(No Model.)

W. H. BRISTOL & W. E. GEYER.

DIFFERENTIAL EXPANSION DEVICE FOR GALVANOMETERS.

No. 383,095. Patented May 22, 1888.

Fig. 1.

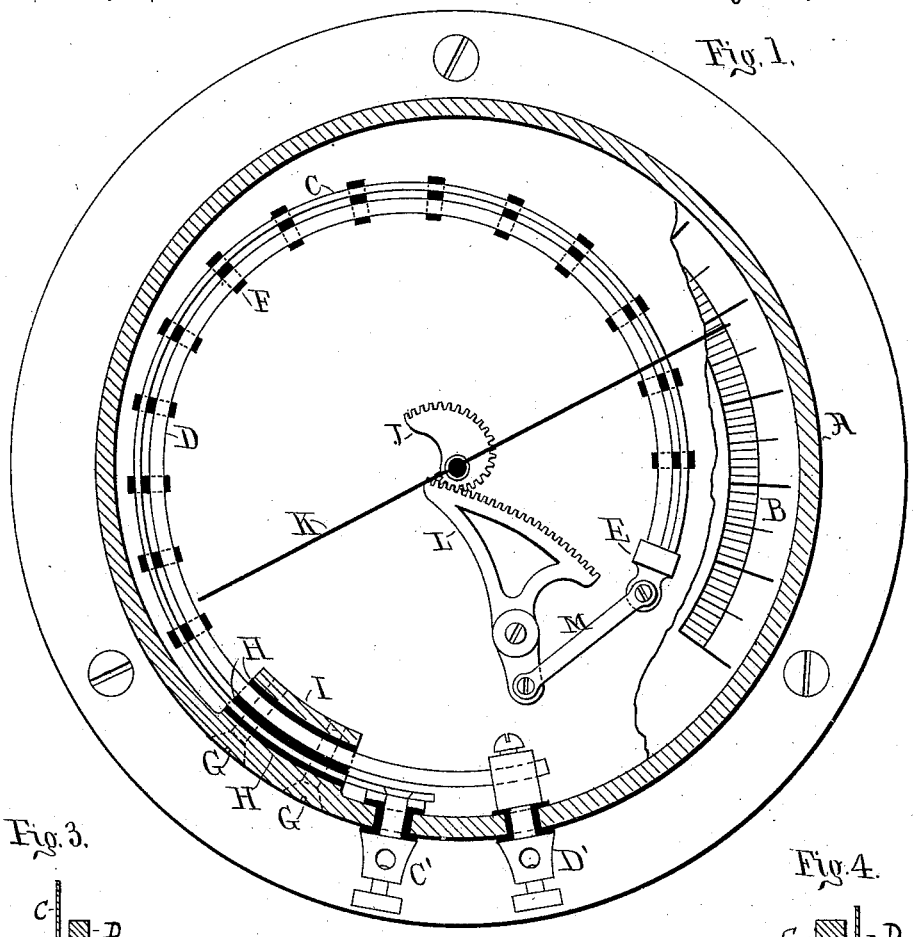


Fig. 3.

Fig. 4.

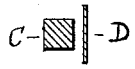


Fig. 2.

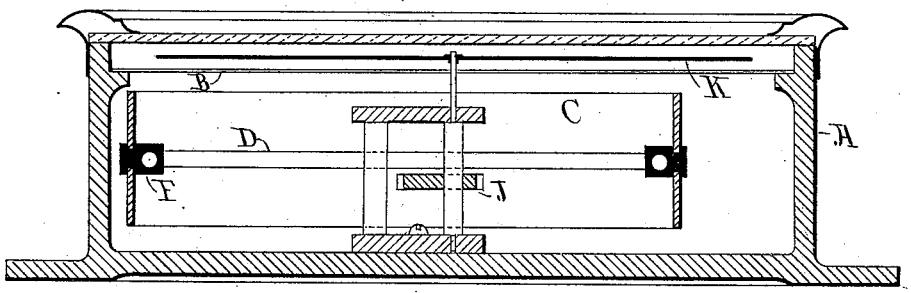
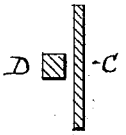


Fig. 5.



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DIFFERENTIAL EXPANSION DEVICE FOR GALVANOMETERS.

SPECIFICATION forming part of Letters Patent No. 383,095, dated May 22, 1888.

Application filed February 24, 1888. Serial No. 265,146. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM H. BRISTOL and WILLIAM E. GEYER, citizens of the United States, residing at Hoboken, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Differential Expansion Devices, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

This invention consists in a device similar in its purposes and uses to the differential expansion-bars heretofore in use for various purposes, such as indicating strength of an electric current, controlling the feed of an electric lamp, and the like.

These devices have heretofore been made by soldering or securing together two metals having different coefficients of expansion, so that when heated by the passage through them of an electric current the unequal rates of expansion will bend the bar, or, in case of a spiral, cause it to unwind.

These devices are all open to the objection that they are affected by the temperature of the surrounding air, and when used in instruments of any degree of delicacy they must be adjusted according to the temperature in which they are used, or some compensation must be made for the differences of position or deflection which varying temperatures cause.

