July 24, 1956 H. SCHWARTZ 2,756,307

VARIABLE RESISTOR

Filed Sept. 1, 1953

Fig. 1.

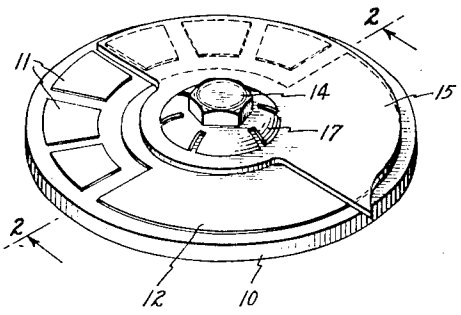
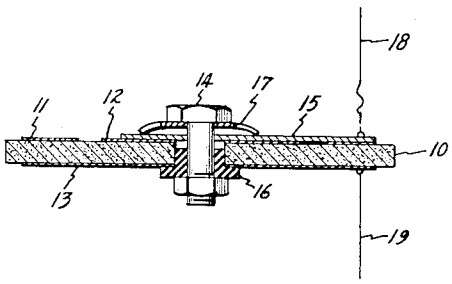


Fig. 2.



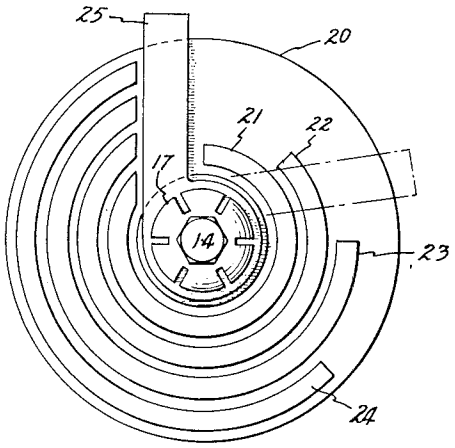


Fig. 3.

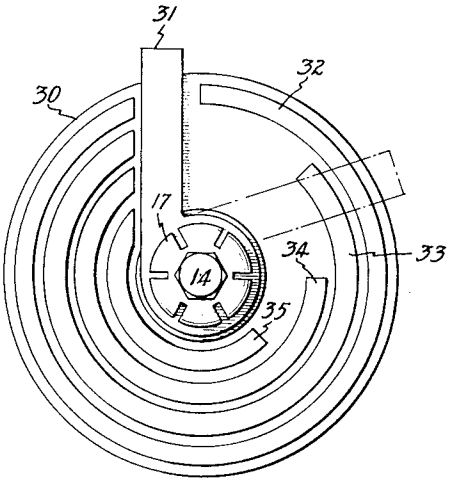


Fig. 4.

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VARIABLE RESISTOR

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5 Claims. (Cl. 201—55)

This invention relates to a resistor, and more particularly, to a variable resistor.

In most fields of electrical components precision parts command premium prices. Ordinarily, where a customer requires a narrower electrical tolerance than the standard product, the additional cost can be economically justified by the customer. However, in the resistor business wide electrcial tolerances are necessary for an economic manufacturing yield. Thus, in the manufacture of a batch of non-linear resistors having a narrow customer specified electrical tolerance, too many resistors of the batch do not have said narrow electrical tolerance but a wider electrical tolerance, and therefore must be discarded.

Accordingly, it is an object of this invention to provide an adjustable or variable resistor whereby narrow electrical tolerances can be obtained.

My invention comprises a variable resistor comprising a piece of resistance material having various shapes and numbers of isolated resistance material portions therein, said portions being an integral part of said piece.

My invention further comprises a variable or adjustable non-linear resistor comprising a piece of non-linear resistance material having various shapes and numbers of isolated non-linear resistance material portions therein, said portions being an integral part of said piece.

The invention will be better understood by considering the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a perspective view of one form of my invention. Fig. 2 is a sectional side view of the variable resistor shown in Fig. 1, the section being taken along the line **2—2** of Fig. 1. Fig. 3 is a top view of another form of my invention. Fig. 4 is a top view of still another form of my invention. Like reference numerals in the various figures refer to identical parts.

Referring now to the drawing, and more particularly to Figs. 1 and 2, shown therein is one form of an adjustable or variable resistor comprising a piece or disk **10** of non-linear resistance material. By a non-linear resistance material I mean a material which will present a low resistance when subjected to a high voltage and which will present a high resistance when subjected to a comparatively low voltage. Such a resistance material is well known in the prior art and one form thereof and method of making same is shown and described in Patent 1,822,742, issued September 8, 1931, to K. B. McEachron and assigned to the same assignee as the instant application. However, as will be more clear hereinafter, my invention is also applicable to a linear resistor wherein piece or disk **10** would be constructed out of a linear resistance material.

Various configurations and numbers of isolated non-linear resistance material portions are formed within the piece **10**. Said isolated portions are an integral part of piece **10**, and can be formed by various methods. A well known process that can be employed is the Schoop process. Thus, conducting coatings **11**, **12** are applied to predetermined areas of the upper surface of piece **10**. Also, a conducting coating **13** is applied to the opposite side or bottom surface of the piece or disk **10**.

