Aug. 19, 1958 P. E. HOCHSTETTER 2,848,679

STABILIZATION OF REGULAR VOLTAGE UNDER SEVERE VIBRATION

Filed Feb. 1, 1954

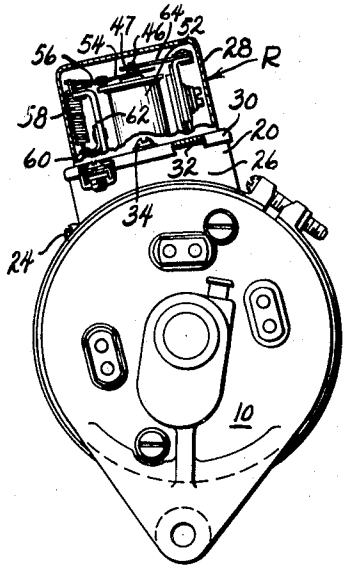


Fig. 3

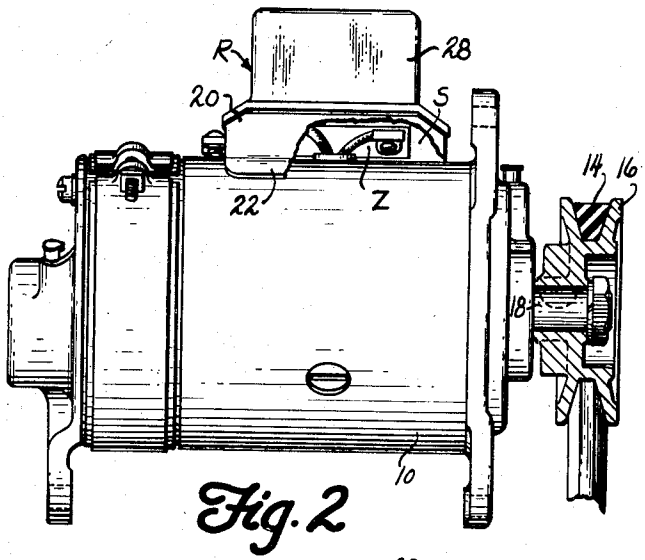


Fig. 2

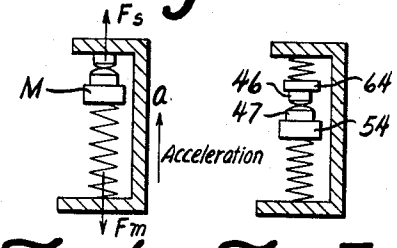


Fig. 6 Fig. 7

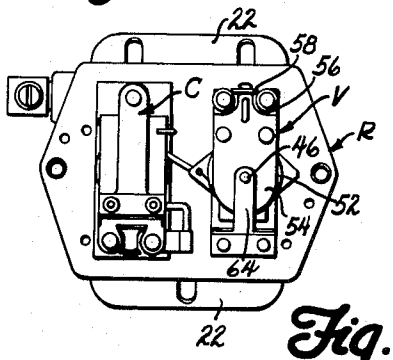


Fig. 5

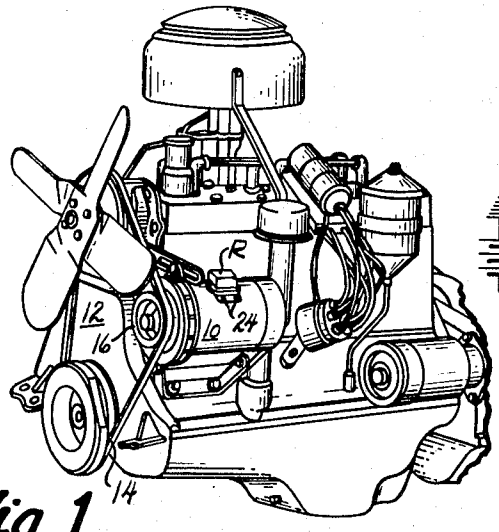


Fig. 1

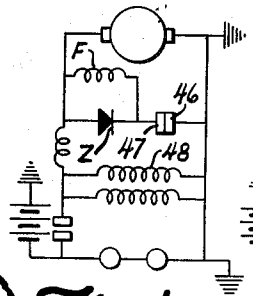


Fig. 4a

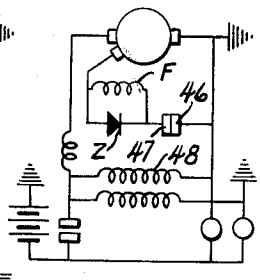


Fig. 4

INVENTOR.
PAUL E. HOCHSTETTER

BY
Talbey, Souther & Stoltenberg

United States Patent Office 2,848,679 Patented Aug. 19, 1958

2,848,679

STABILIZATION OF REGULAR VOLTAGE UNDER SEVERE VIBRATION

Paul E. Hochstetter, Toledo, Ohio

Application February 1, 1954, Serial No. 407,444

2 Claims. (Cl. 322—28)

This invention relates to regulators for variable speed shunt or third brush generators, more particularly to regulators mounted on the frame of such generators where their action may be influenced by vibration.

Vibratory regulators for variations of voltage of variable speed shunt generators have in the past been mounted on a relatively stable base such as the fire wall of an automobile body. When such regulators are mounted directly on the engine of the automobile or a component part thereof, such as the generator itself, the vibration of the engine or component part may be so great that the vibratory action of the regulator is influenced, as, for example, the operating voltage of the regulator is substantially lowered below that found when the regulator is mounted in more stable conditions. Severe external vibrations are, therefore, to be avoided, particularly when the direction of the vibrations is in the same direction as the movement of the vibratory armature of the regulator.

The present invention contemplates the provision of a means to compensate for external vibrations with reference to vibratory regulators, so that the influence of severe external vibrations on the regulator is greatly reduced. This allows the regulator to be mounted in some cases in an unfavorable condition where the vibration heretofore has prevented and thereby takes advantage of other factors not before available, such as shortened leads, cheaper shielding against radio emanations, and the like.