To avoid this objection is the main object of our present invention. We accordingly construct a compound arm, bar, or equivalent device of one metal, or of two metals having the same coefficients of expansion, insulating from one another the two parts of which it is composed, except at one end, and making them of such relative shape or size as to be differently heated and expanded by a current of the same strength. For example, we connect electrically at one end two strips of brass or steel—one of larger cross-section than the other—and by suitable insulating-fastenings secure them together at various points. A given current then passed through these strips in series will raise the strip of smaller cross-section to a higher temperature than the other and produce in it a greater degree of expansion with the effect of bending or deflecting the compound bar. Such a device, it will be seen, is independent of surrounding temperature, for both parts or sides of the bar by any external changes of temperature will be equally and similarly effected. The same result may also be obtained by a compound bar or its equivalent when the two parts, combined or secured in a similar manner, are composed of the same metals, or of any two metals having the same coefficient of expansion, and when the said two parts are of the same cross-section, but different radiating-surface or of different cross section and different radiating-surface.

The details of the construction of this invention are illustrated in the accompanying drawings.

Figure 1 is a plan view of the invention as applied to a current-indicating device, a portion of the dial being removed. Fig. 2 is a central cross-section of the instrument. Figs. 3, 4, and 5 are cross-sections of the compound bar, showing in detail modifications of the relative sizes and shapes of the two metallic conductors.

Let A represent the case of an ordinary kind having a dial-plate, B, marked off with the proper graduations.

C D designate the two parts or elements of the compound or differential expansion device. In the present case they are united at one end by a metallic head, E, and secured together at various points by insulating-fastenings F. The differential bar is secured to the inner wall of the case A, or to any other suitable support, by screws G, insulating-strips H, and metal plate I. The ends of the parts C D are connected, respectively, to binding-posts C′ D′. The differential bar may have many shapes, as will be well understood. We prefer, however, to bend it in substantially the form shown with the less expansible part on the outside. This last-named part, too, it is desirable to make in such form that its moment of bending will be as small as practicable. We therefore make it as a flat strip or band, and the other part, D, as a round wire or bar.

When the current is passed through the two parts C D in series, the part D is raised to a higher temperature than C, and its expansion being greater the compound bar is bent with a tendency to straighten out. This movement may be utilized to shift a pointer over a scale either directly or by intermediate multiplying

mechanism, and in case the movements of the bar are not proportional to the variations in current strength, the multiplying or similar devices may be made to compensate for such movement and produce equal deflections of the needle for equal increments of current strength. For this purpose we may use a toothed cam, J, on the spindle, which carries the needle K, and a sector, L, of requisite shape to mesh with the cam. The sector J is pivoted and connected to the differential expansion device by a link, M.

As above stated, the relative character of the two component parts of the expansion device may differ. In Fig. 3 the two parts have the same cross-section; but the less expansible part has a greater radiating-surface. In Fig. 4 the two parts are shown as having the same radiating surface, but the less expansible part being of greater cross-section than the other. Lastly, the less expansible part may have both greater radiating-surface and greater cross-section, as shown in Fig. 5.

It will be understood that either or both of the parts C D may be divided into two or more smaller parts or longitudinal sections, and that in the practical application of the invention the casing or its equivalent should be well ventilated.

The expansion device may be in any of the forms in which the bimetallic bars or devices have heretofore been made. For example, the bar may be straight, circular, or twisted; or one of the component elements may be straight and the other curved, and the insulating-fastenings may be omitted; but these are all matters of common knowledge to those skilled in the art. We would also state that inasmuch as the results obtained by the use of this instrument are due to the excess of the heating effect of an electric current upon one portion of the bar or its equivalent over the other, it is in a measure immaterial to the principle of the invention whether the current which produces the differences in temperature be caused to heat the two parts directly or indirectly. For example, the more expansible part, in lieu of being included directly in the circuit, may be arranged in close proximity to but insulated from a wire or conductor which is heated by the current. The other part or element may be in the circuit or not; but in either case formed or arranged to be less sensibly heated than the other. It will readily be seen, however, that to heat one or both of the parts of the device in this manner would be clearly equivalent to connecting them both in series in an electric circuit.

This invention is capable of a great many uses and applications, and we do not limit ourselves to the details of the construction or application herein described; but

What we claim is—

1. A compound or differential expansion bar or device composed of two parts secured together in series, and both having the same coefficient of expansion, but differently susceptible to the heating effect of an electric current passed through them, as set forth.

2. A compound or differential expansion device composed of two strips or conductors secured together in series, and both composed of the same metal, but differing in cross-section, or radiating-surface, or both, as set forth.

3. In a compound or differential expansion bar or device, the combination, with two metal strips or parts having each the same coefficient of expansion and united at one end, of insulated fastenings securing at intervals the two parts together and electrical terminals for passing a current through the parts in series, as set forth.

4. A differential expansion device consisting of two conductors, both having the same coefficient of expansion secured together but insulated, except at one end, one being in the form of a flat strip and the other in the form of a rounded bar or wire, as set forth.

5. The combination, with a differential expansion-bar composed of two conductors connected in series and having the same coefficient of expansion, but differently susceptible to the heating effect of an electric current passed through them, of a scale and pointer, and intermediate mechanism for imparting movements of the bar to the pointer, as set forth.

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