Dec. 17, 1946. J. H. JOHNSTON 2,412,811

CARBON PILE ELECTRIC REGULATOR

Filed April 4, 1944

Fig. 1.

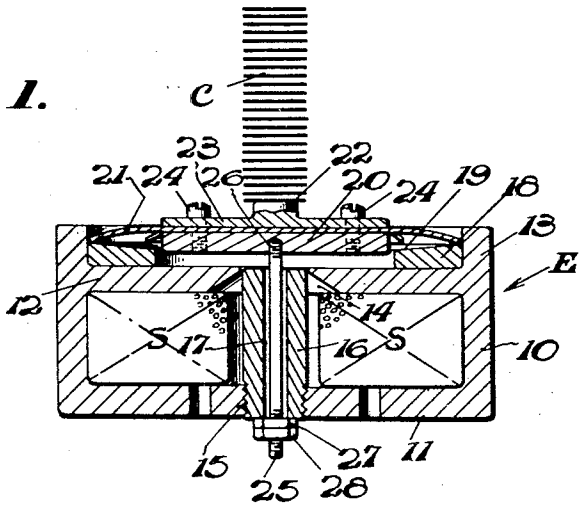
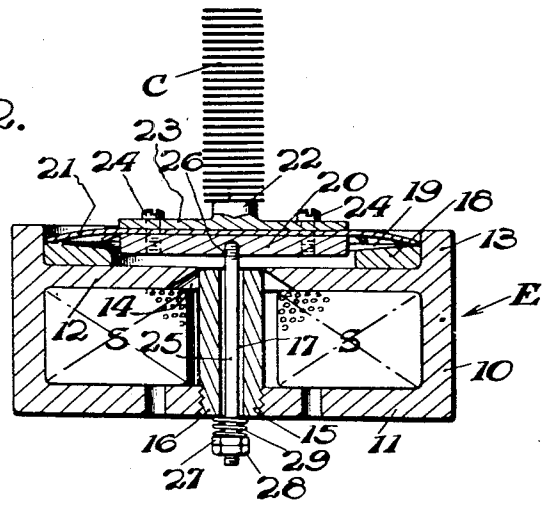


Fig. 2.



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CARBON PILE ELECTRIC REGULATOR

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8 Claims. (Cl. 201—51)

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The present invention deals with electrical regulators and is concerned primarily with regulators of the so-called "carbon pile" type.

At the present time carbon pile regulators have come into widespread use for such purposes as controlling the voltage of the output of generators and also in the governing of current. All of these carbon pile regulators operate on the principle of varying the pressure applied to the carbon pile, the range of effective pressure on the pile being the regulating range of the regulator.

There has now come into fairly widespread use a regulator which is characterized as including the usual carbon pile, one end of which is relatively fixed. Operatively associated with the other end to apply pressure on the pile, is an armature and this armature is carried by a spring of the leaf type, and the extremities of which engage an abutment or top surface of an electromagnet.

The force of the electromagnet is rendered effective on the armature. It is evident that the spring above referred to tends to urge the armature towards the pile, while the magnetic force tends to withdraw the armature from the pile. The difference between these two forces is the regulating force or working force on the pile.

With carbon pile regulators of this type some difficulty has been experienced in obtaining desired regulating effects in that under many conditions the pile is compressed to such an extent as to cause its resistance to fall beneath a desired minimum. Thus, if the regulator is employed as a voltage regulator, this undue decrease in the resistance of the pile causes the voltage to rise beyond a safe limit. Moreover, with no fixed limit on the extent to which the pile may be compressed, chattering and vibration occurs, which is a highly undesirable factor.

With these conditions in mind, this invention has in view as an important object, the provision, in an electric regulator of the character aforesaid, of means for limiting movement of the armature towards the pile whereby definite assurance is had that the pile will not be compressed beyond a predetermined safe limit.

More in detail, the invention has as an object the provision, in a carbon pile regulator of the type above noted, of limiting means for the armature which is adjustable in nature, so that the extent to which the pile may be compressed may be varied as desired.

In carrying out this idea in a practical embodiment, the core of the electromagnet is provided with a bore extending axially thereof. Extending through this bore and freely movable therein, is a rod, one extremity of which is anchored to the armature, while the other extremity carries some adjustable form of stop, such as a nut, which engages the core. It is evident that with such an arrangement, movement of the armature towards the pile is definitely limited and the limit may be adjusted by adjusting the nut.

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In conditions of actual use, it has been found desirable to make the stop which limits the movement of the armature of a yieldable nature, as such an arrangement tends particularly to prolong the life of the carbon pile. Accordingly, a further object is the provision, in a carbon pile regulator of the character above set forth, of yieldable means for limiting movement of the armature towards the pile.

