

Nov. 9, 1954

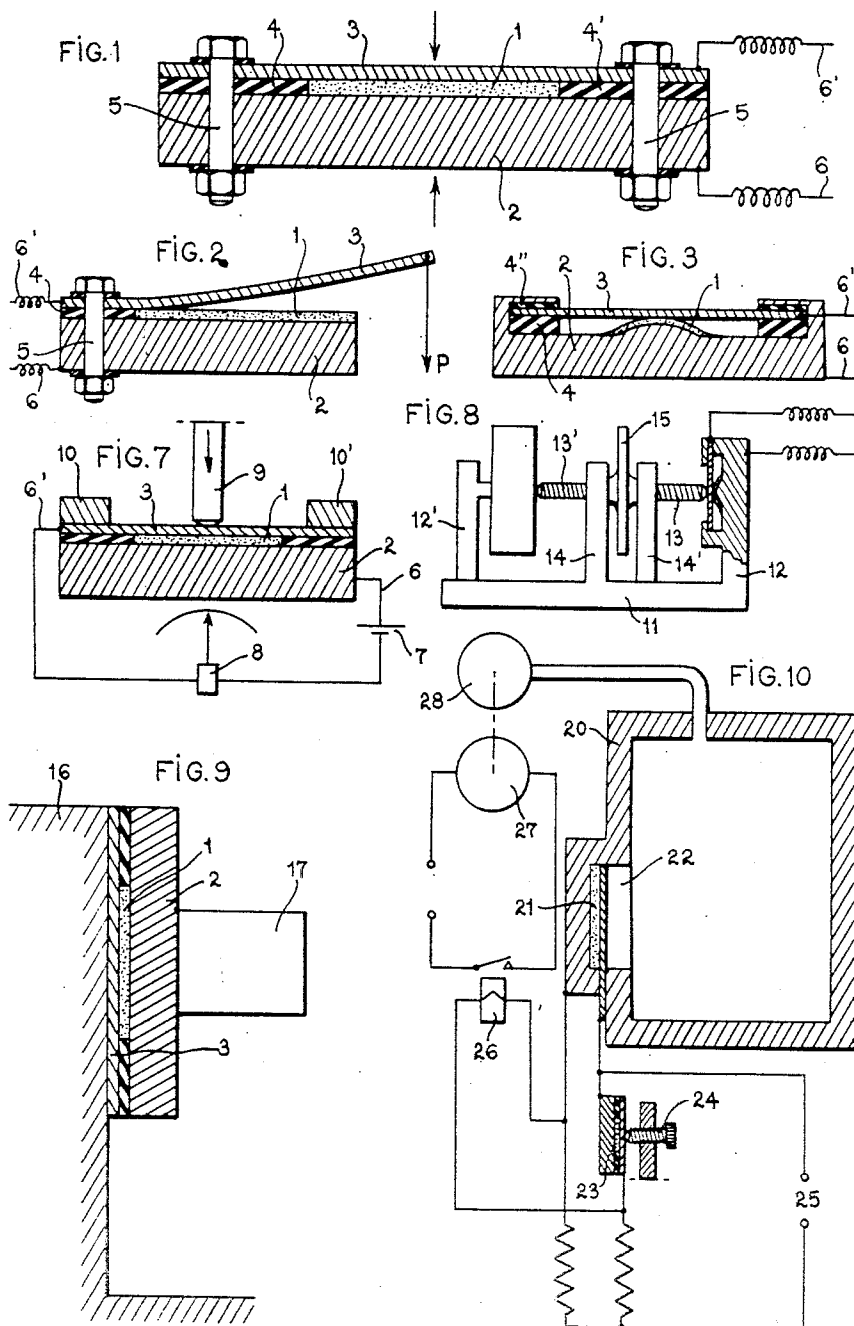
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2,694,128

