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G. M. BARROW ET AL

2,253,318

IMPEDANCE DEVICE

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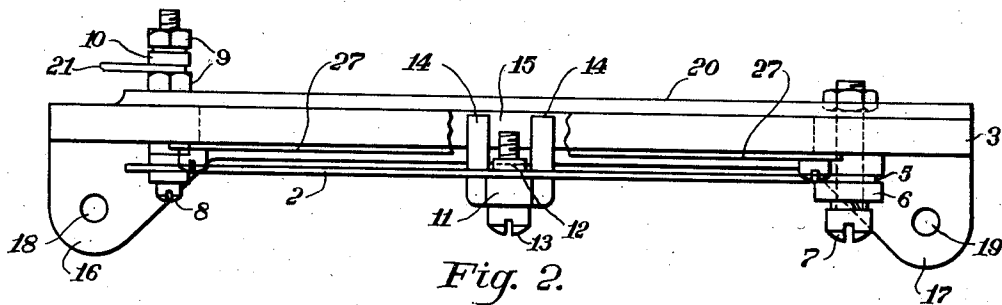


Fig. 2.

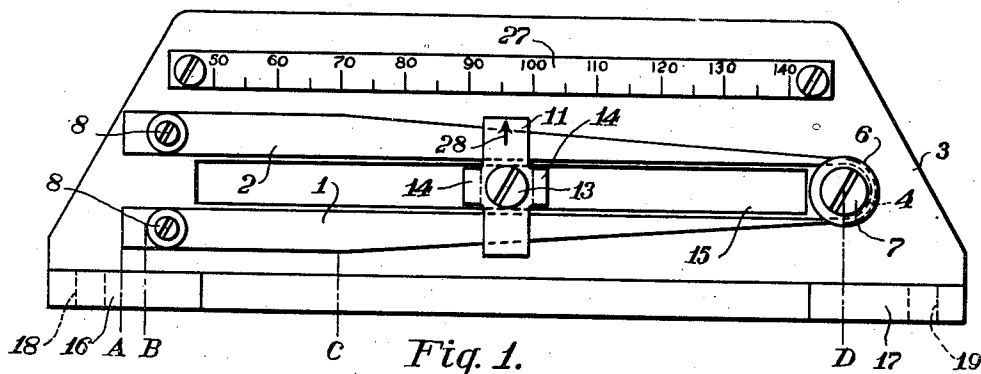


Fig. 1.

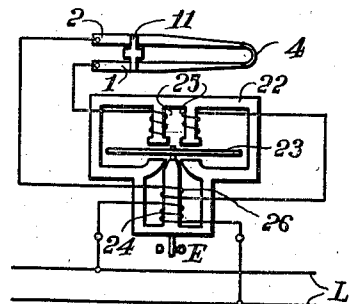


Fig. 4.

WITNESSES:
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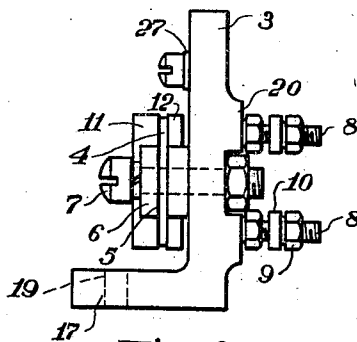


Fig. 3.

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IMPEDANCE DEVICE

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3 Claims. (Cl. 201—62)

This invention relates to an impedance device, and it has particular relation to an adjustable impedance having a wide range of adjustment.

In many applications, an impedance not only must have a large current-carrying capacity, but it must have a wide range of adjustment within reasonably small space limitations. Such requirements are in conflict. If an impedance is designed with a high current-carrying capacity, in order to secure a suitable range of adjustment the impedance must be of a size that is larger than practical. Conversely, if the impedance is designed to have a large range of adjustment and still be compact, its current-carrying capacity ordinarily is so low that the resistance will burn out under many applications.