Another aspect of the invention is that it allows the use of arc-quenching rectifiers with regulators of the vibratory type, which permits the use of higher generator field currents or greatly increases the life expectancy of the regulator contacts. The rectifiers, however, have the disadvantage that they create excessive radio disturbances unless careful shielding of conductors between the regulator and the generator is provided which is commercially unfeasible due to the great cost involved. If, however, the regulator with its arc-quencing rectifier is mounted directly on the generator frame, where it is subject to excessive vibration, the shielding is easily attained, but in the past, this solution was not available due to the influence of the excessive vibration on the regulating action of the vibratory regulator. The present invention obviates this difficulty by providing a means which stabilizes the regulating action of the regulator in a very inexpensive effective manner.

It is, therefore, a principal object of this invention to provide a compensating means which allows it to be mounted directly on the casing of the shunt generator being controlled, so that the regulator remains responsive to predetermined conditions in the generator even though subjected to severe vibration.

It is a further object of the invention to provide compensation in a vibratory regulator for a shunt generator against the effects of severe vibration, so that the regulator operates uniformly under all operating conditions.

It is a further object of the invention to provide compensation in a vibratory regulator against severe vibration, so that the regulator may be mounted directly on the casing of the generator being regulated, and may be provided with simple and reliable shielding means for rectifiers used as arc-quenching means to prevent undue radio disturbances.

Other objects and advantages of this invention relating to the arrangement, operation and function of the related elements of the structure, to various details of construction, to combinations of parts and to economies of manufacture, will be apparent to those skilled in the art upon consideration of the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Referring to the drawings:

Fig. 1 is a perspective view of a motor with a generator mounted thereon with the regulator positioned on the generator housing;

Fig. 2 is a side elevational view of a generator to which the invention has been applied;

Fig. 3 is an end elevational view of the generator shown in Fig. 1;

Fig. 4 is a schematic diagram of connections of the third brush generator with a rectifier in the circuit;

Fig. 4*a* is a view similar to Fig. 4 except with a shunt generator;

Fig. 5 is a plan view of the vibratory regulator, and Figs. 6 and 7 are schematic representations of comparative mounting means for the contact points.