CONDUCTIVE DEVICE WITH VARIABLE ELECTRIC RESISTANCE

Filed July 11, 1952

3 Sheets-Sheet 1



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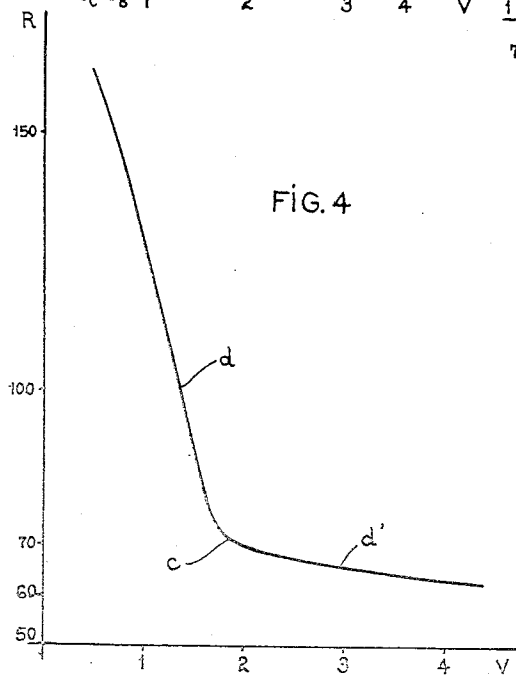
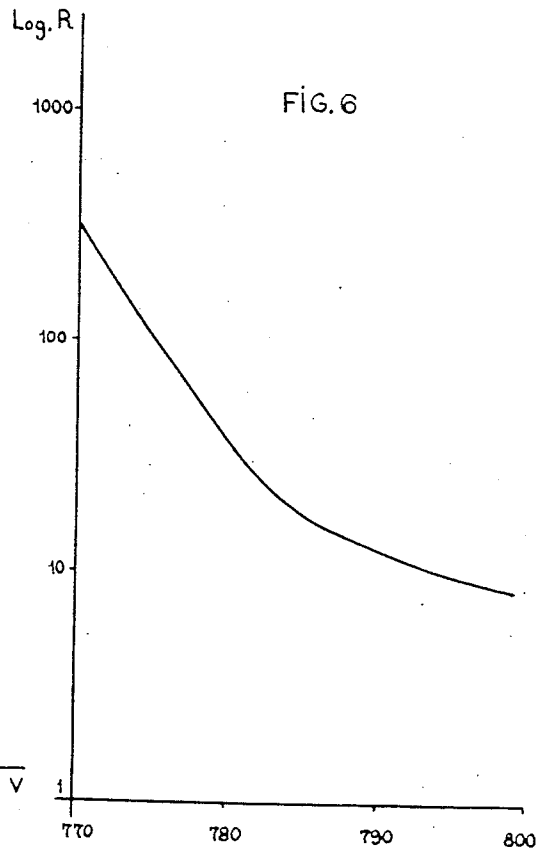
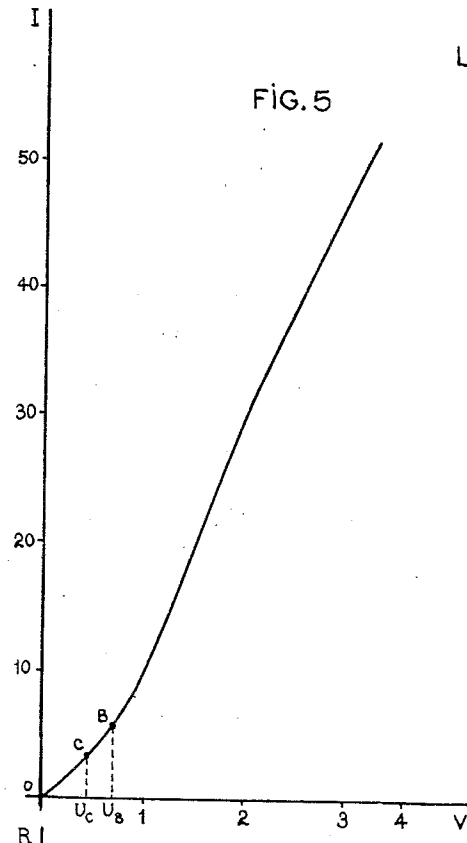
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CONDUCTIVE DEVICE WITH VARIABLE ELECTRIC RESISTANCE

