desirable to reduce the number of parts to a minimun on account of the fact that poor contact may be made therebetween and in order that the work of assembling the parts may be reduced.

By my invention, I provide a resistor in which the employment of separate metallic spacing collars is avoided, and the grids are so shaped as to occupy a minimum amount of over-all space. Furthermore, my construction is readily adaptable for connecting the individual grids in either series or parallel relation, as may be desired.

Reference may now be had to the drawings in which I show a plurality of similar grid members 7, of approximately triangular shape, provided with openings 8 at the respective ends thereof by means of which they are mounted upon insulated tie rods 9. As best shown in Fig. 2, the grids are successively mounted upon the tie rods in such manner that the end of each grid overlaps the adjacent end of the next successive grid and, in this manner, the grids are built up into a prismatic structure, with the grids arranged helically. The layers of grids are separated by means of insulating spacing members 10. By this arrangement, similar grids 11, 12, 13 and 14 are so arranged that, starting from grid 13 the current passes through grids 12, 11 and 14 in the order named and then again to the next succeeding grid 13 which serves as a connecting link between the layers of grids and is disposed at an angle to the other grids.

In the modification shown in Figs. 3 and 4, the structure embodies only three tie-rods and, consequently, only three grids to each layer which are also arranged helically. It will be noted, that by reason of the triangular contour of the grids, substantially all of the internal space of the resistor is utilized and there is a maximum amount of resistance for the volume of the resistor. Any number of tie rods may be used, in fact, a large number is desirable in high-capacity resistors, in which it is desirable to mount a large number of grids. It will be found desirable to adhere to the triangular form of grid, since this form utilizes a maximum amount of the space available within the resistor.

In Figs. 5 and 6, grids 15 and 16 are connected in parallel, as are also grids 17 and 18. From Fig. 6, it will be observed that this arrangement forms a very compact resistor which is easily assembled and is also easily disassembled for repairs. Contact is made at the junction of the grids 16 and 17 and current passes through parallel paths consisting of the grids 16 and 18 and 17 and 15, respectively. The junction of the grids 15 and 18 of the first layer of grids is in electrical contact with the junction of similar grids of the second layer. Thus, it will be seen that the two contacts of each layer of grids are attached to diagonally opposite corners, so that, between each two layers of

grids, there are three insulating spacing members 10, and contact is made between the layers at the fourth corner.

From the foregoing description of my invention, it will be apparent that the grids are formed of flat plates which are simple and inexpensive to construct, and, by means of the arrangement of these plates, the bosses which have formerly been portions of the grid castings and also the separate collar members have been eliminated, and a structure mechanically superior and less expensive to manufacture has been substituted therefor.

While I have shown only three embodiments of my invention it is not so limited but is susceptible of various minor changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or are specifically set forth in the appended claims.

I claim as my invention:

1. An electrical resistor comprising a plurality of separate grid members successively connected to form a polygon, all adjacent members being relatively displaced.

2. An electrical resistor comprising a plurality of separate similarly shaped grid members successively connected to form a polygon, all adjacent members being relatively displaced substantially in the plane of the polygon.

3. An electrical resistor comprising a plurality of separate grid members connected together in end-to-end relation to form a polygon, all adjacent members being relatively displaced substantially in the plane of the polygon.

4. An electrical resistance grid member comprising a member of approximately triangular shape in outline and having alternate slots extending from opposite directions.

5. An electrical resistor comprising a plurality of separate grid members of approximately triangular shape successively connected to form a polygon, all adjacent members being relatively displaced.

6. An electrical resistor comprising a plurality of separate grid members disposed in end-to-end relation to form a polygon, all adjacent members being relatively displaced substantially in the plane of the polygon.

7. An electrical resistor comprising a plurality of separate grid members of approximately triangular shape arranged to each have one side constitute only one side of a polygon and having the opposite apex disposed within said polygon, whereby said apexes are located in proximity in substantially the plane of the polygon.

8. An electrical resistor comprising a plurality of spaced tie rods, a plurality of grid members arranged to form a polygon, each of said grid members being disposed between two successive tie rods.

9. An electrical resistor comprising a plurality of spaced tie rods, a plurality of grid members arranged to form a polygon, each of said grid members being provided with openings in the ends thereof and being mounted between two successive tie rods which project through said openings.

10. An electrical resistor comprising a plurality of tie rods, and a plurality of resistance grids successively mounted thereon in a helical arrangement by means of openings in the end portions thereof, each of said grids being mounted at the ends on two successive pins supporting the adjacent ends of the next successive grids.

11. An electrical resistor comprising a plurality of tie rods, and a plurality of resistance grids mounted thereon by means of openings in the end portions thereof, each of said grids being mounted at the ends on two successive pins supporting the adjacent ends of the next successive grids, the ends of each grid being in engagement with the ends of the next successive grids.

12. An electrical resistor comprising a plurality of tie rods, and a plurality of resistance grids mounted thereon by means of openings in the end portions thereof, each of said grids being mounted at the ends on two adjacent pins supporting the adjacent ends of the next successive grids, the ends of each grid being in engagement with the ends of the next successive grids, and said grids being disposed to form a polygon.

13. A grid resistor element having on one side a number of bends in substantial alinement and having other sides formed by bends of successively increasing distance from said one side.

14. A grid resistor element having on one side a number of bends in substantial alinement and having teeth of gradually increasing size extending from each end of said one side towards the middle thereof.

15. An electrical resistor of general polygonal form, each side of the polygon having on one of its sides a number of bends in substantial alinement and having other sides formed by bends of successively increasing distance from said one side.

16. An electrical resistor of general polygonal form, each side of the polygon having on one of its sides a number of bends in substantial alinement for forming an outer side of the polygon and having teeth of gradually increasing size extending from each end of said one side towards the middle thereof, whereby a relatively large proportion of the enclosed area is usefully employed.

17. An electrical resistor of general polygonal outline, each side of the polygon hav-

ing on one of its sides a number of bends in substantial alinement for forming an outer side of the polygon and having it inner sides extending towards the geometrical center of the polygon.

18. An electrical resistor comprising a plurality of members of general triangular form, said members being assembled in the form of a polygon with corresponding apexes located near the geometrical center of the polygon.

In testimony whereof, I have hereunto subscribed my name this 24th day of Jan. 1919.

ANDREW H. CANDEE.