Referring to the drawings, particularly to Fig. 1, a generator 10 is shown, which is mounted in the well-known manner on the side of a reciprocating engine 12 of an automobile or tractor where it is subjected to all the vibrations attending the operation of the vehicle. The generator is of either the shunt or the third brush type being driven by the engine by a V-belt 14 cooperating with a pulley 16 mounted on the armature shaft 18 in the well-known manner. Mounted on the tubular frame of the generator, preferably adjacent its upper side, is the casing of a vibratory regulator R consisting of a base member 20, having mounting flanges 22 of curved conformation to embrace the tubular frame of the generator to which it (20) is attached by screws 24. The base member 20 is also provided with arcuate end flanges 26 which closely fit against the frame to enclose a space S, into which are fitted operating instrumentalities of the regulator R as will be further described hereinafter.

Fitted above the base member 20 is a casing member 28 having an outwardly extending flange 30 at its lower periphery to cooperate with the base member 20 having a sealing gasket 32 positioned between for the purpose of forming a seal against the atmosphere for the space enclosed by the casing member 28. Screws 34 are provided to hold the parts together in sealed relation. In this manner, two superposed chambers are formed, one within the upper casing 28 which is preferably sealed and a lower chamber S, which is not sealed but forms an enclosure in which operating elements of the device are mounted.

Within the upper chamber and on the base member 20 are mounted a pair of control devices, a circuit breaker C, and a voltage regulator V. The circuit breaker C is constructed in the well known manner of a reverse current relay.

The voltage regulator V is vibratory and is, therefore, more sensitive to vibration. The special provision for compensation contemplated by this invention is applied to this device to obviate the lowering in operating voltage found when the voltage regulator is subjected to severe vibration because the vibration causes its regulating

contacts 46 and 47 to stay open a greater percentage of the time than would be the case where operation occurs without external vibration. The contacts 46 and 47 are connected in series with the field winding F of the generator, which thereby open and close the field in accordance with the voltage generated which acts upon the electromagnetic actuating coil 48, which acts upon vibratory armature 54 mounted on a hinge 56. A helical spring 58 is also provided to bias the armature to open the air gap with the core 52, adjustably anchored on bracket 60 affixed to U-shaped frame 62 of magnetic material which is part of the magnetic circuit acting through coil 48, and to which the end of the hinge 56 is also anchored.

The lower contact 47 of the vibratory contacts is mounted on the upper side of the armature 54 (Fig. 3) while the upper contact 46 is mounted on a leaf spring 64 affixed in substantial parallel relation with the armature 54 and its mounting hinge 56, to the opposite arm of the U-shaped frame. In order to reduce sparking at the contact points when opening and closing the inductive field circuit, a rectifier Z of a dry plate type may be connected in parallel with the field, being preferably mounted in the lower chamber S which completely surrounds the rectifier and forms a metallic shield to substantially prevent radio emanations from the connecting leads between regulator and generator during operation.

The compensating features to obviate the deleterious effects of the vibration are incorporated in the resilient mounting means for the vibratory contact 46 already described and comprise a relation between the mass vibrating in response to the magnetic effects of the coil 48 and the resilient mountings for such vibratory parts including the resilient mount for the relatively fixed (upper) contact point 46. Referring to Fig. 6, if F_s is the spring force, F_m is the magnetic force, both acting upon the mass M, and A is acceleration active in a direction parallel to F_s then if

$$A > \frac{F_s - F_m}{M} > 0$$

the contacts will separate and change the relations in the voltage regulator so as to cause it to operate at a lower voltage. If now both contacts 46 and 47 are mounted resiliently, as shown in Fig. 7, and the supports of the contacts are designed so that their acceleration in response to movement of the framework is substantially alike, the contact points will not as readily separate under shock or when subjected to severe vibration. The rate of acceleration of the contacts in response to the movement of the framework obviously involves consideration of their mass and the resiliency of the mounting means. The combined effect of these two factors can be expressed in what is known as static deflection. When this static deflection of the stationary contact mounted resiliently is greater than .0001 inch, the effect of shock or excessive vibration is substantially reduced, and it is preferable to increase the static deflection of the relatively fixed contact (46) to limits from about .0001 to .0010 inch.