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3 Sheets-Sheet 2



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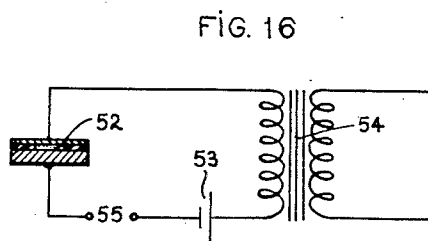
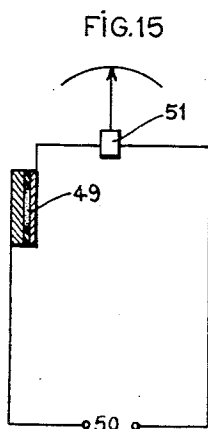
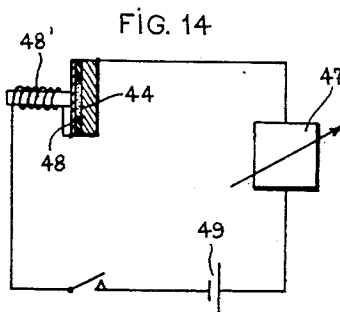
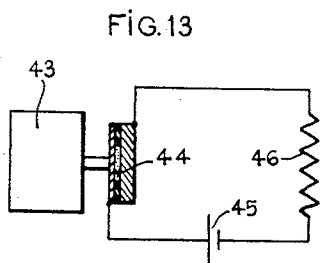
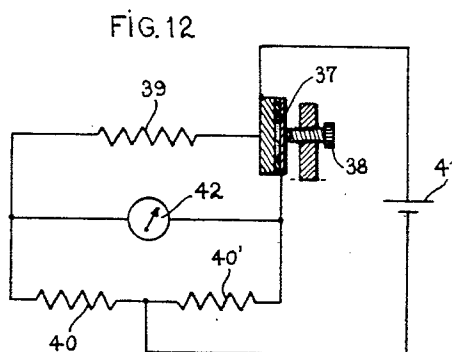
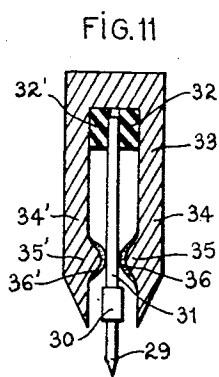
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CONDUCTIVE DEVICE WITH VARIABLE ELECTRIC RESISTANCE

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3 Sheets-Sheet 3



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2,694,128

CONDUCTIVE DEVICE WITH VARIABLE ELECTRIC RESISTANCE

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19 Claims. (Cl. 201—48)

The present invention relates to a conductive device having a variable electric resistance. Attempts have been made since a long time to obtain resistances fitted to vary in relation to the pressure exerted on them or to the applied tension, by using for this purpose rubber, real or synthetic, or an insulating matter having similar elastic properties which were made conductive by the dispersion in the mass of a conductive powdered matter such as carbon, for instance, in the state of lampblack. This conductor can be connected with the utilization circuit by means of metallic electrodes fitted on its ends or on its opposite faces, the resistance of the imperfect contacts between the conductive body and the electrodes varying with the pressure exerted on this body and with the tension applied to the electrodes.

Nevertheless it has been established that the variable resistances made in this way offered drawbacks on account of the hysteresis, that is to say the permanency of the deformations in the rubber and similar materials having a rubber resilience, this hysteresis being as well the cyclic hysteresis resulting from the application to the conductor of a mechanical stress periodically variable as the variation in course of time of the mechanical and electric properties of the conductor, resulting from the permanent set of the material. These drawbacks prevent the use of these conductive rubbers, despite their sensitiveness, in very great many applications in which permanence and reliability are of primary importance.

The present invention has for its object to provide a variable resistance, overcoming the above mentioned drawbacks and characterized in that it consists of a thin strip, having preferably an unchanging thickness, made with an insulating matter possessing a small mechanical hysteresis, a modulus of elasticity greater than 2000 kgs./cm.² in which is scattered the conductive powdered substance, this strip being held with a moderate tightening between the electrodes.

The practice has shown that a device made in this way constitutes a variable resistance having a very high sensitiveness as well for the pressure variations exerted on the electrodes (1% and more for a variation of the pressure of 1 kg./cm.²) as for the variations of the tension applied to the electrodes and without displaying an appreciable hysteresis, offering thereby a good reliability in the course of time.

