J. G. ZIMMERMAN.

RESISTANCE ELEMENT.

APPLICATION FILED AUG. 11, 1911.

1,023,543. Patented Apr. 16, 1912.

Fig. 1

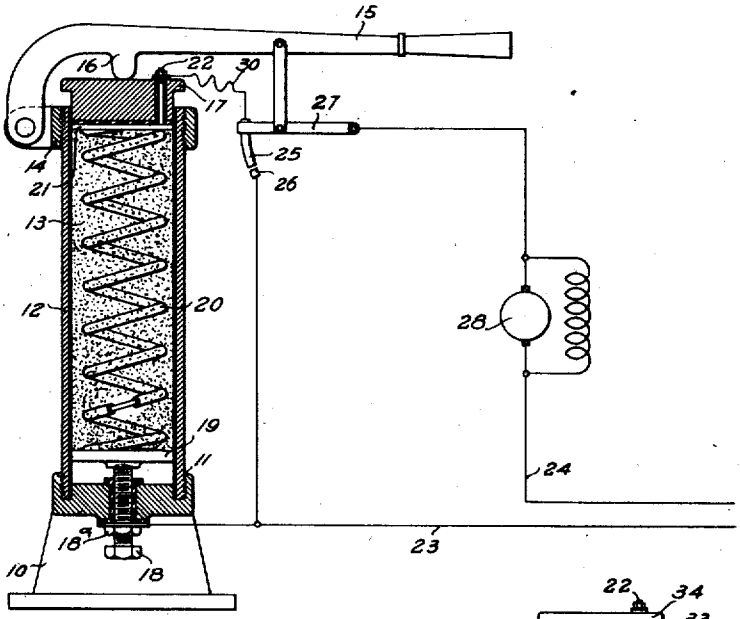


Fig. 2

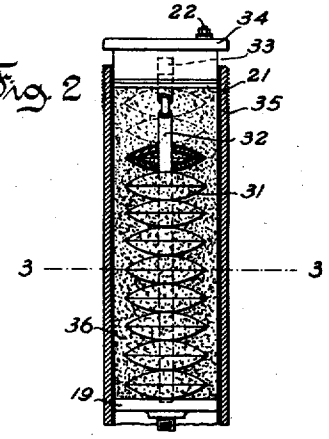
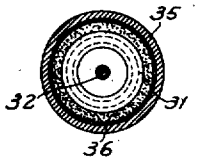


Fig. 3



Witnesses

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RESISTANCE ELEMENT.

1,023,543. Specification of Letters Patent. Patented Apr. 16, 1912.

Application filed August 11, 1911. Serial No. 643,614.

To all whom it may concern:

Be it known that I, JAMES G. ZIMMERMAN, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Resistance Elements, of which the following is a full, clear, and exact specification.

This invention relates to resistances, and especially compressible resistances to be used in electric circuits.

Resistances comprising powdered carbon and various other powdered substances are in common use. When such resistance compositions are subjected to pressure to vary the effective resistance of the compressible resistance medium, the granular or powdered particles are closely packed rendering upon maximum pressure a minimum effective resistance. When the pressure is removed the granular particles remain packed with the result that the initial high effective resistance of the compressible resistance medium is not again reached. Such circumstances are undesirable especially when the resistance medium is to be used frequently for varying the effective resistance in a circuit; for instance, in the circuit of a motor to be started frequently.

It is therefore the object of my invention to render the effective resistance of a variable compressible resistance medium to substantially its original value upon the removal of the pressure. This object is accomplished by providing within the resistance medium a resilient member adapted to disintegrate the compressed mass or to cause the particles comprising the resistance medium to become less densely packed upon the removal of the pressure.

The various novel features of my invention will be apparent from the description and drawings and will be particularly set forth in the appended claims.

The invention is illustrated on the accompanying sheet of drawings, in which—

Figure 1 is a motor starting variable resistance equipped with my invention; Fig. 2 is a modification of that shown in Fig. 1; and Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2.

Attention is first directed to Fig. 1, which shows a pedestal 10 provided with a tapped portion 11 into which is screwed a tube 12 containing preferably a granular or powdered resistance medium 13. Secured to the upper end of the tube 12 is a collar 14 to which is pivoted an operating lever 15 having a projection 16 which engages a cap 17 adapted to be forced down into the tube 12 to compress the variable resistance medium 13. An adjusting bolt 18 having a lock nut 18^a passes through the pedestal 10 and engages a movable conducting support 19, which is in intimate contact with the variable resistance medium, and upon which bears an insulated resilient member or spring 20. This insulated spring or coil 20 is interposed between the conducting member 19 and a conducting member 21, which is electrically connected to a bolt 22 forming part of an electric circuit including bolt 18, resistance 13, conductors 19 and 21, mains 23, 24, stationary contacts 25 and 26, movable contact 27, and motor 28. The tube 12 is lined with insulation and the bolts 18 and 22 and conducting member 21 are all insulated from conducting parts which are not supposed to form a part of the electrical circuit.

