July 25, 1939. R. W. SHOEMAKER ET AL 2,167,378

VENTILATED BUS BAR

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Fig. 1.

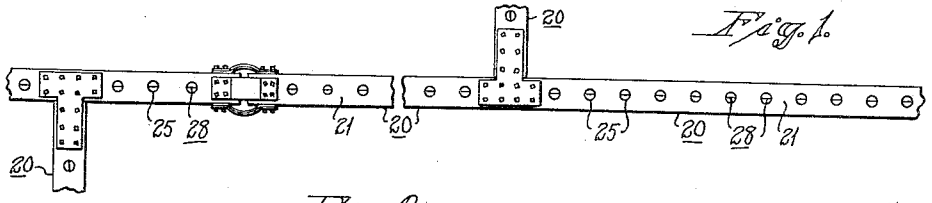


Fig. 6.

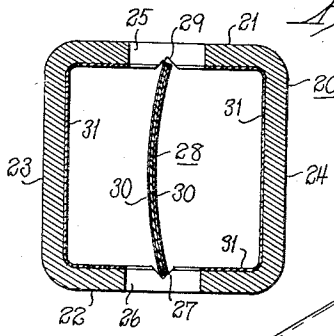


Fig. 2.

Fig. 3.

Fig. 4.

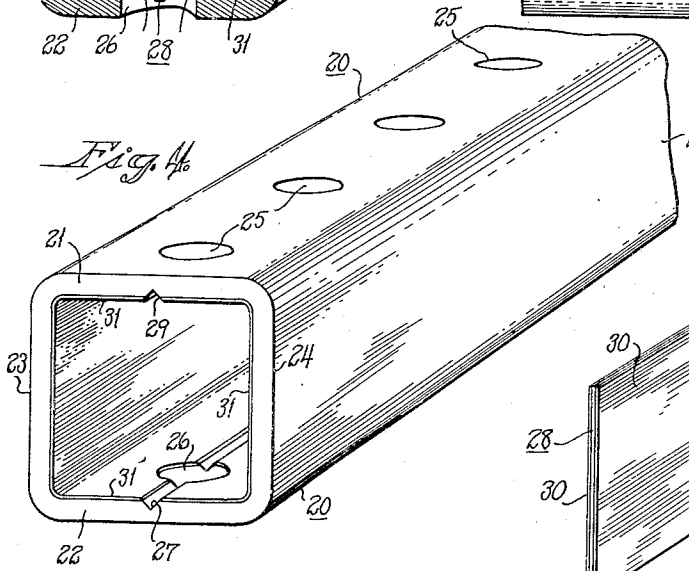
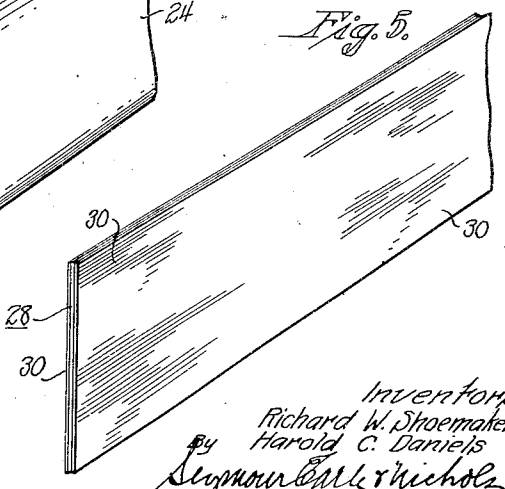


Fig. 5.



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Fig. 8.

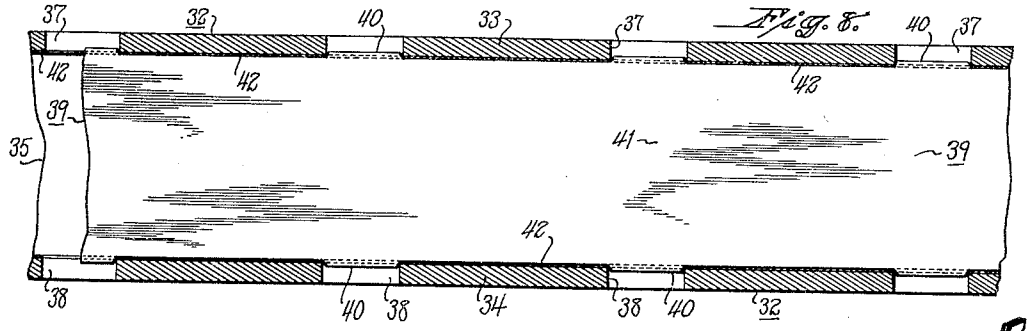


Fig. 7.