By way of example, several embodiments of a variable resistance according to the invention are described hereafter and illustrated in the annexed drawing, together with several applications of the resistance, given in a non-limiting way, to illustrate the properties of the device. These applications can be multiplied within the scope of the invention.

Fig. 1 shows, at an enlarged scale, a section of an embodiment of the device according to the invention.

Figs. 2 and 3 show two other embodiments.

Figs. 4, 5 and 6 illustrate, respectively, the curves showing the variations of the resistance in relation to the applied tension, of the current in relation to the tension and of the resistance in relation to the pressure.

Fig. 7 shows an application of the invention to a balance or to a dynamometer.

Fig. 8 shows a precision comparator.

Fig. 9 shows a device to detect and measure vibrations.

Fig. 10 shows the application of the device according to the invention to the distant control.

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Fig. 11 shows a pick-up equipped with a variable resistance.

Fig. 12 is a diagram in which the variable resistance according to the invention is utilized as a regulating rheostat.

Figs. 13 and 14 are diagrams in which the variable resistance according to the invention is utilized to produce electric oscillations.

Fig. 15 shows a voltmeter utilizing the variation of the resistance according to the invention in relation to the applied tension.

Fig. 16 shows a setting to rectify the alternating currents.

In the embodiment shown in Fig. 1, the strip constituting the variable resistance is made of methylmethacrylate into which is scattered a mixture of conductive powdered matters, the exact proportion in weight being as follows:

	Per cent
Methyl-methacrylate	40
Powdered graphite	35
Petroleum black	12.5
Powdered aluminium	12.5

This strip, 1, having a thickness of a few tenths of millimeter is tightened between the central parts of two small metallic plates, made of brass for instance, 2, 3, and between which are disposed, at both ends of the strip 1, two thin insulating strips 4, 4', made of cellulose acetate for instance. The plates 2, 3 are tightened by means of screwclamps 5, 5'. They are, for instance, 30 mm. long and 5 mm. wide or less; the lower plate 2 has a thickness of 1 to 5 mm. or even more, whilst the upper plate 3 has a thickness ranging about a few tenths of a millimeter and is thereby fit, through its elastic deformation, to transfer the applied stresses to the strip 1. Connection wires 6, 6' are welded or otherwise fixed to the plates 2, 3, acting as electrodes.

To make this device, a fluid solution of methylmethacrylate at 5 or 10% in the trichlorethylene is prepared first: the mixture of powdered graphite, petroleum black and powdered aluminium in the above indicated proportions is urged in suspension into the solution. A drop of the solution is poured on the plate 2 the middle part of which is preferably dulled to secure adhesiveness, and distributed on this middle part by a slight balancing. The plate is dried during a few minutes. The two insulating strips 4, 4' are disposed at both ends of the strip 1, the thin plate 3 is placed to cover the strip 1 and strips 4, 4', and the whole is clamped.

In the characteristic resistance to tension of a resistance built as above described, illustrated in Fig. 4, the resistance decreases first continuously according to a pseudo-linear law, and then decreases slower according to another pseudo-linear law. The appearance of this curve shows immediately that the device can be used as a detector or an amplifier for alternating currents.

Fig. 5 shows the corresponding curve of the variations of intensity of the current passing through the resistance, in relation to the tension applied between the electrodes, and Fig. 6 shows the curve of the decreasing resistance in relation to the pressure applied to the upper bendable electrode 3.

Instead of using methylmethacrylate as an insulating elastic matter, it is also possible to use other matters having similar mechanical and electric properties, particularly the cellulose acetate or nitrate, vinyl chloride, polystyrene or other thermoplastics, or also thermosetting plastics such as pheno or amino-plasters, or, to end, ceramic binders or others, used in the vicinity of their elastic deformation zone; the choice results from the confrontation of the elasticity of the body with the sensitiveness and the accuracy required for instance for the foreseen pass-band of vibrations, when the device, in one of the applications which are described later on, is urged to vibrate.

