Sept. 13, 1949. W. G. NEILD 2,481,771

CARBON PILE REGULATOR

Filed Aug. 25, 1945

Fig. 1

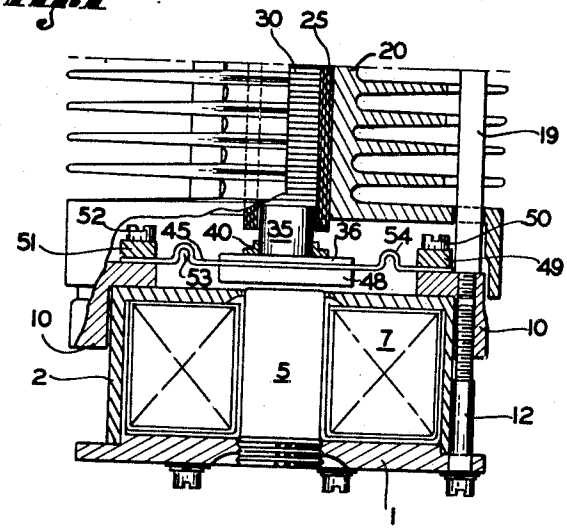


Fig. 2

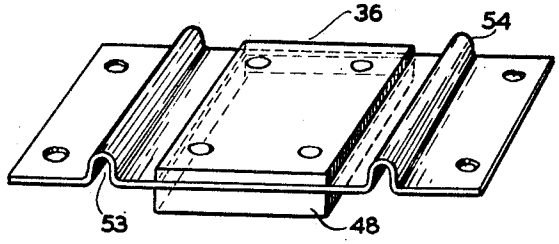
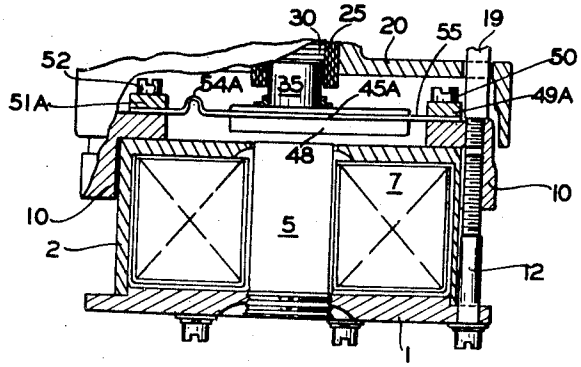


Fig. 3



- INVENTOR -
WILLIAM G. NEILD
BY Herbert L. Davis Jr.
- ATTORNEY -

Patented Sept. 13, 1949

2,481,771

UNITED STATES PATENT OFFICE

2,481,771

CARBON PILE REGULATOR

William Greene Neild, Warren Point, N. J., assignor to Bendix Aviation Corporation, Teterboro, N. J., a corporation of Delaware

Application August 25, 1945, Serial No. 612,691

3 Claims. (Cl. 201—51)

1

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 currents.

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 having a plurality of spring fingers which engage at the extremities thereof, an inclined abutment formed on the electromagnet.

The force of the electromagnet is rendered effective on the armature, and 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 and to force the spring fingers into abutting relation along the inclined surface of the abutment provided on the electromagnet so as to approximately vary the force exerted by the spring inversely as the square of the distance between the armature and magnet so as to effect basic correspondence with the changes in the magnetic force.

With carbon pile regulators of this type considerable mechanical difficulty has been experienced in obtaining desired regulating effects due to the difficulties incident to calibrating the several spring fingers to the inclined abutment, so as to give the effect desired. Moreover, the latter spring has a characteristic which outside its normal limited working range and with lower forces is quite different from that within its limited working range. Thus upon wear of the carbon pile which inevitably results through use, this latter characteristic often results in high voltage and consequent failure of control and damage to the electrical system.

An object of the present invention, therefore, is to simplify and improve the aforenoted spring construction.

Another object of the invention is to provide a leaf spring of normal flat construction having the characteristics aforenoted without the necessity of an inclined abutment. It has been found that the foregoing may be accomplished by use of a leaf spring having suitable kinks or corrugations so as to effect a spring rate having basic correspondence with the changes in magnetic force as the armature moves in relation to the electromagnet. It has been found that such springs are ideally suited for this purpose since

2

the spring characteristics may be readily made to match those of the electromagnetic force acting upon the armature as the air gap varies.

Another object of the invention is to provide an armature spring arrangement of the type described of high efficiency and of such simplicity of construction as to be readily adaptable for manufacture and installation at low cost.

These and other objects and features of the invention are pointed out in the following description in terms of the embodiment thereof which is shown in the accompanying drawings. It is to be understood, however, that the drawings are for the purpose of illustration only, and are not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

Figure 1 is a fragmentary sectional view of a regulator embodying one form of the invention;

Figure 2 is a perspective view of the leaf spring of Figure 1; and

Figure 3 is a fragmentary sectional view of a regulator embodying a second form of the invention.

Referring to Figure 1 of the drawing, there is provided a bottom plate 1 on which is mounted a casing 2. The bottom plate and casing 2 are formed of a suitable ferro-magnetic material. A core 5 of similar material projects from the bottom plate 1 into an electromagnetic winding 7 wound about the core 5 and positioned within the casing 2.

Positioned on the casing 2 is an annular member 10 which is fastened to the bottom plate 1 by suitable screws 12, one of which is shown in the drawing.

A housing 20 of a type such as shown in my copending application Serial No. 570,002, filed December 27, 1944, now Patent No. 2,427,805, issued September 23, 1947, is fastened to the annular member 10 by studs 19.