We have found it possible to reconcile these conflicting requirements and design an impedance that has a high current-carrying capacity at low adjustments and has an extended range of adjustment without being unduly large. In accordance with our invention, an impedance is employed having a tapering cross-section. For low values of impedance, that portion is used which has a large cross-section. For higher values of impedance, that portion having a smaller cross-section is brought into the electrical circuit and provides a high impedance within a small space. Because its higher value of impedance limits the current flowing through the impedance, the smaller cross-sections may be introduced into the circuit without resulting in a failure of the impedance because of excessive temperatures. Additionally, we provide the impedance with increased heat dissipating means preferably by extending the impedance element itself past its contact terminals to provide free heat radiating portions.

It is, therefore, an object of our invention to provide a compact impedance having a wide range of adjustment.

It is another object of our invention to provide an impedance with heat dissipating means.

It is a further object of our invention to provide an impedance having a large current-carrying capacity at low values of the impedance and an extended range of adjustment.

It is a further object of our invention to provide a relay with a calibrating impedance having a range of adjustment sufficient for the relay and having an adequate current carrying capacity over the entire range of adjustment.

Further objects of our invention will be apparent from the following description taken in conjunction with the accompanying drawing, in which:

Figure 1 is a view in elevation of an impedance designed in accordance with our invention;

Fig. 2 is a view in top plan with parts broken away of the impedance shown in Fig. 1;

Fig. 3 is a view in end elevation of the impedance shown in Figs. 1 and 2; and

Fig. 4 is a diagrammatic view of the impedance of Figs. 1 to 3 associated with a relay.

Referring to the drawing, we have shown an assembly including an impedance arm 1 which, as shown, has a cross-section which varies from a large value at point C to a relatively small value at point D. In Figure 1, the impedance has a uniform thickness, the variation in cross-section being produced by a variation in width. Although this one impedance arm may be employed alone, in order to conserve space, we prefer to employ a second similar impedance arm 2 slightly spaced therefrom and substantially parallel thereto. These impedance arms may be mounted in any suitable way on a base member 3, but we prefer to connect the two arms adjacent the points of small cross-section D by means of a connecting link 4. If the impedance arms 1 and 2 are metallic resistance elements, the link 4 may also be of metal soldered or welded to the arms 1 and 2, or we may form the arms 1 and 2 and the link 4 by cutting the entire unit from a single piece of resistance material. In the specific embodiment shown on the drawing, the link 4 is placed in a groove 5 formed in a sleeve 6 which is fastened to the base by means of a bolt 7 which passes through an opening in the sleeve 6 and in the base 3. The end of each arm is attached to the base by means of a terminal machine screw 8 which passes through an opening provided in each arm and through an opening provided in the base, suitable nuts 9 and washers 10 being provided for fastening the screw in place. The fastening means conveniently may be made of brass.

Variations in the resistance offered by the arms 1 and 2 are effected by a bridge 11 which bridges the two arms and is clamped thereto by a clamping member 12, one or both of which may be of electro-conductive material. The bridge 11 and the clamping member 12 are fastened by means of a machine screw 13 which passes freely through the bridge and is received in a threaded opening in the clamping member 12. Alignment of the bridge is facilitated by two guide fingers 14 formed thereon and received in an elongated channel 15 formed in the base 3. The bridge constitutes an adjustable terminal for each of the arms.

The base 3 conveniently may be formed of insulating material, but if formed of metal the various terminal screws may be insulated therefrom by suitable insulating bushings and washers. As illustrated, the base is provided with two ears 16 and 17, which have openings 18 and 19 therethrough for receiving suitable mounting

screws. Adjacent the elongated channel 15, the base is provided with a raised rib 20 which reinforces the base.

It is believed that the operation of the resistance thus far described is apparent. The resistance is connected to an electrical circuit by means of conductors 21, which are attached to the terminal screws 8. The bridge 11 then may be shifted to any position desired to introduce the correct resistance into the electrical circuit. When the bridge 11 is between the points B and C, the resistance introduced into the circuit is small and, consequently, a high current may flow through the resistance. However, this section of the resistance has a large cross-section capable of carrying the high current, without undue temperatures being reached. In order to restrict further the temperature rise in the resistor, each arm 1 or 2 may be provided with a heat dissipating extension. As shown, this extension is formed by extending each arm beyond its terminal screw for any desired distance, A—B. The greater the distance of extension, the greater the heat dissipating properties added to the arms 1 or 2, but we have found that a distance A—B substantially equal to the width of one of the arms, has produced a beneficial decrease in the maximum temperature reached.