Instead of a plane contact between the conductive matter and the electrode, it is also possible to use a linear or even a pin-point contact, to increase the sensitiveness or the accuracy. The two electrode-plates can also be modified and consist for instance in two discs assembled on their whole periphery.

In the embodiment illustrated in Fig. 2, for instance, the thin plate 3 has, at rest, a semi-cylindrical shape, with generating lines parallel to the plane of the thick plate 2: the clamping is carried on by means of a single screw-clamp at one end; one sees that the action of the force "P," at the other end, will tend to increase the contact area.

In the embodiment of Fig. 3, the electrode-plates are circular and set together, the insulating of the plate 2, on the side of the setting, being completed by an insulating strip 4'. The inner center of 2 is inflated in the shape of a portion of a sphere, tangent to 3. One sees that when a pressure is applied on 3, the diameter of the osculatory area common to 3 and to the semi-conductive matter will increase.

Several applications of the device including a variable resistance, according to the invention, are described hereafter. These applications set in action the variation of the resistance either in relation to the pressure exerted on the conductive matter, or in relation to the tension applied to the electrodes, or in relation to both.

Fig. 7 shows the application of the invention to a balance, a dynamometer, a piezometer, or any other device used to measure mechanical stresses of any kind. In this embodiment, the device with the variable resistance, 1-2-3, is placed in a circuit including a source 7 and a galvanometer 8, which can be directly graduated in weight or stress units. A member 9, resting on the middle part of the upper electrode 3, transmits to this electrode the stresses to be measured: this electrode acts like a beam housed at its ends between the lower electrode 2 and the pieces 10, 10'. Whilst, for the weighing, the electrode 3 is very thin, as described with reference to Fig. 1, it can be very thick when used to measure the strength of materials. Instead of having the shape of a rectangular plate, as illustrated in Fig. 1, the variable resistance according to the invention, can also be made as a small disc set in a suitable support and subjected to the pressure to be measured, particularly to the pressure of a fluid.

In the application, according to Fig. 8, to a comparator or to a micrometer, the apparatus includes a stand 11, with two uprights 12, 12'; the variable resistance 1-2-3 is set on an upright 12, whilst the piece to be measured is placed between the other upright 12' and an horizontal screw 13, 13', fitted in holes tapped in the two central uprights 14, 14' and kept in contact, at its other end, by means of the control member 15, with the thin flexible electrode 3 of the variable resistance. The resistance according to the invention can in that manner be used as an extensometer and also as a feeler.

When the resistance is used in a microphone or a vibrometer, the electrode 2 is fixed on a mass the weight of which is chosen to prevent it from vibrating whilst the sizes, the weight and the mode of attachment of the electrode 3 to which the vibrations are transmitted are chosen according to the nature and to the frequency of the vibrations to be transformed into variations of an electric current and according to the properties of the medium in which these vibrations are propagated and with which the electrode 3 is in contact. In the case, for instance, of a seismograph, as illustrated in Fig. 9, the flexible electrode 3 is embedded in the solid 16 in which the vibrations are propagated, the solid being a wall in the present case. The electrode 2 with which the elastic conductive matter 1 is in close contact, is set on a mass having a carefully computed inertia 7 to reduce as much as possible the vibrations transmitted to this electrode.

Fig. 10 shows an application of the invention to a distant control, particularly as used to regulate the pressure in a tank 20 containing a compressed fluid, for instance the tank of an hydraulic press. A variable resistance 21, according to the invention, is mounted as a piezometer, in an aperture 22 of the tank 20 and will be subjected to the pressure variations of the fluid contained therein. This resistance 21 is set in a branch of a Wheatstone bridge; a second resistance, according to the invention, 23, adjustable by means of the micrometer screw 24, is set in the other adjoining branch of the bridge, at the control post. The bridge is fed by a source 25; in its other diagonal is mounted a relay 26, controlling the motor 27; this motor drives a pump 28 to feed the tank 20. When the resistance 23 has been adjusted through the screw 24, to balance the bridge for a given pressure, a variation in the pressure will give rise to a variation of the resistance 21 and thereby to a lack of balance of the bridge and, by attrac-

tion of the relay 26, will start the motor 27 and the pump 28. Of course, the micrometer screw can be replaced by any device having a variable length or strength and particularly by an electro-magnetic device to secure an automatic cycle.