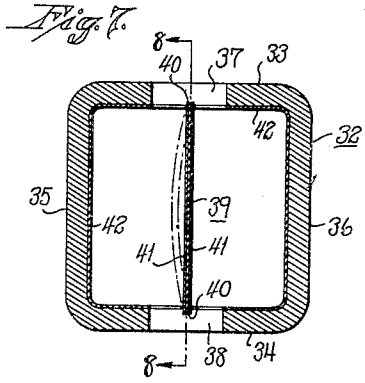


Fig. 9.

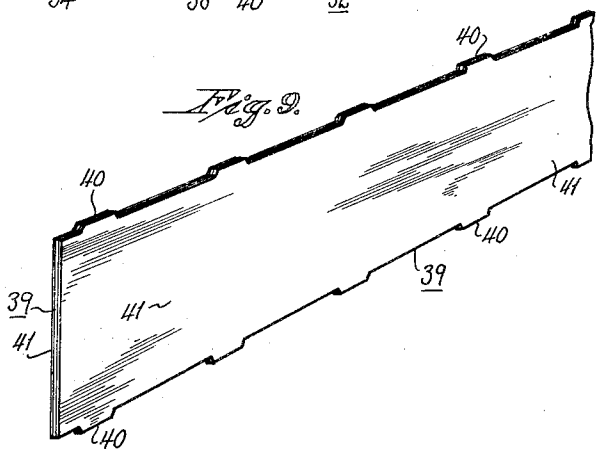


Fig. 10.

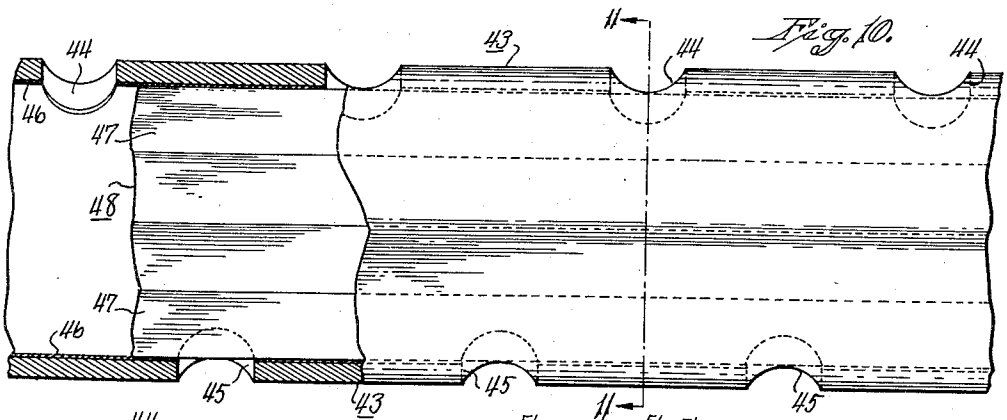


Fig. 11.

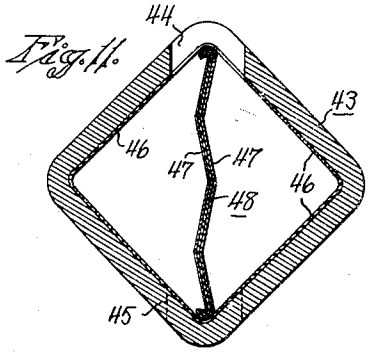
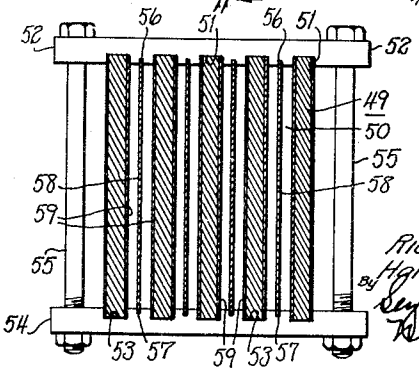


Fig. 12.



