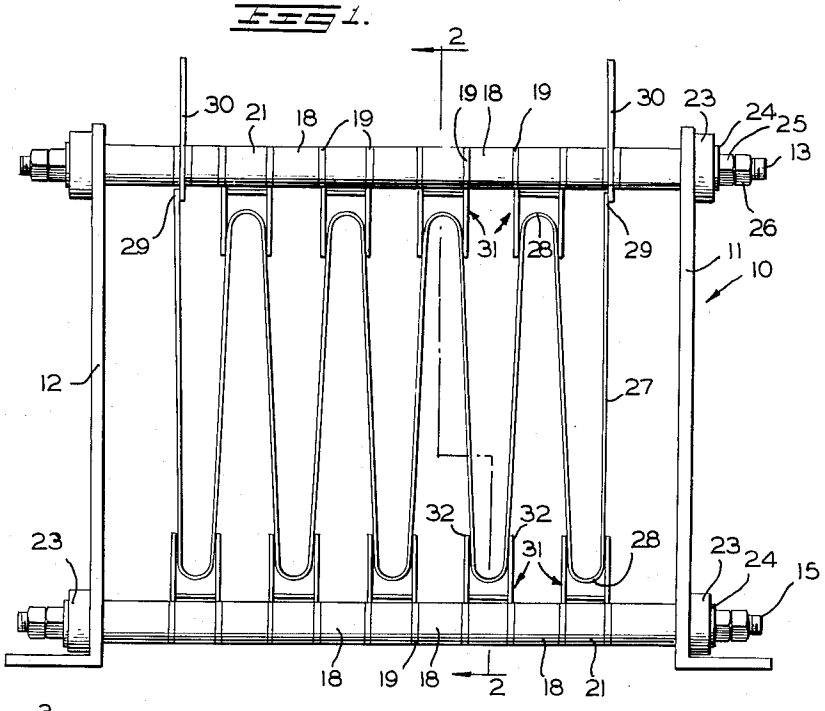
March 27, 1962 R. E. DU BOIS 3,027,532

RESISTOR STRUCTURE

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FIG 1.



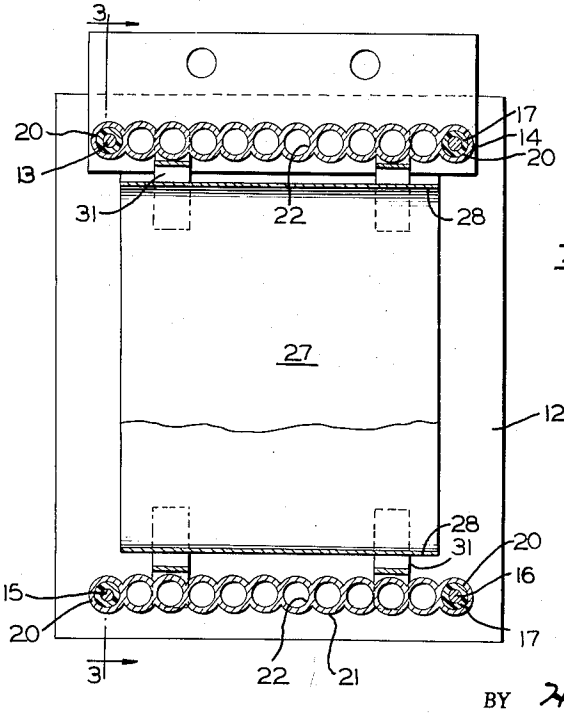


FIG 2.

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RESISTOR STRUCTURE

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Fig 3.

