March 1, 1960 E. M. CROCCO 2,927,173

GOVERNOR FOR SMALL MOTORS

Filed April 29, 1959

FIG. 1

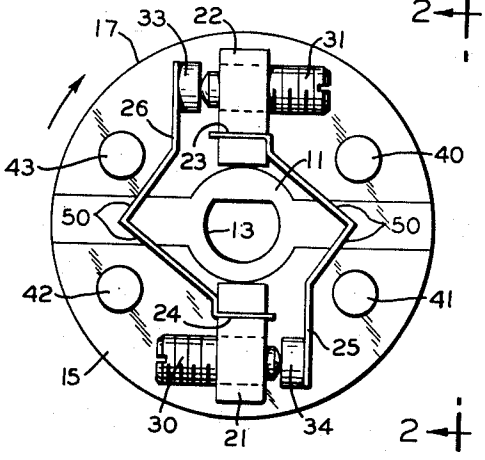


FIG. 2

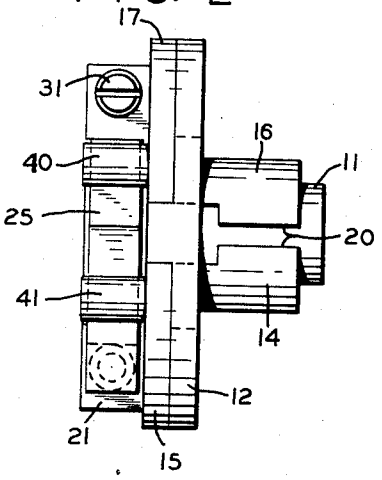


FIG. 3

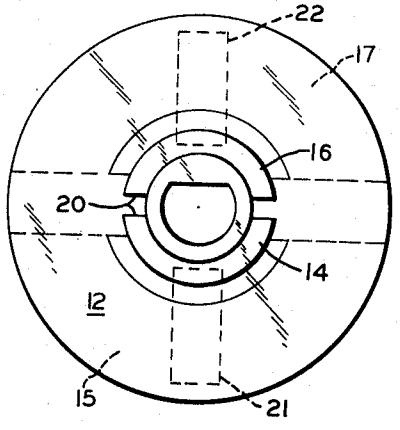


FIG. 4

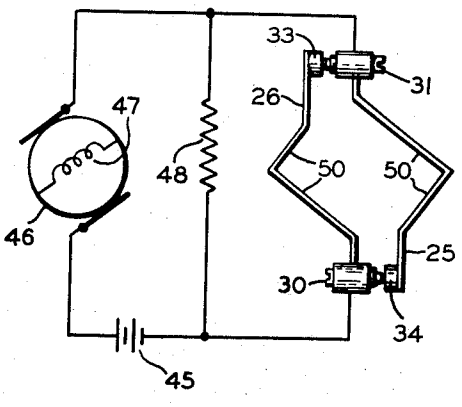


FIG. 5

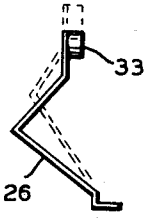


FIG. 6



INVENTOR
EDWARD M. CROCCO

BY Ervin B. Steinberg
AGENT.

United States Patent Office 2,927,173 Patented Mar. 1, 1960

2,927,173

GOVERNOR FOR SMALL MOTORS

Edward M. Crocco, Greenwich, Conn., assignor to The Reflectone Corporation, Stamford, Conn., a corporation of Connecticut

Application April 29, 1959, Serial No. 809,678

8 Claims. (Cl. 200—80)

This invention generally has reference to a governor for electrically energized rotating devices and, more particularly, refers to a speed governor for very small motors, for instance, permanent magnet direct current motors as used in battery operated office machines, portable dictating machines, missile control systems and in many other and similar applications.

This invention is related also to copending applications for U.S. Letters Patent, Serial No. 748,836, filed July 16, 1958, entitled "Governor for Small Motors," now U.S. Patent No. 2,886,666, dated May 12, 1959, and to Serial No. 785,593, filed January 8, 1959, entitled "Speed Governor for Motors or the Like." In these applications governor designs are disclosed which are characterized by extreme reliability, accuracy, and minimum space requirements and, in addition, the latter application reveals a rotational speed governor design which maintains high accuracy of speed regulation for either direction of rotation by taking advantage of the forces acting upon the contact arrangement during acceleration and deceleration of the rotating assembly.

