April 24, 1945. A. H. CHILTON ET AL 2,374,417

ELECTRIC REGULATOR

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FIG. 1.

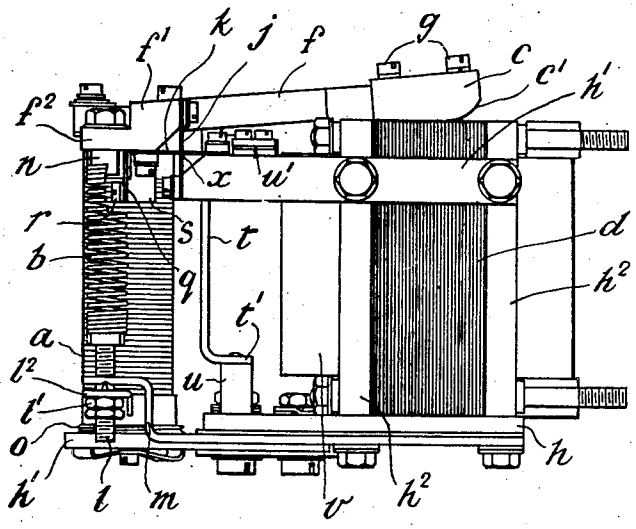
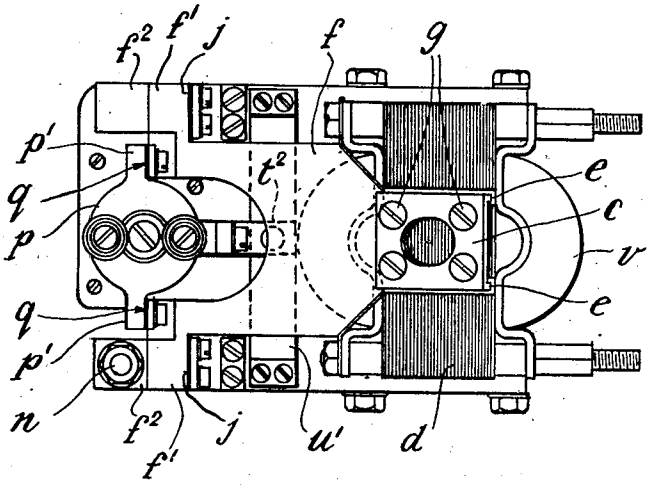


FIG. 2.



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FIG. 3

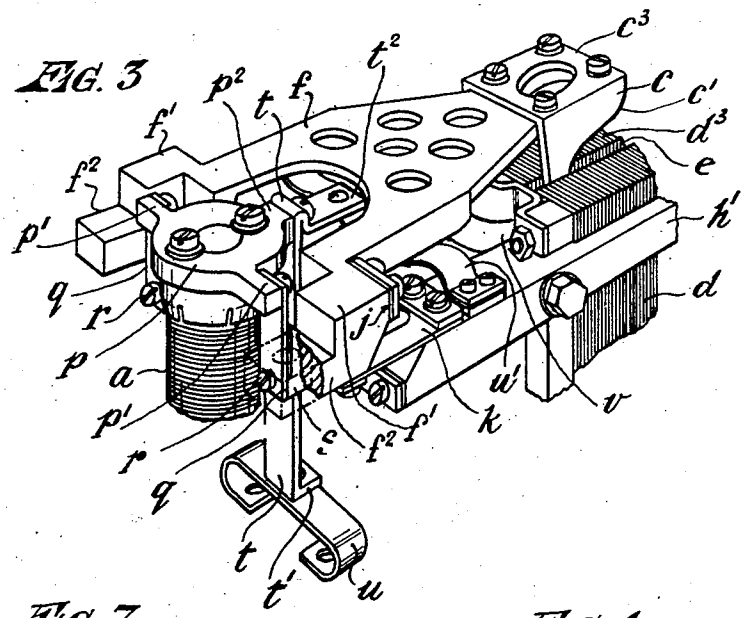


FIG. 7.