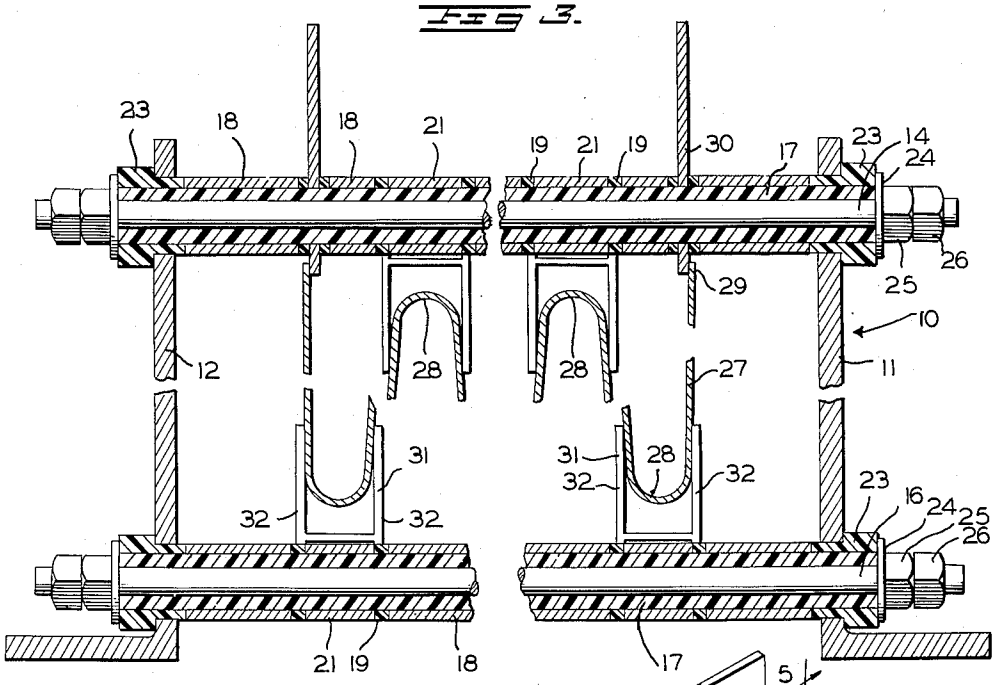


Fig 5.

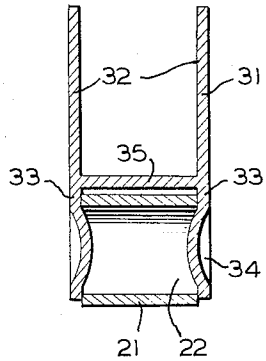


Fig 4

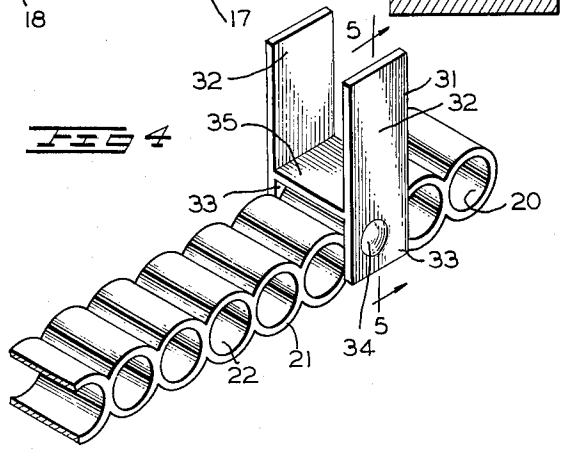
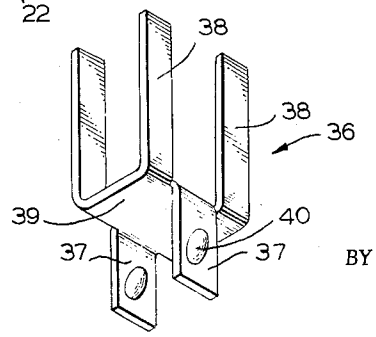


Fig 6.



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RESISTOR STRUCTURE

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Fig. 1.

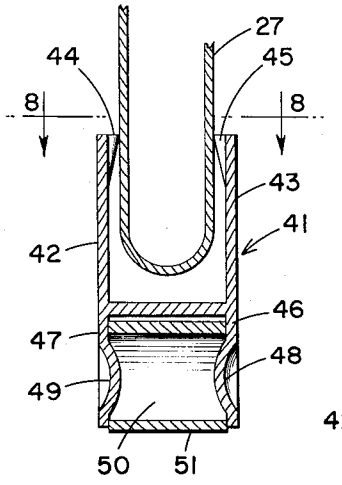


Fig. 3.

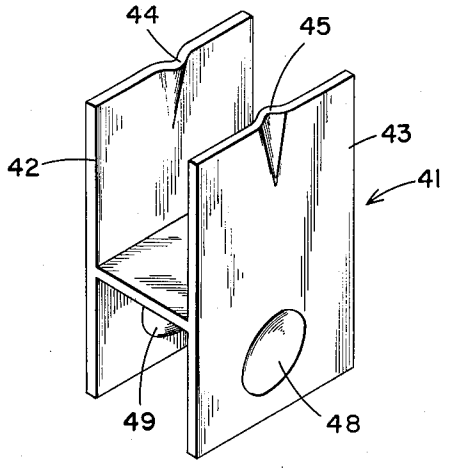
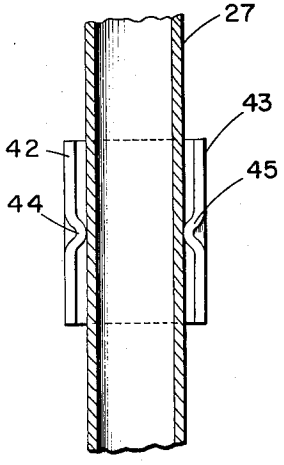


Fig. 2.