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UNITED STATES PATENT OFFICE

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VENTILATED BUS BAR

Richard W. Shoemaker and Harold C. Daniels, Woodbury, Conn., assignors to Chase Brass & Copper Co. Incorporated, Waterbury, Conn., a corporation of Connecticut

Application May 10, 1937, Serial No. 141,647

14 Claims. (Cl. 174—16)

This invention relates to an improvement in bus-bars, and more particularly to bus-bars which are constructed and arranged to permit the passage of air therethrough to dissipate heat developed under operating conditions.

Heat developed in ventilated bus-bars as the result of the passage of current therethrough may be dissipated mainly in two ways, i. e., by the wiping action of air currents (convection) and by radiant heat emanation. The bright surfaces of copper and other high electroconductive materials, however, are not usually efficient as regards radiant heat emissivity, and if rendered efficient in this respect by surface treatments, the radiant heat tends to be shuttled back and forth between opposing surfaces without materially lowering the temperature of the bus-bar structure. Thus, with respect to the inner surfaces of hollow bus-bar structures or the opposed surfaces of the laminae or component elements of composite bus-bars, but a relatively small amount of heat may be effectively dissipated in the form of radiation.

The main object of the present invention is to provide a ventilated bus-bar structure having superior capacity for dissipating heat developed by the passage of current therethrough to thus enable the bus-bar to function with greater efficiency.

A further object of the present invention is to provide a bus-bar structure having superior capacity for dissipating radiant heat.

Another object is to provide a bus-bar structure having superior means for dissipating radiant heat by convection.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art and which are not claimed by me in a separate application.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a broken plan view of a portion of a bus system composed of bus-bars embodying the present invention;

Fig. 2 is a broken perspective view of a portion of the tubular bus-bar structure;

Fig. 3 is a fragmentary top or plan view thereof;

Fig. 4 is a broken perspective view showing the tubular bus-bar prior to the introduction thereinto of the radiant-heat-absorbing member;

Fig. 5 is a similar view of the radiant-heat-absorbing member;

Fig. 6 is a transverse sectional view showing the radiant-heat-absorbing member as transversely bowed for its ready introduction into the hollow bus-bar;

Fig. 7 is a transverse sectional view illustrating another form of radiant-heat-absorbing member or partition;

Fig. 8 is a longitudinal sectional view thereof taken on the line 8—8 of Fig. 7;

Fig. 9 is a perspective view of the radiant-heat-absorbing member of Figs. 7 and 8;

Fig. 10 is a view mainly in side elevation and partly in vertical section of another form of tubular bus-bar structure embodying the present invention;

Fig. 11 is a transverse sectional view thereof taken on the line 11—11 of Fig. 10; and

Fig. 12 is a transverse sectional view of still another form of bus-bar structure embodying the present invention.

The particular bus-bar 20 illustrated in Figs. 1 to 6 inclusive is a one-piece tube of rectangular form in cross-section and is preferably formed of drawn-copper or other high electro-conductive material. The tubular bus-bar includes a flat top-wall 21, a flat bottom-wall 22, and oppositely-located flat side-walls 23 and 24.

Along the transverse center of its top-wall 21, the bus-bar is formed with a longitudinal series of spaced-apart air-egress ports or passages 25, and, similarly, the bottom-wall 22 is formed with a longitudinally-extending series of air-ingress ports or passages 26.

The upper surface of the bottom-wall 22 of the tubular bus-bar 20 is formed centrally with a longitudinally-extending upwardly-opening groove 27 receiving the lower edge of a plate- or partition-like radiant-heat-absorbing member 28, which has its upper edge seated in a downwardly-opening longitudinally-extending groove 29 formed in the under face of the top wall 21 of the tubular bus-bar 20. The radiant-heat-absorbing plate or partition 28 is, in the instance shown, formed of non-ferrous metal such as copper, and is provided on each of its respective opposite sides with a radiant-heat-absorbing coating 30, which coating may be in the form of a black paint, cupric oxide, or other material having a high factor of radiant heat-absorption. If desired, instead of employing a metallic plate or partition, a plate or partition of black vulcanized fiber or the like may be employed, in which case the coating such as 30 is not required. Other non-metallic materials which may be mentioned as suitable are molded mica, phenolic resins, etc.

For convenience in assembling the member 28

within the bus-bar proper **20**, the said member may have imparted to it an initially-transverse curvature, as illustrated in Fig. 6, and after it has been drawn endwise into position within the said bus-bar, it may be straightened out by any suitable means into the form shown particularly well in Fig. 2, to thus seat its respective opposite edges in the grooves **27** and **29**.