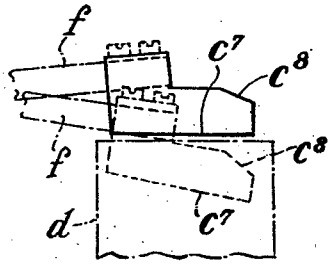


FIG. 4

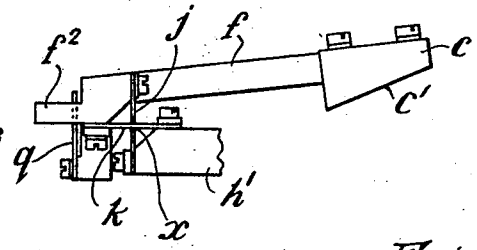
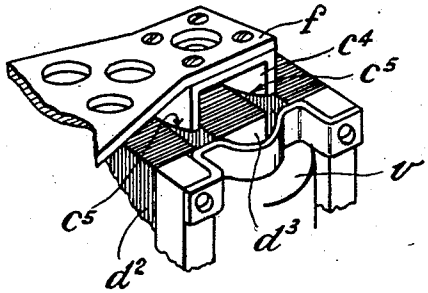


FIG. 5



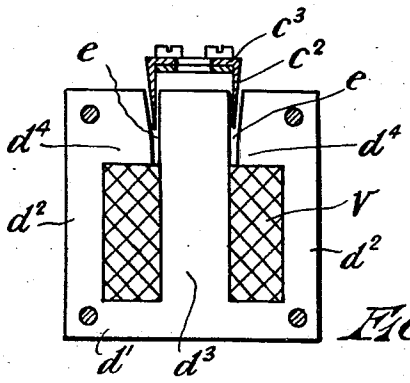


FIG. 6.

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ELECTRIC REGULATOR

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Application May 7, 1943, Serial No. 486,034
In Great Britain June 8, 1942

5 Claims. (Cl. 201—51)

This invention relates to improvements in electric regulators of the carbon pile type and is principally concerned with the electromagnets and their operative connections in such regulators. There is a growing demand, particularly in connection with aircraft, for a compact, sturdy and efficient carbon pile regulator adapted for working with a minimum of friction and with a high degree of accuracy over prescribed working ranges. The principal object of the present invention is to provide a regulator capable of meeting this demand and of satisfying the exacting requirements referred to.

According to this invention the magnet of a carbon pile regulator comprises a central pole and two side poles and the clapper type armature which is frictionlessly mounted is of U-form presenting two chopper-like blades which enter the gaps between the poles. By contouring the edges of the blades, the magnet can be given a straight line rising pull characteristic to match the action of the spring, the compressive action of the latter on the pile being opposed by the attraction of the armature by the magnet. The clapper like carrier of the U-form armature piece is tiltably mounted by the aid of blade spring fulcra so as to work as frictionlessly as possible and an extension of the clapper beyond the fulcrum point is under the influence of the pile-compressing spring and flexibly connected with a presser device engaging the appropriate end of the pile.

In order to enable the invention to be readily understood reference is made to the accompanying drawings, wherein:

Figure 1 is a side elevation and Figure 2 is a plan of a carbon-pile regulator constructed and adapted for operation in accordance with the present improvements.

Figure 3 is a perspective view to a larger scale of operative parts similar to those embodied in the construction illustrated by Figures 1 and 2.

Figure 4 is a side elevation illustrating a modification of the armature.

Figure 5 is a perspective view illustrating a further modification of the armature,

Figure 6 is a sectional elevation illustrating a modification involving changes in both the armature and the magnet of a regulator, and

Figure 7 is a side elevation illustrating a further modification of the armature.

Referring to Figures 1 and 2, the regulator therein illustrated comprises a carbon pile *a* which is put under compression by a tension spring *b* the compression being relieved by an armature *c* when sufficiently attracted by a magnet *d*.

The electro-magnet *d* in Figures 1 and 2, is generally of the construction seen more clearly in Figure 6. That is to say, it consists of an assemblage of laminations of the so-called W-form, each lamination comprising a base portion d^1, two side limbs d^2, a middle limb d^3, and lateral projections d^4 on the limbs d^2, such projections forming pole pieces. Polar gaps *e* are thus provided between the edges of the lateral projections d^4 and the opposed edges of the upper parts of the middle limbs d^3 of the laminations. The magnet coil *v* is disposed around the core *d* and within the side limbs d^2. In Figure 6, the gaps *e* are wider at the top than at the bottom but in Figures 1 and 2 these gaps would lie between parallel walls so as to be of the same width from top to bottom.