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United States Patent Office 3,027,532 Patented Mar. 27, 1962

3,027,532

RESISTOR STRUCTURE

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Filed May 31, 1960, Ser. No. 33,360
13 Claims. (Cl. 338—280)

This invention relates generally to resistor structures and more particularly to an improved supporting structure for a zig-zag type of resistor grid. This application is a continuation-in-part of my prior application Serial No. 848,976 filed October 27, 1959, now abandoned.

The primary object of this invention is to provide an improved supporting structure for a zig-zag grid element.

A specific object of this invention is to provide an efficient, economical, supporting structure for zig-zag grid elements which will permit normal expansion and contraction of the grid in its supported position.

A further object of this invention is to provide an improved, economical supporting element for a zig-zag resistor grid in a resistor structure.

Another object of this invention is to provide a supporting structure for zig-zag grid elements in a resistor structure in which the supporting structure is readily adaptable to grids of different widths and lengths without requiring substanial part changes in the structure.

A further object of this invention is to provide an economical combination of frame members for resistor structures which is readily suitable to supporting zig-zag grid elements of various widths.

Another object of this invention, in a modified form, is to provide an improved resistor grid supporting clip for resistor structures.

With the foregoing and other objects in view, the invention resides in the following specification and appended claims, certain embodiments and details of construction being illustrated in the accompanying drawings in which:

FIGURE 1 is a view in front elevation of the resistor structure comprising the invention;

FIGURE 2 is a sectioned view of the invention taken along the lines 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary, sectioned view in front elevation of the invention;

FIGURE 4 is a perspective view of the combined frame member and clip support structure for the grid of the invention;

FIGURE 5 is a sectioned view taken along the lines 5—5 of FIGURE 4;

FIGURE 6 is an angular view of a modified form of clip for the grid support member of this invention;

FIGURE 7 is a sectioned view in front elevation of a modified and preferred form of grid supporting clip, illustrating a fragmentary portion of a grid supported in standoff relationship;

FIGURE 8 is a sectioned view taken along the lines 8—8 of FIGURE 7; and

FIGURE 9 is a perspective view of the clip of FIGURES 7 and 8.

Referring more particularly to the drawings the resistor structure **10** is illustrated as including frame members **11** and **12** rigidly interconnected by two pairs of spaced bolts **13** and **14** and **15** and **16**, each pair of which lies in a spaced, substantially parallel plane to the other pair. Surrounding each bolt over its length is an insulating sleeve **17** of suitable insulating material such as mica. Telescoped over the sleeves **17** are regularly positioned tubular spacers **18**, insulating washers **19** and the end openings **20** of grid supporting, tranvserse frame members **21**. The frame members **21**, which are clearly illustrated in FIGURES 2 and 4, preferably are formed by an aluminum extrusion and include a plurality of openings **22** between the end openings **20** for a purpose to be described. Thus during assembly, depending on the overall, desired length of the structure, a plurality of spacers **18**, washers **19** and frame members **21** are assembled in a similar fashion along each pair of frame bolts **13** and **14** and **15** and **16** over the sleeves **17**. The projecting ends of the bolts are then capped with insulating grommets **23**, retaining washers **24** and nuts **25** and **26**. Obviously, upon tightening of the nuts, a rigid over-all frame structure is obtained.

Within the confines of the bolt and end frame members is mounted a zig-zag resistor grid **27** of suitable resistor material. The grid **27** as illustrated is formed from a single piece of material, and is folded into a plurality of spaced sections with open, curved junctures **28**. Each end **29** of the grid **27** is secured by suitable means such as welding to a terminal strap **30** which is rigidly clamped about bolts **13** and **14** between insulating washers **19** during the assembly of the frame. In order to support and position the folded sections of grid **27**, each transverse frame member **21** is provided with a grid juncture engaging clip **31** having a substantially H-shaped cross section. The preferred form of clip is cut from an aluminum extrusion and includes spaced, upwardly extending grid engaging legs **32** and spaced downwardly extending legs **33** to be selectively attached to transverse members **21**. Depending upon the width of the grid **27**, one or more such clips **31** may be utilized. As illustrated in FIGURE 2, two such clips are provided on each member **21** in spaced relationship to support the grid **27**. Once the particular width of a resistor grid **27** to be utilized is known, the downwardly extending legs **33** are dimpled or otherwise deformed inwardly at **34**, FIGURE 4, to firmly attached the clip **31** to a selected opening of the plural openings **22** of transverse frame members **21**. Obviously, the clips are secured to the members **21** prior to general assembly of the resistor structure.