This end is achieved by incorporating in the mechanism above described an expansion spring which is disposed about the rod and interposed between the end of the core and the nut. The force of this spring opposes the force of the leaf spring carrying the armature and its effect is to provide a yielding stop for the armature.

Various other more detailed objects of the invention such as arise in carrying out the above noted thoughts in a practical embodiment will in part become apparent and in part be hereinafter stated as the description of the invention proceeds.

The invention, therefore, comprises a carbon pile electric regulator, including an electromagnet having a core with which is operatively associated an armature. The armature is carried by a leaf spring, the extremities of which engage the top of the electromagnet. The position of this armature determines the pressure on the carbon pile. The core is formed with a bore through which extends a rod, one end of which is anchored to the armature, and the other end of which carries a stop in the form of a nut which engages the end of the core. In a modified form a coiled expansion spring may be interposed between the core and the nut.

For a full and more complete understanding of the invention, reference may be had to the following description and accompanying drawing, wherein:

Fig. 1 is a section through those parts of a carbon pile regulator with which this invention is immediately concerned; and

Fig. 2 is a similar sectional view of a modification.

Referring now to the drawing, wherein like reference characters denote corresponding parts,

and first more particularly to Fig. 1, an electromagnet is referred to in its entirety by the reference character E. This electromagnet comprises the usual pot made up of a cylindrical wall 10, bottom 11, top 12 and upper peripheral flange 13. The top 12 is provided with the usual central opening which is preferably conical in shape, as illustrated, and which is designated 14.

Substantially opposite to the opening 14 and coaxial therewith, the bottom 11 is formed with a threaded opening 15. Screwed into the threaded opening 15 is a core 16, the upper extremity of which extends into the opening 14. The core 16 is provided with a bore 17 which extends throughout. Assembled within the cylindrical wall 10 and between the bottom and top walls 11 and 12 is the usual solenoid winding which is identified by the reference character S.

Carried on the upper face of the top wall 12 and preferably in engagement with the peripheral flange 13 is an abutment ring 18, the exposed surface of which has a slight taper to provide the conical formation depicted at 19.

An armature is indicated at 20 and is carried by a leaf spring assembly 21. It will be noted that the springs 21 are of slightly arched or bowed shape and the free ends of this spring rest against the upper surface 19 of the abutment 18. They also fit within the peripheral flange 13 with a reasonably snug fit, so that in the assembled relation the armature 20 is properly centered with respect to the core 16.

A boss 22 is carried by backing plate 23 which bears against the upper face of the spring assembly 21. Any appropriate fastening element, such as the screws shown at 24, may be employed to assemble the plate 23, springs 21 and armature 20, as a unit. The boss 22 engages the lower end of a carbon pile which is designated C.

The carbon pile C and solenoid S may be connected into an electrical circuit in any way to provide the desired regulating effects. When used as a voltage regulator for a generator, the pile C will be placed in series with the shunt field of the generator, while the solenoid S will be connected in across the generator. Thus, as the voltage across the generator varies, so will be voltage in the solenoid S.

The intensity of the magnetic field of the electromagnet E is thereby caused to vary with the voltage, and will be effective to in turn vary the position of the armature 20. It is evident that as the armature 20 applies more pressure to the carbon pile C, its resistance decreases, which in turn makes the field stronger and thus causes the voltage to rise. To prevent this voltage rise from exceeding a safe limit, the stop now to be described is provided.

A rod 25 is threaded at each end. One end of this rod is screwed into a complemental threaded socket in the armature 20, as indicated at 26. This anchors this end of the rod to the armature. The other end of the rod 25 carries a nut 27 which engages the end of the core 16. This nut 27 may be accompanied by a lock nut 28, so that when an adjusted position is once set, it will be maintained.

With this arrangement it is evident that the armature 20 can move towards the pile C only up to the point where the nut 27 engages the core, any further movement being positively inhibited by the stop arrangement. Thus, the voltage may be prevented from rising beyond a predetermined safe limit.

With this arrangement all of the desired regulating effects of the carbon pile regulator are maintained, but at the same time these regulating effects are rendered more stable and all chattering is substantially eliminated. It is evident that by properly adjusting the nuts 27 and 28, any desired operating range of regulation may be established.

In the form of the invention disclosed in Fig. 2, all of the parts described above in connection with Fig. 1 are repeated. However, in order to render the stop or limit of movement for the armature 20 of a yielding nature, an expansion coil spring 29 is disposed about the rod 25 and interposed between the nut 27 and the core 16.