Fig. 11 shows a pick-up for gramophone records; the needle 29 is held in a holder 30 integral with a blade 31, made of brass for instance, embedded at its other end, by means of the insulating blocks 32, 32' in a head 33, which is carried by the arm of the pick-up (not shown). The head 33 includes two jaws 34, 34' bearing, on opposite sides of the vibrating blade 31, two bosses 35, 35'; each boss bears a variable resistance 36, 36', according to the invention, in the shape of a coating made in the same way as the conductive strip of Fig. 1. These resistances are in contact respectively with the opposite faces of the blade 31 holding the needle and thereby have to sustain the pressure variations produced by the lateral vibrations resulting from the undulations of the sound-groove. These two resistances 36, 36' are advantageously disposed on a Wheatstone bridge.

Fig. 12 illustrates a resistance 37, according to the invention, controlled by a micrometer screw 38 and used as a variable resistance or rheostat, for instance in a mounting like a Wheatstone bridge, to measure a resistance 39, the two other branches of the bridge being constituted by equal resistances 40, 40' and the diagonals by a source 41 and a galvanometer 42.

Fig. 13 illustrates diagrammatically a device to produce low frequency oscillations by the action of a mechanical vibrator 43 on a resistance 44 according to the invention which is mounted in a circuit including a source 45 and an utilization impedance 46. This device can, according to the diagram of Fig. 12, be transformed in an independent generator or oscillator. For this purpose, the circuit includes an impedance 47 such that the frequency of the entire electric circuit is tuned to the proper frequency of mechanical vibrations of the flexible electrode plate of the variable resistance 44, including, for instance, a ferromagnetic blade actuated by a magnet 48 or connected to a magnetostrictive bar, the excitation winding of which is inserted in series in the circuit of the source 49 and of the tuned impedance 47. Under these conditions, the closing of the circuit gives rise to an impulse of current generating oscillations which are sustained on account of the resonance between the circuit impedance and the resistance 44. A power oscillator is thereby created, the oscillations being collected at the terminals of the impedance 47.

It must be noted that in this application to the achievement of an oscillator, the tuned impedance 47 can also be connected in parallel with the variable resistance 44; the tension variations at the terminals of the impedance 47, thus received by the resistance 44, will generate variations in this resistance 44. In this case, the sustained oscillations can be obtained without the help of a magnet or of a magnetostrictive bar 48.

Figs. 15 and 16 are concerned with applications in which is used the variation of the resistance according to the invention, in relation to the tension applied to the electrodes.

In the example of Fig. 15, the variable resistance is connected with the terminals of a source 50 in series with a current measuring apparatus 51. As the resistance 49 varies in inverse ratio to the tension of the source 50, the resulting tension is amplified, so that the measurement of the current allows to measure this tension with a greater accuracy, the whole apparatus forming thus a voltmeter. This amplifying function may be used for many other applications, particularly for radio engineering.

Fig. 16 relates to a rectifier device based on the shape of the characteristic curve voltage-current of Fig. 5. This characteristic shows first a slow increase of the current in relation with the tension applied to the electrodes, then, after a bend B, a much faster increase. One understands that, if the resistance is set to work at the point B, that is to say if a positive continuous bias tension U_b is applied to the resistance, an alternating tension applied to the resistance will supply, during the positive alternations, an intensity of current much higher as during the negative alternations. The mounting includes, then, a bias generator 53 and the secondary of the feeding transformer 54, in series with a resistance 52 according to the invention, the rectified tension being sup-

plied between the terminals 53. Of course, a double symmetrical mounting can be done to rectify the two alternations of the feeding tension. This mounting is specially mentioned for explanation purposes, the intensity of the bias generator ranging about the same as the rectified intensity. To meet this drawback, it is possible to bias only in the C point, such for instance that $U_c = \frac{1}{2} U_B$. The injected alternative amplitude is then $\pm U_B$: one sees that the positive alternation is increased to the cost of the negative alternation and the intensity of the bias generator is smaller than the rectified intensity.

It is obvious that the above described applications are only given by way of non limitative examples as the resistance according to the invention is fit for an exceedingly large number of applications, in the most varied domains.