To render the inner surfaces of the walls **21** to **24** inclusive of the bus-bar **20** more effective in emitting radiant heat, it is preferable to provide the same with a coating **31** of suitable material such, for instance, as light gray transformer paint or other suitable material, for the purpose of which there are numerous recognized in the heating art.

As thus constructed and arranged, when the bus-bar structure becomes heated by the passage of current therethrough, radiant heat, represented by the broken-line arrows in Fig. 2, will be emitted by the inner surfaces of the walls **21** to **24** inclusive of the bus-bar **20**, and will impinge upon and be largely absorbed by the radiant-heat-absorbing member **28**, and in the main will not be reflected back toward their point of origin. The current of air entering through the air-ingress ports **26** in the bottom-wall **22** and passing upwardly and outwardly through the air-egress ports **25** will wipe over, so to speak, the opposite surfaces of the member **28**, as indicated by the full-line arrows in Fig. 2, and thus continually remove the heat absorbed, as described, by the member **28**.

Tests under a 60-cycle 3200-ampere load have shown that a 5-inch-square copper bus-bar of the type shown in Figs. 1 to 6 inclusive has a temperature rise of only about 25.5° F. when the average room temperature was about 72.5° F. The same tube provided with only the air-ports **25** and **26** showed, under the same conditions, a temperature rise of about 39° F.

From the foregoing, it will be seen that by means of the present invention, the temperature of a bus-bar structure under operating conditions may be maintained at a relatively-low level and thus at a relatively-high degree of electro-conductive efficiency.

In Figs. 7 to 9 inclusive, a one-piece tubular bus-bar **32** is shown which is preferably formed of copper or other high electro-conductive material, and like the bus-bar **20**, previously described, it includes a top-wall **33**, a bottom-wall **34**, and complementary side-walls **35** and **36**.

Also, like the bus-bar structure of Figs. 1 to 6 inclusive, the bus-bar **32** is provided in the lateral center of its top-wall **33** with a longitudinal series of air-egress ports or passages **37** arranged in line with a longitudinally-spaced series of air-ingress ports or passages **38** formed in the bottom-wall **34**.

Installed within the bus-bar **32** substantially parallel with and midway between the respective opposite side-walls **35** and **36** thereof is a radiant-heat-absorbing member **39** provided along its respective opposite edges with a plurality of stabilizing-tongues **40**, slightly tapered and spaced apart to conform to the longitudinal spacing of the ports **37** and **38** and adapted to extend thereinto, as shown in Figs. 7 and 8. To permit the ready installation of the member **39**, the same may be transversely bowed, as indicated by broken lines in Fig. 7, then forcibly straightened out, or permitted to straighten out under its own resiliency, to assume the position indicated by full lines in Fig. 7. Each of the respective opposite faces of the plate-like radiant-heat-absorbing member **39** is provided with a coating **41**, preferably of dark coloration and having superior capacity for the absorption of radiant heat and for the dissipation of heat by convection than have the interior surfaces of the bus-bar **32**, which surfaces are preferably provided with a continuous coating **42** providing high radiant-heat emissivity.

In Figs. 10 and 11 is illustrated a bus-bar **43** which is of rectangular form in cross-section and positioned so that two of its apices are in vertical alignment, one over the other. The upper apex of the bus-bar **43** is provided at longitudinally-spaced points with air-egress ports or passages **44** through which outwardly pass air currents entering the bus-bar through air-ingress ports or passages **45** drilled or otherwise formed in the lower apex of the bus-bar **43** in longitudinally-staggered relationship with respect to the said air-egress ports **44**.

The interior of the bus-bar **43** is provided with a surface **46** having a high degree of radiant-heat emissivity as compared to the respective opposite faces **47** of a transversely-corrugated resilient radiant-heat-absorbing member or partition **48**. The surfaces **47**, just referred to, of the member **48** are characterized by a superior capacity for absorbing radiant heat emitted by the surfaces **46**, so that such absorbed radiant heat may be readily carried off by air currents which wipe thereacross in passing through the bus structure from the air-ingress ports **45** outwardly to the air-egress ports **44**.