When a higher value of resistance is to be introduced into the electrical circuit, the bridge 11 is moved to the right, as shown in Fig. 1, to a position between the points C and D. Between these two points the resistor has an increased gradient of electrical resistance; that is, a movement of the bridge 11 between the points C and D results in a greater increment in resistance than an equivalent movement between the points B and C. It is obvious that the current-carrying capacity of the resistance arms between the points C and D is lower than that of the arms between the points B and C, but the increased value of the resistance between the former points restricts the current passing through the arms to a value which may be carried safely thereby. Because of the excellent heat dissipating characteristics provided by the wide resistance portions between the points B and C, because of the spacing provided between the arms 1 and 2 and the base, and because of the extensions provided on the arms 1 and 2, the temperature reached by any portion of the resistance, regardless of the position of the bridge 11, is held to a reasonable limit. The flat surfaces of the bridge 11 and arms 1, 2 result in a good contact therebetween.

An impedance constructed in accordance with our invention has proved to be very desirable in a relay, especially one of the induction type. Such relays often require appreciable ranges of adjustment, and the adjustment or calibration device must often carry heavy currents. In the relay illustrated in Fig. 4, a magnetic structure 22 has a plurality of poles for directing magnetic flux through an air gap within which a disk 23, usually of aluminum or copper, is positioned for rotation. In the case of a voltage responsive relay, one of the poles may be energized in accordance with the voltage of a circuit by means of a coil 24 surrounding the pole and connected to the line conductors L of the circuit. A pair of coils 25 surrounding the remaining poles are energized from an auxiliary coil 26 inductively related to the coil 24 in a manner well known in the art.

The structure and operation of the relay thus far described are well known. A spring (not shown) biases the disk 23 against rotation. When the torque produced by the magnetic flux generated by the coils 24, 25 overcomes the torque of the spring, the disk rotates to close or open a pair of contacts E. These contacts may be connected to any circuit to be controlled.

Adjustment or calibration of the voltage at which the relay operates is effected by connecting the arms 1, 2 of the resistance shown in Figs. 1 to 3 in the relay circuit which includes the coils 25, 26. For convenience, the resistance unit is provided with a calibrated scale 27 which may be attached to the base 3 by suitable screws. For a voltage relay, this scale would show the voltage at which the relay operates, an index mark or pointer 28 on the sliding contact or bridge 11 being provided for indicating the operating voltage.

In prior installations it has been necessary to employ an auxiliary external resistance for controlling the relay setting. With our improved design it has been found possible to eliminate this external resistance.

It is obvious that many modifications of our invention are possible. Therefore, we do not desire our invention to be restricted except as required by the appended claims when interpreted in view of the prior art.

We claim as our invention:

1. In an electrical impedance device, a flat ribbon current-carrying resistance element folded for providing a pair of spaced arm portions, each of said arm portions having a small cross-section and width adjacent the fold in said resistance element gradually enlarging to a larger cross-section and width distant from said fold, a separate electro-conductive terminal attached to each of said larger cross-sections, and an electro-conductive member bridging said arm portions and adjustable therealong, said member being designed to engage substantially the entire widths of said arm portions at any point of adjustment thereof.

2. In an electrical impedance device, a current carrying resistance element folded for providing a pair of spaced arm portions, each of said arm portions having a small cross-section adjacent the fold in said resistance element gradually enlarging to a larger cross-section spaced from said fold, a separate electro-conductive terminal attached to each of said larger cross-sections, said arm portions having ends extending for a substantial distance from said terminals, and an electro-conductive member bridging said arm portions and adjustable therealong between the fold and said terminals.

3. In an electrical impedance device, a supporting element, a self-supporting flat ribbon current-carrying resistance having a narrow central portion gradually widening towards the ends of said ribbon resistance, said ribbon resistance being folded around said supporting element for providing substantially parallel spaced arms, said central portion being adjacent said supporting element, a separate electro-conductive terminal attached a substantial distance from each end of said ribbon resistance, and an electro-conductive member bridging said arms and adjustable between said terminals and said supporting element.

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