Oct. 30, 1956 A. J. HOOKHAM 2,769,134

VOLTAGE REGULATORS FOR ELECTRIC CURRENT GENERATORS

Filed Sept. 17, 1953

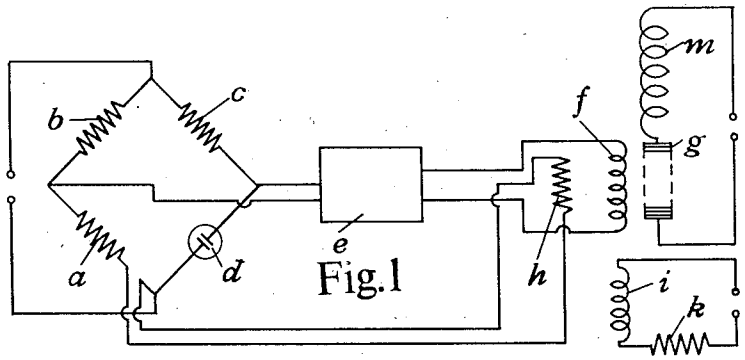


Fig.1

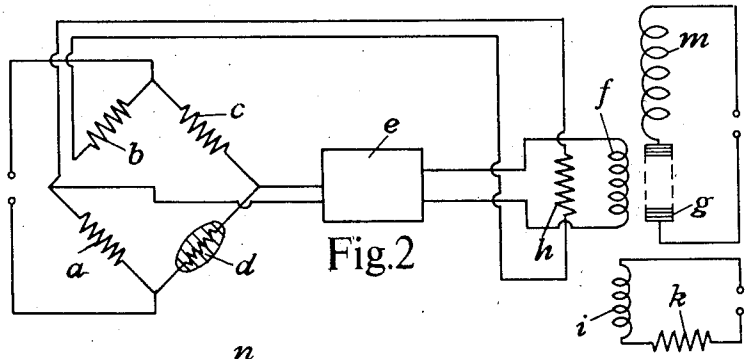


Fig.2

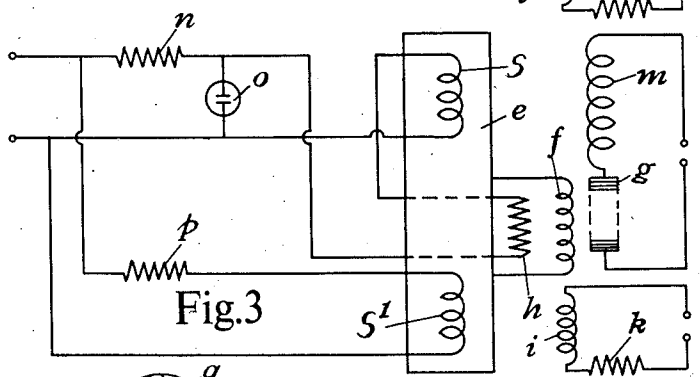


Fig.3

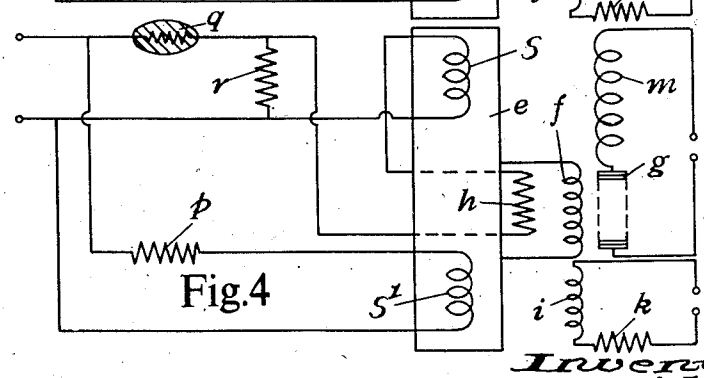


Fig.4

Inventor
A. J. Hookham
By Glascock Downing & Seibold
Attys.

United States Patent Office 2,769,134 Patented Oct. 30, 1956

2,769,134

VOLTAGE REGULATORS FOR ELECTRIC CURRENT GENERATORS

Albert John Hookham, Ewell, Empson, England, assignor to Rotax Limited, London, England

Application September 17, 1953, Serial No. 380,810

2 Claims. (Cl. 322—28)

This invention relates to voltage regulators for electric current generators, of the kind comprising a carbon-pile resistance for connection in series with the field winding of the generator; and electromagnetic means responsive to the generator or an associated voltage for controlling the resistance; the said electromagnetic means being provided with current through a bridge or equivalent means which includes a neon or equivalent gas-discharge bulb, or other resistance device having a non-linear voltage-current characteristic, and current-amplifying means between the said bridge or its equivalent and the said electromagnetic means.

The primary object of the invention is to enable the effect of temperature changes on the said electromagnetic means to be automatically compensated.

A further object of the invention is to enable transient changes in the controlling means to be automatically stabilised.