By viewing Fig. 2, it will be readily apparent to those skilled in the art that the portions of piece 10 immediately superposed by coatings **11** and **12** are isolated from each other. For instance, if two leads from an electrical source are connected to one of the isolated coatings **11** and the coating 13 current will be uniformly distributed within coating **11**. Said current will flow from coating **11** in a path substantially perpendicular to coating **11** towards coating **13**. Substantially no current will flow in a path that is not substantially perpendicular to coating **11** since this represents a path longer and of greater resistance than a path perpendicular to coating **11**. Accordingly, the areas **11**, **12** are isolated from each other by the integral portions of piece **10** positioned between areas **11**, **12**.

Within piece or disk **10** is formed a central aperture. Disposed within said aperture is a bolt or pin **14**. Said bolt or pin **14** carries a contact means or plate **15** which is cooperative with piece **10** and isolated portions **11**, **12** whereby different combination of said isolated portions can be connected electrically in parallel. Bolt or pin **14** is insulated from the non-linear resistance material piece or disk **10** by an insulating material gasket or bushing **16**.

Surrounding pin **14** and disposed between the head of pin **14** and contact plate **15** is a spring element or washer **17** whereby when a nut is turned down on the threaded end of pin **14** the contact plate **15** will be urged against the coatings **11** and **12** for intimate broad surface contact therewith. Electrical leads **18** and **19** can be connected to contact means **15** and coating **13** respectively by soldering or the like whereby the piece **10** can be placed in an electrical circuit.

It will now be apparent that I have provided a device whereby the wide electrical tolerances incurred in manufacturing a batch of linear or non-linear resistors can be reduced. For instance, in manufacturing a batch of non-linear resistors those units of the batch that have a wider electrical tolerance than the narrow electrical tolerances specified by the customer no longer need be discarded. By schooping a predetermined portion or portions of the non-linear resistance material piece and placing plate **15** in contact with one or more of said portions a narrower electrical tolerance can be attained. Accordingly, my invention has effected a substantial cost reduction in the manufacture of non-linear resistors having narrow electrical tolerances.

Furthermore, I have provided an adjustable and variable resistor. Depending upon the position of contact means **15** the resistance of the non-linear resistor **10** can be varied. That is to say, different combinations of schooped portions **11** and **12** can be electrically connected in parallel whereby the effective resistance of piece **10** can be varied. Viewing Fig. 1, upon a 90 degree clockwise rotation of contact means **15** it will be seen that only the schooped portion **12** will be placed in the electrical circuit. If the contact means **15** is rotated 90 degrees counterclockwise then all the schooped areas **11** are placed in the electrical circuit. Also, by partial rotation of the contact means 15 the schooped area 12 and one or more of the schooped areas **11** can be placed electrically in parallel.

Referring now to Figure 3, shown therein is another form of my invention wherein the adjustable non-linear resistor comprises a flat circular disk **20** of non-linear resistance material. Formed on the disk **20** are a plurality of isolated concentric arc-like schooped portions **21**, **22**, **23**, and **24**. The contact means comprises a flat elongated arm **25**. By rotating arm **25** clockwise one or more of the isolated concentric arc-like schooped portions **21**, **22**,

23 and 24 may be placed in parallel whereby the effective resistance of the disk 20 can be adjusted.

Referring to Fig. 4, shown therein is still another form of my invention wherein the adjustable non-linear resistor comprises a flat circular disk 30 of non-linear resistance material having a flat elongated contact arm 31 movable over the upper surface of said disk 30. Within disk 30 are formed isolated concentric arc-like schooped areas 32, 33, 34 and 35 which have a different configuration and arrangement from the isolated schooped areas shown in Fig. 3 whereby it will be obvious that the resistance of the non-linear resistance material disk 30 can be adjusted at different increments depending upon the configurations and number of the isolated schooped areas.

While there have been shown and described particular embodiments of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and that it is intended by the appended claims to cover all such changes and modifications as fall within the true scope and spirit of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A variable non-linear resistor comprising a flat disk of non-linear resistance material, a plurality of isolated predetermined areas of the upper surface of said disk having a conducting coating applied thereto, the bottom surface of said disk having a conducting coating applied thereto, and rotatable contact means cumulatively engageable with said plurality of coatings on said upper surface.

2. A variable resistor comprising a flat disk of resistance material, a plurality of isolated predetermined areas of the upper surface of said disk having a conducting coating applied thereto, the bottom surface of said disk having a conducting coating applied thereto, and contact means cumulatively engageable with said plurality of coatings on said upper surface.

3. A variable resistor comprising a body of resistance material, a plurality of isolated predetermined areas on one side of said body having a conducting coating applied thereto, another side of said body having a conducting coating applied thereto, all of said conducting coatings electrically isolated each from the other, and contact means adapted to engage either at least one of said one side plurality of coatings singly or engageable with at least two of said one side plurality of coatings simultaneously.

4. A variable resistor comprising a disk of resistance material, a plurality of isolated radially extending predetermined areas on one side of said disk having a conducing coating applied thereto, the other side of said disk having a conducting coating applied thereto, all of said conducting coatings electrically isolated from each other, and contact means additively engageable with said one side plurality of coatings.

5. An adjustable resistor comprising a disk of resistance material, a plurality of isolated generally concentric and arc-like predetermined areas on one side of said disk having a conducting coating applied thereto, the other side of said disk having a conducting coating applied thereto, all of said conducting coatings electrically isolated from each other, and contact means additively engageable with said one side plurality of coatings.

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