March 2, 1926. 1,574,993

D. F. MINER

BUS BAR

Filed Sept. 24, 1920

Fig. 1.

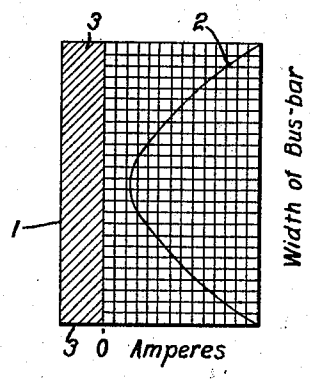


Fig. 2.

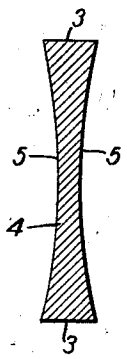


Fig. 3.

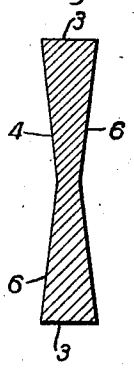
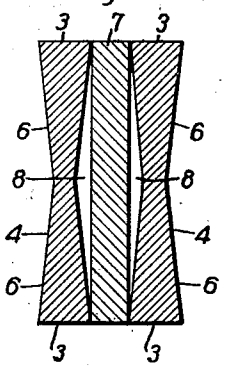


Fig. 4.



WITNESSES:

H. B. Funk.

F. H. Miller

INVENTOR

Douglas F. Miner

BY

Wesley G. Carr

ATTORNEY

Patented Mar. 2, 1926. 1,574,993

UNITED STATES PATENT OFFICE.

DOUGLAS F. MINER, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

BUS BAR.

Application filed September 24, 1920. Serial No. 412,529.

To all whom it may concern:

Be it known that I, DOUGLAS F. MINER, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Bus Bars, of which the following is a specification.

My invention relates to electrical conductors and particularly to bus-bars for switchboard structures.

One object of my invention is to provide a conductor that shall be so shaped as to compensate for the skin effect thereof to effect thereby a uniform distribution of current therethrough, eliminate undue heating and utilize the conductor effectively and economically.

Another object of my invention is to provide a bus-bar, or a similar conductor, and a spacing or supporting member therefor that shall be so formed and related as to provide a ventilating space therebetween.

When alternating current passes through a conductor, a periodically expanding and collapsing magnetic field is set up in and around the conductor. This field induces a counter-electromotive force in the conductor which produces what is known as skin effect. The apparent resistance of a given conductor to alternating current, divided by its resistance to direct current, is known as the skin effect ratio for the particular conditions and the frequency of the alternating current considered.

With alternating currents of relatively high values, the skin effect causes serious unequal distribution of current throughout the cross-sectional area of the conductor, causing relatively greater current density at the outer portions than at the central portions of the conductor. Thus, the central portion is underworked and the outer portions are overworked, resulting in an inefficient and uneconomical use of material for a given limitation of temperature of the conductor.

In practicing my invention, I provide a conductor that is formed, as by rolling or drawing, to conform to the distribution of current at standard frequencies, thus eliminating undue heating and permitting the efficient and economical use of copper or other conducting material.

In my copending application, Serial No. 410,896, filed Sept. 17, 1920, is disclosed a structure for accomplishing similar results, as those herein set forth, by adding magnetic metal members to the conductors instead of by shaping the latter in special manners. Other devices appertaining to the distribution of current in conductors are set forth in my copending applications, Serial No. 412,530, filed Sept. 24, 1920, and Serial No. 412,531, filed Sept. 24, 1920, and in a copending applicaiton of C. F. Wagner, Serial No. 412,461, filed Sept. 24, 1920.

Figure 1 of the accompanying drawings is a cross-sectional view of a bus-bar of usual form combined with a diagram showing the ditribution of current therein.

Fig. 2 is a cross-sectional view of a bus-bar constructed in accordance with my invention.

Fig. 3 is a cross-sectional view of a modified form of bus-bar embodying my invention, and

Fig. 4 is a cross-sectional view of two of the bus-bars of Fig. 3 and a spacing or supporting member with which they may be associated.

In Fig. 1, a bus-bar 1 of usual form is so affected by alternating current as to cause a distribution of current, as indicated by the curve 2. With the zero or reference ordinate coincident with one side of the bus-bar, this figure shows, in general, that the current density of such a conductor is greatest at the outer edges 3 thereof and that the density decreases gradually toward the center of the conductor.

To obviate this condition, the conductor 4 of Fig. 2 is provided. This conductor is shaped in accordance with the distribution of current as indicated in the current curve 2 of Fig. 1, that is, the thickness of the conductor at any point between the center and edges of the conductor is made proportional to the value of the current density indicated at the corresponding point of the current curve 2. Thus each increment of the conductor of equal area carries an equal current density. By reason of this construction, a bus-bar having less cross-sectional area than the rectangular bar, indicated in Fig. 1, may serve to carry the same amount of current for a given temperature rise. The reduction in the quantity of conductive

metal necessary to form a bar having a given capacity results in considerable saving of relatively expensive material. The conductor may be provided with regular concave curved surfaces 5 extending throughout the length thereof or, as in Fig. 3, may be tapered along straight lines 6 from the edges to the center thereof. The latter construction, while providing substantially as good operating characteristics, may have manufacturing advantages over the form shown in Fig. 2.

Either form may be employed with a positioning member of usual form, such as a spacing or supporting member 7, to therewith form longitudinal ventilating spaces 8 therebetween.

While I have shown and described particular forms of my invention, changes may be effected therein without departing from the spirit and scope thereof, as set forth in the appended claims.

I claim as my invention:

1. A bus-bar of substantially strap formation having its edge portions thicker than its center portion to effect uniform distribution of current through the bus-bar.

2. A substantially flat conductor having its opposed surfaces concave to form a cross-sectional area corresponding in distribution to the current densities determined by skin effect whereby substantially uniform current density is effected.

3. A conductor having double-concave surfaces so disposed that the cross-sectional area of the conductor corresponds in distribution to the natural current densities due to skin effect.

4. A substantially flat conductor having a cross-sectional area corresponding in shape to the natural current densities of the conductor caused by skin effect for effecting uniform current density throughout the cross-section of the conductor.

5. A solid conductor having its cross-sectional area distributed in accordance with the natural current density caused by skin effect whereby substantially uniform distribution of current density is effected.

6. A conductor having greater width than thickness and having its thickness at any point proportioned in accordance with the current density at such point determined by skin effect whereby substantially uniform current density is effected throughout the area of the conductor.

In testimony whereof, I have hereunto subscribed my name this 11th day of September, 1920.

DOUGLAS F. MINER.