During assembly the grid **27** is positioned within the general confines of the frame members so that the junctures **28** of adjacent grid sections are received between and are supported by the upwardly extending spaced legs **32** of the clips **31** which are longitudinally spaced relative to the resistor frame bolts in their secured positions on the frame members **21**. The length of each folded section of grid **27**, relative to the space between the upper and lower clips **31**, as viewed in FIGURE 1, is such as to normally position the junctures **28** of adjacent grid sections about half the distance between the outer edges of clip legs **32** and the bridging section **35** of the clip **31**. No fixed attachment is made between clip legs **32** and the folded grid sections which are thus supported in such a manner as to permit expansion and contraction of the grid along the length of each section under varying temperature conditions. Thus, while the grid **27** is restrained against transverse movement by the attachment to terminal straps **30**, and the folded sections of the grid are restrained against longitudinal shifting by the clips **31**, each individual folded section is capable of expansion and contraction without buckling or breaking.

FIGURE 6 illustrates a modified form of clip **36**, having one pair of spaced legs **37** for engaging a transverse frame member **21**, and two pairs of spaced, grid engaging legs **38**. Clip **36** is formed from a piece of sheet metal with the legs **37** and **38** being cut and then bent in opposite directions from a bridging section **39**. In securing a clip **36** to a cross member **21** the legs **37** are dimpled or deformed at **40** during assembly to engage an opening **22** in a member **21**.

Referring now to the modified and preferred form of resistor clip **41** in FIGURES 7, 8 and 9, it will be noted that the upstanding legs **42** and **43** are provided with inwardly deformed portions or ridges **44** and **45**. The

ridges 44 and 45 provide point contact with the grid 27 and thereby reduce the tendency of such structures to have hot spots. In other words, the stand-off support between the grid 27 and the clip 41 due to the ridges 44 and 45 is such that cooling air can circulate between the legs 42 and 43 and the grid 27 to preclude or reduce hot spots in the resistor structure. The clip 41 is further provided with downwardly extending legs 46 and 47 which are dimpled at 48 and 49 respectively to engage in passage 50 of a transverse frame member 51. It is obvious, therefore, that the clip 41 permits a free sliding action of grid 27 when expansion and contraction occurs under varying temperature conditions, and also permits maximum cooling of the grid portion within the clip due to the stand-off support provided by ridges 44 and 45.

The advantages of this resistor structure should now be readily apparent to one skilled in the art. The prime advantage is that the various parts of the frame assembly are readily adaptable to supporting grids of different widths and length. Thus by using somewhat longer or shorter frame bolts, a different length grid may be properly with no other part change requirement. Support of grids of different widths than that illustrated is readily accomplished without requiring a part change. The structure is also adaptable to supporting plural grids in side-by-side relationship by the same frame parts. Therefore, once a general range of grid widths, lengths, and folded section lengths is established, frame member parts may be dimensioned and produced as standard items to cover the grid range without the necessity of producing special frame parts at high cost for special resistor requirements.

Thus it is seen that this invention provides a resistor structure which provides a novel and useful manner of supporting a grid with attendant production economies. It is realized that the construction may be subject to various obvious modifications, and it is intended that the inventor be only limited to a liberal interpretation of the specification and the appended claims which would cover such obvious modifications.

I claim:

1. A resistor structure comprising a pair of frame members, means interconnecting said frame members and holding them in rigid spaced relationship, said interconnecting means including two pairs of spaced insulated bolts lying in planes normal to the frame members and normal to a plane taken longitudinally of the structure through the members, a plurality of transverse frame members interconnected between the spaced bolts at spaced intervals along the longitudinal dimension of the bolts, each said transverse member having a plurality of openings, grid supporting clip means secured to each of the transverse frame members in selected openings of said members, and a zig-zag resistor grid carried by the clip means.

2. The invention according to claim 1 wherein the grid is carried by the clip means in free sliding relationship therewith.

3. The invention according to claim 1 wherein each clip means is provided with a ridge to engage and support the grid in stand-off relationship.