The static deflection is preferably measured by mounting the contact assembly in such a manner that the direction of its movement by gravity is substantially vertical. The position of the contact relative to the rigid framework can then be determined. If this framework is now turned upsidedown, so that the direction of contact movement is again substantially vertical, the position of the contact relative to the framework will have changed by double the amount of the static deflection. It will be understood that the static deflection can be measured by other well known methods or means.

When the regulator R is mounted directly on the generator frame where it is subjected to the engine vibration, the predetermined resilient mounting of the regulatory contact point 46 will compensate for the effects of the vibration and allow the vibratory regulator to regulate the field current in the usual manner. By carefully fitting the base member 26 to the curved frame of the generator, a shielded space S is provided in which is mounted the rectifier Z as shown in Fig. 2, so that radio emanations encountered by the use of the rectifier in the regulating circuit, as shown in Fig. 4, are shielded and, therefore, nullified. The use of the rectifier Z in parallel with the field and in series with the contact points, connected to block a short circuit of the generator through the contact points, allows the use of a substantially heavier field current for the generator giving a higher relative output with the same life expectancy for the contact points 46 and 47. This result is a substantial commercial advantage by providing a higher generator output with the same weight and size of generator and with the same life expectancy. In the past, this was not commercially feasible, because no cheap and satisfactory shielding means was available to screen the radio emanations when the regulator was mounted in separated relation with reference to the generator, as was necessary because the excessive vibration of the generator changed the operational characteristics of the regulator when mounted thereon.

It is to be understood that the above detailed description of the present invention is intended to disclose an embodiment thereof to those skilled in the art, but that the invention is not to be construed as limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of being practiced and carried out in various ways without departing from the spirit of the invention. The language used in the specification relating to the operation and function of the elements of the invention is employed for purposes of description and not of limitation, and it is not intended to limit the scope of the following claims beyond the requirements of the prior art.

What is claimed is:

1. In a device of the class described, a pair of cooperating vibratory contacts adapted to open and close a regulating circuit for a generator operating under conditions of severe vibration, said vibratory contacts being mounted on said generator and subject to said vibration, electromagnetic means also mounted on the generator to vibrate said contacts relative to each other to open and close the field circuit of said generator to thereby regulate the voltage generated by the generator, resilient means to mount each of said contacts on said generator, the resiliency and mass of the resilient means and contacts being selected so that their static deflections are substantially equal and greater than .0001 inch.

2. In a voltage regulating device for a direct current generator mounted for use under severe vibration and provided with a metallic housing member enclosing the generator, a pair of operative vibratory contacts each resiliently mounted on resilient means on said generator the mass and flexibility of the contacts and their mounting means being selected to be substantially equal and having static deflections greater than .0001 inches said contact points being connected in series with the generator field and adapted to open and close the field circuit to thereby regulate the voltage of said generator, electromagnetic means to actuate one of the vibratory contacts in response to voltage variations to open the field circuit, a rectifier connected in parallel with the generator field to suppress the arc at the vibratory contacts when the contacts are separated by the electromagnetic means to open the field circuit, and a metallic housing enclosing said regulating device adapted to be attached to the metallic housing member of the generator to completely enclose and shield the regulating device to substantially prevent radio emanations therefrom.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

1,398,648	Replogle	Nov. 29, 1921
1,576,768	Loudon	Mar. 16, 1926
1,691,203	Lee et al.	Nov. 13, 1928
1,844,790	Norviel et al.	Feb. 9, 1932
2,091,174	Zapp et al.	Aug. 24, 1937
2,203,727	Herbst	June 11, 1940
2,209,051	Clayton	July 23, 1940
2,372,144	Weybrew	Mar. 20, 1945
2,595,024	Toulon	Apr. 29, 1952

FOREIGN PATENTS

379,888	Germany	Sept. 1, 1923
457,131	Great Britain	Nov. 23, 1936
636,366	Great Britain	Apr. 26, 1950