In Fig. 12 is illustrated a ventilated bus-bar structure of laminated form, which includes a series of spaced-apart conductor-plates or bars **49** providing between them a series of vertically-extending ventilating-passages **50**. The said conductor-plates or bars **49** are held in the spaced relationship referred to by having their upper edges seated in notches **51** formed in the under faces of an upper clamp-member **52** and their lower edges seated in upwardly-opening notches **53** formed in a lower clamp-member **54** which is rigidly coupled to the complemental upper clamping-member **52** by suitable bolts **55**.

Mounted centrally in each of the ventilating-passages **50** of the bus structure of Fig. 12 and held in place by having its respective opposite edges seated in notches **56** and **57** in the clamps **52** and **54**, is a plate-like radiant-heat-absorbing member **58** which is characterized by having a superior capacity for absorbing radiant heat as compared to the adjacent surfaces **59** of the conductor-bars or plates **49**, which latter surfaces are preferably treated to provide a relatively-high degree of radiant-heat emissivity as compared to the members **58**.

All of the forms of the present invention herein illustrated are characterized by superior capacity for dissipation of heat developed in the bus-bar structure, and particularly radiant heat.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

We claim:

1. A bus-bar structure having a ventilating passage therethrough and provided with an

inner radiant-heat-emitting surface and an inner radiant-heat-absorbing surface spaced from each other and the latter surface having greater heat-absorbing properties than the former and being positioned in the bus-bar structure so as to be swept over by air currents passing through the ventilating passage therein to cause the said air currents to remove by convection the radiant heat absorbed by the said radiant-heat-absorbing surface from the said radiant-heat-emitting surface.

2. A bus-bar structure having a ventilating passage therethrough and provided with an inner radiant-heat-emitting surface and an inner heat-absorbing surface spaced from each other and the latter surface being provided with a radiant-heat-absorbing coating having greater heat-absorbing properties than the said heat emitting-surface and positioned in the bus-bar structure so as to be swept over by air currents passing through the ventilating passage therein to cause the said air currents to remove by convection the radiant heat absorbed by the said radiant-heat-absorbing surface from the said radiant-heat-emitting surface.

3. A bus-bar structure having a ventilating passage therethrough and having an inner surface coated with a radiant-heat-emitting material, the bus-bar also having an inner surface spaced from the first-mentioned surface and provided with a radiant-heat-absorbing coating having greater heat-absorbing properties than the said heat emitting-surface and positioned in the bus-bar structure so as to be swept over by air currents passing through the ventilating passage therein to cause the said air currents to remove by convection the radiant heat absorbed by the said radiant-heat-absorbing coating from the said radiant-heat-emitting material.

4. A bus-bar structure having a ventilating passage therethrough and provided with an inner radiant-heat-emitting surface and an inner radiant-heat-absorbing surface spaced from each other and the latter surface being positioned in the bus-bar structure so as to be swept over by air currents passing through the ventilating passage therein to cause the said air currents to remove by convection the radiant heat absorbed by the said radiant-heat-absorbing surface from the said radiant-heat-emitting surface, the radiant-heat-emitting surface having a coating of radiant-heat-emitting material of relatively-light coloration, and the radiant-heat-absorbing surface having a radiant-heat-absorbing coating of relatively-dark coloration.

5. A bus-bar structure having a ventilating passage therethrough; said bus-bar structure including an electro-conductive member having an inner radiant-heat-emitting surface; and said bus-bar structure also including a radiant-heat-absorbing member organized with said electro-conductive member and having greater heat-absorbing properties; the said radiant-heat-absorbing member being located in position to receive and absorb radiant heat from the said inner surface of the electro-conductive member of the bus-bar structure and being arranged in exposed relation to be swept over by air currents flowing through the said ventilating passage to cause the said air currents to remove by convection the radiant heat absorbed by the radiant-heat-absorbing member from said inner radiant-heat-emitting surface.

6. A bus-bar structure having a ventilating passage therethrough; said bus-bar structure including an electro-conductive member having an inner radiant-heat-emitting surface; and said bus-bar structure also including a radiant-heat-absorbing member having a radiant-heat-absorbing coating having greater heat absorbing properties than the said heat emitting-surface; the said radiant-heat-absorbing member being organized with the said electro-conductive member in position to receive and absorb radiant heat from the said inner surface of the electro-conductive member of the bus-bar structure and being arranged in exposed relation to be swept over by air currents flowing through the said ventilating passage to cause the said air currents to remove by convection the radiant heat absorbed by the radiant-heat-absorbing member from said inner radiant-heat-emitting surface.