The armature in Figures 1 and 2 is of the clapper type, the armature piece *c* being an inverted U-section short length of iron carried by a clapper plate *f*. The latter, as seen in Figure 2, is narrowed down at the right hand end so that it can be straddled by the armature piece *c*, screws *g* being used for fixing the piece *c* down on the narrow end portion of the plate *f*. At its opposite end, the plate *f* is additionally widened by lateral extensions f^1 which extensions are formed with drop arm portions f^2. The regulator framing comprises a base plate *h*, top bars h^1 and vertical pillars h^2. To the ends of the top bars h^1 there are secured by screws the lower ends of vertical blade springs *j* the upper ends of these springs being secured by screws to the front faces of the lateral extensions f^1 of the clapper. Upon the top surface of the end portions of the top bars h^1 there are secured the inner ends of horizontal blade springs *k*, the outer ends of the latter being secured by screws to the lower surfaces of the drop arms f^2 of the clapper. The horizontal blade springs *k* may be wider than the vertical blade springs *j* and may be slotted to permit the latter to pass through and intersect them. The point of intersection, marked *x* in Figure 1, is the centre point of the pivotal mounting provided by the two blade springs *j k* at right angles to one another. The springs *j k* are described as vertical and horizontal respectively because they appear so in the drawings. In use, the regulator would usually be mounted with the pile disposed horizontally, so that the aforesaid descriptive terms would not apply. Owing to the widening of the clapper plate *f*, the lateral extensions f^1 are spaced widely apart with the consequence that

the two sets of springs j k form widely spaced fulcra permitting of the hinge-like movements of the clapper plate f in a very desirable manner. These blade spring mountings are in themselves known, but they are very advantageously adopted for use in combination with the means provided in accordance with the present improvements.

The lower end of the spring b is attached to a screw threaded rod l which passes freely downwards through a hole in a bent bracket m bolted to the base plate. A nut l^1 screwed on to the rod l forces a washer l^2 formed with knife edge projections, as seen in Figure 1, against the underside of the bracket m. The tension of the spring b is thus adjustable by operating the nut l^1. At its upper end, the spring b is attached to a stud n engaged with one of the drop arms f^2 of the clapper plate f. If desired, two springs may be used, one at each side, instead of at one side only as shown. The pile a is supported by a screw threaded plug o screwed through an extension h^1 of the base plate h. The compression of the pile can be adjusted by turning the screw plug o in the usual manner.

Means for applying pressure at the top of the pile for the compression thereof will now be described with reference to Figures 1, 2 and 3. A presser ring p is fitted on top of the pile a, the ring p being formed with side lugs p^1. Short flexible steel straps q have their upper ends secured by screws to the lugs p^1 and their lower ends secured by screws r to drop arms s on the extensions f^1 of the plate f, as will be clear by examining Figures 1 and 3 together. Due to the nature and disposition of the flexible straps q only a purely downward and balanced pull is imparted to the presser ring p at diametrically opposite side points. The ring p is further provided with a front lug p^2 to which is attached by a screw the folded upper end of a flat bar or stiff strip t. The lower end of the strip t is bent at right angles to form a foot t^1 which rests upon and is attached to a bow spring u or a flexible diaphragm. The extremity of the folded portion at the top of the bar t is likewise bent at right angles to form a lug t^2 which rests upon and is attached to an upper bow spring u^1 or an upper diaphragm. By mounting the bar or strip t in this manner it can have only straight line motion and due to its rigid attachment to the lug p^2 of the ring p the latter is guided and constrained to have only straight line motion in compressing and decompressing the pile a. The circular or annular discs composing the pile are thus at all times uniformly compressed all over their surface area, owing to the manner in which the pull and guidance are imparted to the ring p.

The spring b, acting through the connections above described, normally compresses the pile a and maintains the clapper plate f in the tilted position seen in Figures 1 and 3 with the blades of the armature piece c out of or just entering the gaps e between the magnet poles. These gaps e in Figures 1 and 3 would be parallel gaps having a width a little greater than the thickness of the armature blades and they would not be flared gaps such as are shown in Figure 6. Now, by contouring the edges c^1 of the armature blades, as in Figures 1 and 3, or as in Figure 4, it follows that a determined increasing amount of iron enters the pole gaps e as the armature is attracted. By adopting an appropriate contour, therefore, it is possible, with great accuracy, to obtain a straight line rising pull characteristic with fixed ampere turns on the magnet coil v and such characteristic can be determined so as to match the characteristic of the spring b. In Figure 3, the contour of the edges c^1 is composed of curves so that the blades in side elevation have a contour something like an inverted shoe. In Figure 4 the contour of the edge c^1 is a straight line running from the shallow forward end of a blade to the deeper rearward end.