The invention comprises a regulator of the kind aforesaid having in association with the electromagnetic means acting on the carbon pile, a temperature-variable resistive, or resistive and inductive, means adapted to modify the action of the bridge or equivalent means for maintaining in the winding of the said electromagnetic means an exciting current which is independent of the effects of temperature changes in the winding.

In the accompanying diagrams:

Figure 1 illustrates one form of voltage regulator in accordance with the invention.

Figures 2 to 4 illustrate respectively three modified forms of the invention.

In carrying the invention into effect as shown in Figure 1, there is provided a four-arm bridge, three of the arms of which consist of resistances *a*, *b*, *c*, and the fourth arm of which includes a neon or other equivalent gas-discharge bulb *d*. One opposite pair of points of the bridge are connected through an amplifier *e* to the ends of the winding of the electromagnet *f* which controls the carbon pile *g*. The other opposite pair of points are connected to the generator, or an associated system supplied by the generator. When applied to an alternating current generator the said points are connected to the generator or said system through a rectifier.

In the arm of the bridge containing the resistance *a* there is connected in series with the said resistance a temperature-variable compensatory winding *h* which is mounted in thermal association with the electromagnet winding *f* above mentioned.

The compensatory winding *h* is made from copper or other metal having a positive temperature coefficient of resistance, and is suitably correlated with the normal working temperature of the electromagnetic winding *f*. For the purpose of the first mentioned object of the invention, the winding *h* is non-inductive and is adapted to modify the action of the bridge for compensating the effects of temperature changes in the winding *f*. For the purpose of the second object the winding *h* is made inductive and is adapted also to supplement or oppose the magnetic action of the winding *f*, with transient changes of current in the winding *f*.

As an alternative to a gas discharge tube *d* in one of the arms of the bridge, there may be inserted a resistance having a non-linear voltage-current relationship, such as for example the material known by the registered trademark "Metrosil."

In addition there may be combined with the winding *f* an auxiliary winding *i* adapted to provide a minimum electromagnetic action on the pile, to avoid having to provide through the amplifier *e* the whole of the current required by the electromagnet. Direct current is supplied to the auxiliary winding *i* through a resistance *k* from any convenient source of supply, the resistance being adapted to swamp the effect of temperature changes of resistance in the winding *i*.

The field winding of the generator to be controlled by the pile is indicated by *m*, and direct current is supplied to it from any convenient source.

As another alternative to the neon tube *d* or the equivalent resistance above mentioned in one arm of the bridge, a barretter as indicated by *d* in Figure 2 may be used. In this arrangement the part *h* is connected to the arm of the bridge containing the resistance *b*. Otherwise the arrangement shown in Figure 2 is similar to that shown in Figure 1.

Instead of a bridge any other equivalent means may be used for supplying current to the amplifier, and two examples are illustrated by Figures 3 and 4.

Referring to Figure 3, two oppositely-acting electromagnetic coils *s*, s^1 forming part of the amplifier *e* are connected to a direct current source through a pair of separate circuits. The circuit connected to the coil *s* contains a resistance *n* and the compensating component *h*, the potential across this circuit being maintained constant by a neon bulb *o* arranged as shown. The circuit of the other coil s^1 includes a resistance *p* and is connected to the source in parallel with the first. The potential in the second circuit varies with that of the source. In other respects the system shown in Figure 3 is similar to that of Figure 1, and is identifiable therewith by the same reference letters.

The arrangement shown in Figure 4 is suitable for connection to either a direct or an alternating current source, and it differs from Figure 3 in that a barretter *q* is included in the constant potential circuit connected to winding *s*, this circuit being also provided with a resistance *r* connected in parallel as shown. The variable-potential circuit connected to the other coil s^1 contains a resistance *p*. In other respects this arrangement is similar to that of Figure 3.

By means of regulators as exemplified above, the specified objects of the invention can be achieved in a satisfactory manner.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a voltage regulator of the kind specified for an electric current generator having a field winding, the combination of a carbon-pile resistance for connection in series with the field winding, electromagnetic means which is provided with an exciting winding and which is responsive to the generator voltage for controlling said resistance, circuital means forming resistive paths for current derived from the generator, current-amplifying means which is connected to said exciting winding and circuital means, and which serves in conjunction with said circuital means for supplying current to said exciting winding, said circuital means having a controlling resistance device which serves by its effect on current flow in one of said paths to cause the current supply to said exciting winding to vary with variations in the generator voltage, and a temperature-variable resistive means ar-

ranged in thermal association with said exciting winding and connected in series with one of said paths for modifying the action of said circuital means to maintain in said exciting winding a current which is independent of the effects of temperature changes in said exciting winding.

2. A voltage regulator according to claim 1, in which the circuital means comprises a pair of circuits each connected to the current-amplifying means, one of said circuits containing the temperature-variable resistive

means, and having the controlling resistance device connected thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

2,424,464	Honeywell	July 22, 1947
2,459,669	Mershon	Jan. 18, 1949
2,467,856	Rich	Apr. 9, 1949