If it is desired to start the motor 28, a circuit is first established through main 23, bolt 18, conducting support 19, variable resistance medium 13, conductor 21, bolt 22, flexible conductor 30, stationary contact 25, movable contact 27, motor 28, to the other main 24. In order to decrease the effective resistance of the variable resistance medium 13, to permit the motor to speed up, the lever 15 is depressed, thereby compressing the variable resistance medium causing the resistance particles thereof to be more closely packed together and causing the spring to be compressed storing energy therein. Upon the continued depression of the lever 15, the effective resistance of the variable resistance medium continues to decrease causing the motor to speed up more and more and the movable contact 27 to slide over the stationary contact 25 approaching stationary contact 26. When the movable contact 27 reaches the stationary contact 26, the variable resistance medium has been compressed with a predetermined maximum force causing the effective resistance of the variable resistance medium to

be a predetermined minimum, and said resistance medium is thereupon short-circuited, the motor being connected between the mains 23 and 24 through contacts 26 and 27. The operating lever 15 can be held in this operating position as long as desired by any suitable means. When the lever 15 is raised to reinsert the variable resistance medium 13 in the motor circuit, the spring 20, due to the energy stored therein, expands, causing the particles forming the variable resistance medium to loosen or become less densely packed and thereby raising the effective resistance of said medium to practically its initial value. The resistance medium is then ready to be again compressed at any time for starting the motor. By adjusting the bolt 18 the effectiveness of the spring 20 may be varied to meet all practical requirements thereof.

A modification of that shown in Fig. 1 is illustrated in Figs. 2 and 3. Here, instead of using a spiral spring 20, a plurality of flexible insulated shells 31 are slidably mounted upon a central support 32 which is adapted to slide into a slotted portion 33 of a cap 34 when the latter is forced down into the tube 35 containing the resistance medium 36. These shells 31 are preferably made of cup-shaped pieces of steel coated with a flexible insulating material. These shells act in practically the same manner to loosen the resistance particles when pressure on the variable resistance medium has been decreased.

There may be other modifications in the precise forms and arrangements herein shown and described, and it is my aim to cover all such modifications and arrangements which do not involve a departure from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new is:

1. In combination, a compressible resistance medium comprising granular particles, and means within said resistance medium to cause said particles to become less densely packed upon a change of pressure on said resistance medium.

2. In combination, a compressible resistance medium comprising granular particles, means for compressing said resistance medium to decrease its effective resistance, and means within said resistance medium to restore said resistance medium to its initial effective resistance upon the removal of the pressure.

3. In combination, a compressible resistance medium comprising granular particles, means for compressing said resistance medium to vary the effective resistance thereof, and resilient means to cause the particles of said resistance medium to become less densely packed upon a decrease in pressure.

4. In combination, a compressible resistance medium comprising granular particles, and an insulated spring within said resistance medium adapted upon a decrease in pressure on said medium to loosen the particles thereof to increase its effective resistance.

5. In combination, a compressible resistance medium comprising conducting particles, means for compressing said resistance medium to decrease its effective resistance, and a spiral insulated resilient member embedded in said resistance medium and adapted upon the removal of pressure to loosen the particles of said resistance medium to increase the effective resistance thereof.

6. In combination, a compressible resistance medium comprising conducting particles, means for compressing said resistance medium to decrease the effective resistance thereof, means within said resistance medium adapted upon decrease in pressure on said resistance medium to loosen the particles and to increase the effective resistance thereof, and means to vary the effectiveness of said separating means.

7. In combination, a tube, a variable resistance medium within said tube, a lever associated with said tube and adapted to compress said variable resistance medium, and a spring within said tube to restore said resistance medium to its initial effective resistance upon the removal of the pressure.

8. In combination, a tube, a variable resistance medium comprising granular particles within and insulated from said tube, means for compressing said variable resistance medium to decrease the effective resistance thereof, a resilient member within said tube and adapted to loosen said particles upon the removal of pressure to increase the effective resistance of said resistance medium, and an adjustable member for varying the effectiveness of said resilient member.

9. In combination, a compressible resistance medium comprising conducting particles, relatively movable conducting members between which said resistance medium is compressed, and a coil within said medium and tending to move said members apart.

10. In combination, a compressible resistance medium comprising conducting particles, conducting members between which said resistance medium is compressed, and a coil within said medium and engaging said members and tending to force them apart.

11. In combination, a compressible resistance medium comprising conducting particles, members between which said resistance medium is compressed, and a coil embedded in said medium and engaging said members and tending to force them apart.

12. In combination, a compressible resistance medium comprising conducting particles, and a coil within said resistance medium to cause said particles to become less

densely packed upon a change of pressure on said resistance medium.

13. In combination, a compressible resistance medium, means for varying the effective resistance of said medium upon change of pressure, and a coil embedded in said medium.

Milwaukee, Wis., July 29, 1911.

In testimony whereof I affix my signature, in the presence of two witnesses.

JAMES G. ZIMMERMAN.

Witnesses:

CHAS. L. BYRON,

CLARA E. BENSEL.