Alternatively to contouring the edges of the armature blades in the manner just explained, it is possible to contour the faces of the armature blades to provide a variable air gap and secure the desired characteristic. For example, and as illustrated in Figure 6, the armature blades c^2 are of tapered thickness, so that they are thin at the edge and thick at the root. Also the gaps e are correspondingly tapered or flared. Generally speaking, it is more convenient to contour the edges and employ parallel air gaps as described with reference to Figures 1 and 3.

The yoke or bridge piece c^3 Figures 3 and 6, connecting together the armature blades at the top of the inverted U-form may be arranged to provide an additional pull when the armature reaches its inward position, such additional pull being due to the direct attraction of such bridge piece c^3 by the end of the magnet core d^3. For this purpose, the U-section armature instead of straddling the narrow end portion of the plate f, as above described, may be fixed with its bridge piece c^3 against the under surface of such narrow end portion.

In the foregoing examples, the armature blades c were extended at right angles to the fulcrum axis x of the clapper. If desired, however, and as illustrated in Figure 5, the inverted U-section armature piece may be mounted transversely of the clapper plate f and so that its blades c^4 are parallel with the fulcrum axis x above referred to. A desired characteristic can be obtained by contouring the entering edges of the armature blades c^4. In the example illustrated in Figure 5, the edges c^5 are curved so that each blade c^4 is deeper in the middle than at the ends. This arrangement has the advantage of causing less side strain on the spring hinge mountings j k, Figures 1 to 4, of the clapper, in the event of the armature blades not being correctly centered in their air gaps, seeing that the blades c^4 in Figure 5 are spaced in tandem along the clapper and do not depend from respective sides thereof as in Figures 1 to 4 and 6. In Figure 5, it will be observed that the U-section armature piece is secured to the underside of the clapper plate, thereby illustrating the alternative arrangement referred to as possible for the constructions in Figures 1 to 4 and 6. Instead of contouring the edges c^5 of the blades c^4 as described with reference to Figure 5, a desired characteristic can be obtained by chamfering or otherwise contouring the faces of the blades c^4, as will be readily understood after the description given with reference to Figure 6.

Figure 7 shows an armature having a cross section such as is shown in Figure 6, but the leading or entering edge c^7 of the armature is made so that it enters the polar gap abruptly; a straight line force-movement characteristic is ensured by contouring the trailing edge c^8 which is the last portion of the armature to enter the said gap.

The examples hereinbefore described achieve the objects of this invention and are adapted for giving with a high degree of accuracy the working effects predetermined for a given regulator. The working of armature blades in respective gaps

between a middle pole and two side poles is highly advantageous as compared with known devices wherein a single contoured armature piece works in a single gap between two poles only, because in the former the two side poles provide a magnetic shield which keeps the external magnetic field down to a comparatively low value. This consideration is of particular importance when regulators are required for use on aircraft.

We claim:

1. An electric regulator of the carbon pile type comprising a magnet having a central pole and two side poles, and a U-form clapper type armature frictionlessly mounted and presenting two chopper-like blades entering the gaps between the poles.

2. An electric regulator of the carbon pile type comprising a magnet having a central pole and two side poles, and a U-form clapper-type armature frictionlessly mounted and presenting two blades entering the gaps between the poles, the edges of said blades being contoured to give a predetermined magnet characteristic.

3. An electric regulator of the carbon pile type comprising a magnet having a central pole and two side poles, and a U-form clapper-type armature frictionlessly mounted and presenting two blades entering the gaps between the poles, the faces of the blades being contoured to give a predetermined magnet characteristic.

4. An electric regulator of the carbon pile type comprising a three-pole magnet, a U-form clapper-type armature, presenting contoured blades for entry into the polar gaps, and blade spring mountings providing frictionless pivotal support for said armature, the blades of said armature and the polar gaps being disposed at right angles to the pivot axis of said blade spring mountings.

5. An electric regulator of the carbon pile type comprising a three-pole magnet, a U-form clapper-type armature presenting contoured blades for entry into the polar gaps and blade spring mountings providing frictionless pivotal support for said armature, the blades of said armature and the polar gaps being disposed parallel with the pivot axis of said blade spring mountings.

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