What I claim is:

1. A device comprising a resistance adapted to vary its electrical conductivity in response to the mechanical stresses to which it is subjected and to the voltage thereon applied, including a thin semi-conductive strip made of an insulating resilient material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, and two metallic plates forming electrodes arranged in contact with the opposite faces of the semi-conductive strip respectively, at least one of which is simply applied upon said semi-conductive strip under moderate tightening without being intimately bound therewith.

2. A device comprising a resistance adapted to vary its electrical conductivity in response to the mechanical stresses to which it is subjected and to the voltage thereon applied, including a thin semi-conductive strip made of an insulating resilient material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, and two metallic plates forming electrodes arranged in contact with the opposite faces of the semi-conductive strip respectively, adhesive means to intimately bind one of said electrodes to the corresponding face of said strip and adjustable tightening means for simply applying the other electrode under moderate pressure upon the opposite face of said strip.

3. A device comprising a resistance adapted to vary its electrical conductivity in response to the mechanical stresses to which it is subjected and to the voltage thereon applied, including a thin semi-conductive strip made of an insulating resilient material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, and two metallic plates forming electrodes arranged in contact with the opposite faces of the semi-conductive strip respectively, and adjustable tightening means to apply both said electrodes under moderate pressure upon the corresponding faces of said strip.

4. A device comprising a resistance adapted to vary its electrical conductivity in response to the mechanical stresses to which it is subjected and to the voltage thereon applied, including a thin semi-conductive strip made of an insulating resilient material selected in the group consisting of cellulose acetate, cellulose nitrate, vinylic resins, acrylic resins, polystyrene in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, and two metallic plates forming electrodes arranged in contact with the opposite faces of the semi-conductive strip respectively, at least one of which is

simply applied upon said semi-conductive strip under moderate tightening without being intimately bound therewith.

5. A device comprising a resistance adapted to vary its electrical conductivity in response to the mechanical stresses to which it is subjected and to the voltage thereon applied, including a thin semi-conductive strip made of an insulating resilient material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, a rigid metallic plate forming a first electrode and having a length greater than that of the semi-conductive strip, adhesive means to firmly attach said semi-conductive strip to the median part of said rigid electrode plate, two insulating layers arranged at both ends of the semi-conductive strip on said rigid electrode and having substantially the same thickness as said strip, a second metallic plate arranged over the semi-conductive strip and the insulating layers and adjustable tightening means to assemble the whole under moderate pressure.

6. A device comprising a resistance adapted to vary its electrical conductivity in response to the mechanical stresses to which it is subjected and to the voltage thereon applied, including a thin semi-conductive strip made of an insulating resilient material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, a rigid metallic plate forming a first electrode and having a length greater than that of the semi-conductive strip, adhesive means to firmly attach said semi-conductive strip to the median part of said rigid electrode plate, two insulating layers arranged at both ends of the semi-conductive strip on said rigid electrode and having substantially the same thickness as said strip, a second thin and flexible metallic electrode arranged over the semi-conductive strip and the insulating layers, and adjustable tightening means to assemble the whole under moderate pressure.

7. Device according to claim 6 wherein the thin and flexible electrode is curved to form a cylindrical surface, the tightening means being provided to apply at rest said flexible cylindrical electrode against the semi-conductive strip substantially along a generating line.

8. Device according to claim 6 wherein the flexible upper electrode is provided in its median part with a spherical surface, the tightening means being provided for applying at rest said spherical surface against the semi-conductive strip to form a substantially punctual contact area.

9. Device for the automatic regulation of a physical phenomenon resulting in a varying pressure, comprising a pressure responsive electrical resistance including a thin semi-conductive strip made of an insulating resilient material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, a rigid metallic plate forming a first electrode and having a length greater than that of the semi-conductive strip, adhesive means to firmly attach said semi-conductive strip to the median part of said rigid electrode plate, two insulating layers arranged at both ends of the semi-conductive strip on said rigid electrode and having substantially the same thickness as said strip, a second thin and flexible metallic electrode arranged over the semi-conductive strip and the insulating layers and adjustable tightening means to assemble the whole under moderate pressure, means to apply said pressure to the flexible electrode, a second similar resistance equipped with means to adjust the tightening pressure of its flexible

electrode on the semi-conductive strip, means to connect these two variable resistances to two branches of a Wheatstone bridge, a current source set on a diagonal of the bridge, a relay set on the other diagonal and members controlled by this relay to regulate said physical phenomenon.