Mounted within the housing 20, as shown in greater detail in the aforenoted application, is a non-conducting tube 25 of a suitable refractory material, such as porcelain. The tubular member 25 carries carbon discs 30 forming a carbon pile. A contactor member 35 is positioned between one end of the carbon pile 30 and an armature plate 36. The contactor member 35 is positioned in a cup shaped securing member 40 mounted on the armature plate 36.

The armature plate 36, as shown in Figure 1, is positioned at one side of a leaf spring 45. At the opposite side of the leaf spring 45 is positioned a second armature plate 48 and the leaf spring 45 is clamped between the armature plates 36 and 48 by suitable fastening screws.

As shown in Figure 1, the leaf spring 45 is clamped at one end between a bar 49 and the top surface of the annular ring 10 by bolts 50. The opposite end of the leaf spring 45 is clamped be-

tween a bar 51 and the top surface of the annular ring 10 by bolts 52.

Formed in the leaf spring 45 in spaced relation to the annular ring 10 and the armature plate 48 are suitable kinks or corrugations 53 and 54.

It is notable that the ends of the leaf spring 45 are fixedly mounted on the annular ring 10 and extend across the ring 10 suspending the armature 48 therein. Axial movement of the armature 48 in the ring 10 is accommodated by the kinks or corrugations 53 and 54 formed in the leaf spring 45. It has been found that by providing the leaf spring 45 of suitable material and thickness and the corrugations 53 and 54 of proper depth basic correspondence with the varying magnet pull results due to changes in the distance across the air gap may be effected without the necessity of an inclined abutment or other auxiliary means for effecting such basic correspondence.

In Figure 3 a second form of the invention is illustrated in which the leaf spring 45A does not include a kink or corrugation 53, but rather has a flexible hinge 55 at one side of the armature and the kink or corrugation 54A at the opposite side.

The leaf spring is fastened at opposite ends to the ring 10 by bars 49A and 51A and bolts 50 and 52, respectively.

In the latter arrangement due to the hinge mounting greater stability is effected than in the form shown in Figure 1.

From the foregoing it will be seen that there is provided a novel, and compact armature spring arrangement of such simplicity of construction as to readily adapt the same for manufacture and installation at low cost.

Although only two embodiments of the invention have been illustrated and described, various changes in the form and relative arrangements of the parts, which will now appear to those skilled in the art, may be made without departing from the scope of the invention. Reference is, therefore, to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In a regulator of the class including a carbon pile, a solenoid having an essentially non-linear magnetic force characteristic, and said solenoid including a pole piece and an armature for varying the compression of said carbon pile; the improvement comprising a flexible sheet spring member having a first portion thereof secured to said armature for applying a pressure in opposition to the pull of said solenoid, means for anchoring second outer portions of said spring member in a fixed position for preventing movement of the outer portions during the flexing of said spring member, said spring member also having a third corrugated portion intermediate the first and second portions, the first and second portions being positioned in substantial alignment, said third corrugated portion movable with said armature under the action of said solenoid in a direction tending to affect said corrugated portion so as to develop a tension force opposing the action of the solenoid, the corrugated portion so constructed and arranged as to continuously increase said tension force in excess of a linear relation as said armature approaches the pole piece of said solenoid and to effect basic correspondence with the changes in the magnetic force of said solenoid due to such movement of the armature.

2. In a regulator of the class including a carbon pile, a solenoid having an essentially non-linear magnetic force characteristic, and said solenoid including a pole piece and an armature for varying the compression of said carbon pile; the improvement comprising a flexible sheet spring member having a first portion thereof secured to said armature for applying a pressure in opposition to the pull of said solenoid, means for anchoring a pair of opposite second outer end portions only of said spring member in a fixed position for preventing movement of the outer portions during the flexing of said spring member, said spring member forming a flexible hinge between said armature and one of said outer end portions, said spring member also having a third corrugated portion intermediate the armature and the opposite anchored end portion only of said spring member so as to permit pivotal movement of said armature under force of the solenoid about the hinged end and in opposition to the pressure of said spring member, the first and second portions being positioned in substantial alignment, said third corrugated portion movable with said armature under the action of said solenoid in a direction tending to affect said corrugated portion so as to develop a tension force opposing the action of the solenoid, the corrugated portion so constructed and arranged as to continuously increase said tension force in excess of a linear relation as said armature approaches the pole piece of said solenoid and to effect basic correspondence with the changes in the magnetic force of said solenoid due to such movement of the armature.

3. In a regulator of the class including a carbon pile, a solenoid having an essentially non-linear magnetic force characteristic, and said solenoid including a pole piece and an armature for varying the compression of said carbon pile; the improvement comprising a flexible sheet spring member having a first portion thereof secured to said armature for applying a pressure in opposition to the pull of said solenoid, means for anchoring a pair of opposite second outer end portions only of said spring member in a fixed position for preventing movement of the outer portions during the flexing of said spring member, said spring member also having a third corrugated portion intermediate the first and second portions, the first and second portions being positioned in substantial alignment, said third corrugated portion movable with said armature under the action of said solenoid in a direction tending to affect said corrugated portion so as to develop a tension force opposing the action of the solenoid, the corrugated portion so constructed and arranged as to continuously increase said tension force in excess of a linear relation as said armature approaches the pole piece of said solenoid and to effect basic correspondence with the changes in the magnetic force of said solenoid due to such movement of the armature.

WILLIAM GREENE NEILD.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,191,992	McLarn	Feb. 27, 1940
2,332,140	Finnegan	Oct. 19, 1943
2,394,753	Crotch	Feb. 12, 1946
2,419,491	Gartner	Apr. 22, 1947