7. A bus-bar structure having a ventilating passage therethrough; said bus-bar structure including an electro-conductive member having an inner surface provided with a radiant-heat-emitting coating; said bus-bar structure also including a radiant-heat-absorbing member having a radiant-heat-absorbing coating having greaer heat-absorbing properties than the said heat emitting-surface; the said radiant-heat-absorbing member being organized with the said electro-conductive member in position to have its coating receive and absorb radiant heat from the said radiant-heat-emitting coating of the electro-conductive member of the bus-bar structure and being arranged in exposed relation to be swept over by air currents flowing through the ventilating passage therein to cause the said air currents to remove by convection the radiant heat received by the said radiant-heat-absorbing coating from the said radiant-heat-emitting coating.

8. A bus-bar structure having a ventilating passage therethrough; said bus-bar structure including an electro-conductive member having an inner radiant-heat-emitting surface; said bus-bar structure also including a radiant-heat-absorbing member; the said radiant-heat-absorbing member being organized with the said electro-conductive member in position to receive and absorb radiant heat from the said inner surface of the electro-conductive member of the bus-bar structure and being arranged in exposed relation to be swept over by air currents flowing through the said ventilating passage to cause the said air currents to remove by convection the radiant heat absorbed by the said radiant-heat-absorbing surface from the said radiant-heat-emitting surface; the inner radiant-heat-emitting surface being provided with a radiant-heat-emitting coating of relatively-light coloration and the radiant-heat-absorbing member being provided with a radiant-heat-absorbing coating of relatively-dark coloration.

9. A bus-bar structure having a ventilating passage therethrough and having an inner surface provided with a radiant-heat-emitting coating; a radiant-heat-absorbing partition having a radiant-heat-absorbing coating having greater heat-absorbing properties than the first said coating and installed in the bus-bar structure intermediate opposed walls thereof in position to have its coating receive and absorb radiant heat from the radiant-heat-emitting coating of the bus-bar structure and to be swept over by air currents flowing through the ventilating passage therein.

10. A bus-bar structure having a ventilating passage therethrough and also having an inner

radiant-heat-emitting surface; a radiant-heat-absorbing partition installed in the bus-bar structure intermediate opposed walls thereof in position to receive and absorb radiant heat from the inner surfaces of the bus-bar structure and to be swept over by the air currents flowing through the ventilating passage therein; the inner radiant-heat-emitting surface being provided with a radiant-heat-emitting coating of relatively-light coloration and the radiant-heat-absorbing partition being provided with a radiant-heat-absorbing coating of relatively-dark coloration.

11. A one-piece tubular bus-bar having a longitudinal series of spaced-apart air-ingress ports in its lower face and also having a similar series of air-egress ports in its upper face; and a radiant-heat-absorbing partition installed within the bus-bar structure intermediate the respective opposite side-walls thereof and in line with both the said air-ingress and air-egress ports in position to receive and absorb radiant heat from the interior of the tubular bus-bar, and in position to be swept over by the air currents flowing between the said air-ingress and air-egress ports.

12. A one-piece tubular bus-bar having a longitudinal series of spaced-apart air-ingress ports in its lower face and also having a similar series of air-egress ports in its upper face; a partition having each of its respective opposite faces provided with a radiant-heat-absorbing coating and installed in the bus-bar structure intermediate the respective opposite side-walls thereof and in line with both the said air-ingress and air-egress ports in position to be swept over by the air currents flowing between the said ports.

13. A bus-bar structure comprising: a series of laterally-spaced-apart conductor-bars providing ventilating passages therebetween; and a radiant-heat-absorbing member positioned laterally intermediate two of the said conductor-bars and having greater heat-absorbing properties than the latter in position to receive and absorb radiant heat from the adjacent surfaces of the said conductor-bars and in position to be swept over by air currents passing therebetween.

14. A bus-bar structure comprising: a series of laterally-spaced-apart conductor-bars providing ventilating passages therebetween; and a radiant-heat-absorbing member positioned laterally intermediate two of the said conductor-bars in position to receive and absorb radiant heat from the adjacent surfaces of the said conductor-bars and in position to be swept over by air currents passing therebetween, the surfaces of the said conductor-bars facing toward the said radiant-heat-absorbing member being provided with radiant-heat-emitting coatings having greater heat-reflecting properties than the said radiant-heat-absorbing member.

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