10. Pick-up for gramophone records, including a head in the shape of a metallic fork, a vibrating metallic blade embedded in the inside of the fork with interposition of an insulator, a needle holder fixed at the end of the vibrating blade, between the two sides of said blade and the corresponding arms of the fork, two variable resistances including each a thin, semi-conductive strip made of an insulating resilient material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders.

11. Electric oscillation generator comprising a variable resistance consisting of a thin, semi-conductive strip made of an insulating material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, a rigid metallic plate forming a first electrode and having a length greater than that of the semi-conductive strip, adhesive means to firmly attach said semi-conductive strip to the median part of said rigid electrode plate, two insulating layers arranged at both ends of the semi-conductive strip on said rigid electrode and having substantially the same thickness as said strip, a second thin and flexible metallic electrode arranged over the semi-conductive strip and the insulating layers and adjustable tightening means to assemble the whole under moderate pressure, in series with this resistance a current source, a magnet with an armature adapted to exert a pressure on the flexible electrode of said resistance, an impedance the value of which is selected so that the proper electric frequency of the whole circuit is equal to the proper frequency of the mechanical oscillations of the variable resistance.

12. Device for measuring electric voltages, including between the terminals supplying the voltage to be measured, a current indicating apparatus connected in series with a voltage responsive resistance consisting of a thin, semi-conductive strip, made of resilient insulating material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders and two metallic plates forming electrodes arranged in contact with the opposite faces of the semi-conductive strip respectively at least one of which is simply applied upon said semi-conductive strip under moderate tightening without being intimately bound therewith.

13. Device for rectifying alternating currents comprising in series a biasing D. C. source and a variable resistance including a thin, semi-conductive strip, made of resilient insulating material selected in the group consisting of thermoplastic, thermosetting and ceramic materials having a small mechanical hysteresis and a modulus of elasticity greater than 2000 kg./cm.², in the proportion of 30% to 85% in volume, and a powdered conductive material scattered into said insulating material in a proportion of 15% to 70% in volume and selected from the group consisting of powdered carbon, graphite and metallic powders, and two metallic plates forming electrodes arranged in contact with the opposite faces of the semi-conductive strip respectively, at least one of which is simply applied upon said semi-conductive strip under moderate tightening without being intimately bound therewith, the voltage furnished by said D. C. source being adjusted to apply to the resistance a positive bias voltage fairly equal to the half of the voltage corresponding to the elbow of the voltage current curve of said variable resistance.

14. Device according to claim 1 in which the semi-conductive strip consists of a mixture of in weight 40% of methyl-metacrylate, 35% of powdered graphite, 12.5% of petroleum black and 12.5% of aluminium powder.

15. Process for the making of a variable resistance according to claim 1, including the step of dissolving a plastic material in a suitable solvent, the step of urging in suspension in said solution a powdered conductive substance, the step of coating with this suspension an electrode plate and the step of evaporating the solvent.

16. Process for the making of a variable resistance according to claim 1, including the step of dissolving a plastic material in a suitable solvent, the step of urging in suspension in said solution a powdered conductive substance, the step of coating with this suspension a previously dulled electrode plate and the step of evaporating the solvent.

17. Process for the making of a variable resistance according to claim 1, including the step of urging in suspension a powdered conductive substance in a liquid, non polymerized, synthetic resin, the step of coating with this suspension an electrode plate and the step of polymerizing the coating on the plate.

18. Device according to claim 6 including a recessed supporting member wherein the ends of the thin and flexible electrode plate are inserted and a member to transmit pressure stresses to the central part of said plate.

19. Device according to claim 6 intended to transform vibrations in electric current variations, including a source of current connected with both electrodes of the variable resistance, means to set the thin and flexible electrode on the vibrating member and a mass of inertia set on the rigid electrode.

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