4. A resistor structure comprising a pair of frame members, means interconnecting said frame members and holding them in rigid spaced relationship, said interconnecting means including two pairs of spaced insulated bolts lying in planes normal to the frame members and normal to a plane taken longitudinally of the structure through the members, a plurality of transverse frame members interconnected between the spaced bolts at spaced intervals along the longitudinal dimension of the bolts, each said transverse member having a plurality of openings, at least one H-shaped clip, including pairs of legs extending oppositely from a bridging section, secured to each transverse member by having one pair of clip legs deformed into rigid engagement with the member within the confines of one of the member openings, and a zig-zag resistor grid freely supported within the frame members by the nonconnected legs of said clips.

5. The invention according to claim 4 wherein said nonconnected legs of said clips are provided with ridges to engage and support the grid in a point contact, stand-off relationship.

6. A resistor structure comprising a pair of frame members, means interconnecting said frame members and holding them in rigid spaced relationship, said interconnecting means including two pairs of spaced insulated bolts lying in planes normal to the frame members and normal to a plane taken longitudinally of the structure through the members, a plurality of transverse frame members, each said transverse member having a plurality of openings therethrough, said bolts being interconnected with said transverse members by extending through spaced openings in said members, at least one H-shaped clip, including pairs of legs extending oppositely from a bridging section, secured to each transverse member by having one pair of clip legs deformed into rigid engagement with the member within the confines of one of the member openings, and a zig-zag resistor grid freely supported within the frame members by the nonconnected legs of said clips.

7. A resistor structure comprising a pair of frame members, means interconnecting said frame members and holding them in rigid spaced relationship, said interconnecting means including two pairs of spaced insulated bolts lying in planes normal to the frame members and normal to a plane taken longitudinally of the structure through the members, a plurality of transverse frame members, each said transverse member having a plurality of openings therethrough, said bolts being interconnected with said transverse members by extending through spaced openings in said members, at least one clip having a grid engaging portion and a transverse member engaging portion with the member engaging portion being deformed into rigid engagement with the member within the confines of one of the member openings, and a zag-zig resistor grid supported in a restrained, sliding relationship by the grid engaging portions of the clips within the frame members.

8. A resistor structure comprising a pair of frame members, means interconnecting said frame members and holding them in rigid spaced relationship, said interconnecting means including two pairs of spaced insulated bolts lying in planes normal to the frame members and normal to a plane taken longitudinally of the structure through the members, a plurality of transverse frame members, each said transverse member having a plurality of openings therethrough, said bolts being interconnected with said transverse members by extending through spaced openings in said members, at least one H-shaped clip, including a pair of grid engaging legs and a pair of member engaging legs, secured to each transverse member by having the member engaging legs deformed into rigid engagement with the member within the confines of one of the member openings, and a resistor grid formed of a strip of resistance material bent into a plurality of spaced folded sections, the grid engaging legs of each clip engaging and supporting the juncture of a pair of adjacent grid sections in a restrained, sliding relationship.

9. A resistor structure comprising a plurality of members having openings therein and interconnected to form a rigid frame, a plurality of clips, including a pair of grid engaging legs and a pair of member engaging legs, secured to certain of said frame members by having the member engaging legs deformed into rigid engagement with the openings of the frame members, and a resistor grid supported by the grid engaging legs of the clips, and means carried by said clips to engage said resistor grid with a slidable point contact.

10. The invention according to claim 9 wherein said

last mentioned means comprising ridges formed in the grid engaging leg.

11. A resistor structure comprising a plurality of members interconnected to form a rigid frame, certain of said members being provided with a plurality of openings therethrough, a plurality of clips, each clip including a grid engaging portion and a member engaging portion and each clip being connected to a member with openings by having the member engaging legs deformed into rigid engagement with the member within the confines of one of the member openings, and a resistor grid having folded sections, each such section being supported in and by the grid engaging portions of a clip in a restrained, sliding relationship.

12. The invention according to claim 11 wherein each grid engaging portion of a clip is provided with a ridge to engage and support the grid in a point contact, stand-off relationship.

13. A resistor structure comprising a plurality of members interconnected to form a rigid frame, certain of said

members being provided with a plurality of openings therethrough, a plurality of H-shaped clips, each clip including a pair of grid engaging legs and a pair of member engaging legs and each clip being connected to a member with openings by having the member engaging legs deformed into rigid engagement with the member within the confines of one of the member openings, and a resistor grid having folded sections, each such section being supported between the grid engaging legs of a clip in a restrained, sliding relationship.

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