The force of this spring 29 opposes that of the spring assembly 21. It is evident that the armature 20 may move towards the pile C, but this movement is resisted by the spring 29 in addition to the magnetic force. As the armature moves further away from the core, the magnetic force decreases in strength but the resistance of the spring 29 becomes progressively greater. It is evident that the movement of the armature is limited, although not in so positive a nature. Moreover, the presence of the spring 29 exhibits a definite tendency to dampen vibrations on the part of the armature.

While two preferred embodiments of the invention are hereinbefore set forth, it is to be clearly understood that the invention is not to be limited to the exact construction illustrated and described, because various modifications of these details may be provided in putting the invention into practice within the purview of the appended claims.

What is claimed is:

1. In an electric regulator including a carbon pile, an armature, a spring carried by said armature for compressing said pile, and an electromagnet, the improvement consisting of stop means for limiting movement of said armature towards said pile, said stop means being so arranged as to limit the compression of said pile to a permissible value substantially less than its maximum value and a permissible value such as to prevent a decrease in the resistance of the pile to below a predetermined safe value.

2. In an electric regulator including a carbon pile, an armature having means engaging one end of said pile to apply pressure thereon, a spring carrying said armature, said spring being arranged so as to compress said pile, an electromagnet supporting said spring, and a core fixedly mounted as a part of said electromagnet; the improvement comprising stop means carried by said armature and arranged so as to be engageable by said fixedly mounted core to limit movement of said armature towards said pile and the maximum extent of compression of the pile by said spring to a value sufficient to prevent a decrease in the resistance of the pile below a predetermined safe value.

3. In an electric regulator including a carbon pile, an armature having means engaging one end of said pile to apply pressure thereon, a spring carrying said armature, said spring being arranged so as to compress said pile, an electromagnet supporting said spring, and a core included as a part of said electromagnet, said core being provided with a bore, a rod freely movable in said bore and having one end anchored to said armature, and a stop carried by the other end of said rod for engaging said core so as to limit the maximum extent of compression of the pile by

said spring to a value sufficient to prevent a decrease in the resistance of the pile to below a predetermined safe value.

4. In an electric regulator including a carbon pile, an armature having means engaging one end of said pile to apply pressure thereon, a spring carrying said armature and applying pressure to said pile through said armature for compressing the pile, an electromagnet supporting said spring, and a core included as a part of said electromagnet, said core being formed with a bore, a rod freely movable in said bore and having one end anchored to said armature, the other end of said rod being threaded and a nut carried on said threaded end and forming a stop adapted to engage said core to determine the limit of movement of said armature towards said pile, said nut being arranged so as to be adjustable exteriorly of said regulator for increasing and decreasing the initial pressure applied to said pile by said spring so as to vary the maximum permissible compression of said pile.

5. In an electric regulator including a carbon pile, an armature, a spring carried by said armature for biasing the armature so as to compress said pile, and an electromagnet, said first mentioned spring opposing movement of said armature toward said electromagnet; the improvement comprising an additional yieldable spring means operably connected intermediate said electromagnet and armature so as to oppose movement of said armature towards said pile and arranged so as to limit the compression of said pile by said first mentioned spring to a value substantially less than its maximum and a limited value sufficient to prevent a decrease in the resistance of the pile below a predetermined safe value.

6. In an electric regulator including a carbon pile, an armature having means engaging one end of said pile to apply pressure thereon, a spring carrying said armature, an electromagnet supporting said spring, and a core fixedly mounted as a part of said electromagnet, and spring means operably connected to said armature and bearing upon said core for yieldably opposing movement of said armature towards said pile and limiting the maximum compression of said pile to within a predetermined safe operating range.

7. In an electric regulator including a carbon pile, an armature having means engaging one end of said pile to apply pressure thereon, a spring carrying said armature, an electromagnet supporting said spring, and a core included as a part of said electromagnet, said core being formed with a bore, a rod freely movable in said bore and having one end anchored to said armature, a stop carried by the other end of said rod, an expansion spring associated with said rod and positioned between said stop and said core so as to bias said armature in a direction tending to withdraw said armature from said pile, and the stop and expansion spring on the other end of said rod for limiting the maximum compression of said pile to within a predetermined safe operating range.

8. In an electric regulator including a carbon pile, an armature having means engaging one end of said pile to apply pressure thereon, a spring carrying said armature, an electromagnet supporting said spring, and a core included as a part of said electromagnet, said core being formed with a bore, a rod freely movable in said bore and having one end anchored to said armature, a nut threaded on the other end of said rod and forming a stop for limiting movement of said armature in a pile compressing direction, and a coil expansion spring disposed about said rod and interposed between said core and nut and tending to oppose movement of said armature in a pile compressing direction so as to limit the maximum compression of said pile to within a predetermined safe operating range.

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