The design described hereafter refers to improvements in the governor contact construction in order to extend the useful life of the unit and concerns primarily the form and shape of the contact so as to effect a pronounced wiping action between a pair of interrupting contacts. This wiping action is achieved by providing the leaf spring type oscillating contact element with a formed portion intermediate its two ends thereby increasing the developed length of the spring. Under the influence of centrifugal force, the contact disposed at the free end of the spring not only is forced away from engagement with a fixed contact, but the leaf spring tends to elongate thereby obtaining a wiping action during opening and closing of the periodical interrupting contacts. The improvement described in the instant disclosure refers, therefore, to a governor construction employing a plurality of leaf spring contacts, each of the leaf spring contacts having a formed or fluted portion which substantially increases the developed length of each leaf spring.

One of the objects of this invention, therefore, is the provision of a new and improved governor design which avoids one or more of the disadvantages and limitations of prior art devices.

Another object of this invention is the provision of a governor design equipped with improved leaf spring contacts.

A further object of this invention is the provision of a governor for small direct current motors which employs a set of leaf spring contacts, each leaf spring being provided with an intermediate formed portion to increase the developed length of the spring.

A still further object of the invention is the provision of a governor design employing leaf spring contacts wherein each leaf spring is provided with means which cause a pronounced wiping action during opening and closing of the interrupting contact.

A further and other object of this invention is the

provision of a governor design employing a set of leaf springs with increased wiping action between the interrupting contacts, the assembly being designed for preferred clockwise or counterclockwise rotation so as to maintain precise speed regulation.

Further and still other objects of this invention will be apparent by reference to the following specification taken in conjunction with the accompanying drawings in which:

Figure 1 is a plan view of the governor design showing the contact arrangement assembled for clockwise rotation;

Figure 2 is a side elevational view as seen along lines 2—2 in Figure 1;

Figure 3 is a plan view at the underside of the governor design;

Figure 4 is a schematic circuit diagram showing the electrical connections of the governor in conjunction with the motor to which the governor is attached;

Figure 5 is a sketch showing in an exaggerated manner the effect of certain forces on the leaf spring contact, and

Figure 6 is a typical alternate design for a leaf spring contact embodying the principle described herein.

Referring now to the figures and Figures 1, 2 and 3 in particular, numeral **11** identifies an annular bushing, which together with plate **12** forms a unitary flange made of insulating material, for instance, nylon or other suitable plastic compositions. This flange is usually mounted by means of aperture **13** on a rotatable shaft which extends through the flange.

Onto this flange made of insulated material, there is mounted a divided flange made of metallic material, for instance, brass, which includes a first flange half comprising half bushing **14** and plate **15**, and a second flange half comprising half bushing **16** and plate **17**. Both metallic flange halves are separated by a slot **20** in order to effect electrical isolation therebetween. It will be understood, however, that both metal portions and the portions made of plastic material form a unitary molding.

Projecting upward from metal plate **15** there is an upstanding metal block **21** which forms a part of plate **15** and conversely upstanding block **22** forms a part of metal plate **17**. Each of these blocks is equipped with a transverse slot **23** and **24**, respectively, in which there is secured a leaf type contact spring **25** and **26**, respectively. This type of mounting is commonly known as cantilever type. The leaf contact springs are made of resilient metal, for instance, beryllium-copper alloy or similar material in order to be compliant. The contact springs may be secured in the slot by staking.

Screws **30** and **31**, respectively, protrude transversely through each of the blocks to engage the free end of one of the contact leaf springs extending thereto, the free end of each spring being equipped with suitable contact material **33** and **34**, respectively. The contact material, for example, may be a platinum-iridium alloy and similarly, the tips of the screws **30** and **31** may be made of the same alloy.

When the entire assembly is mounted on a shaft and rotated, by action of centrifugal force the free end of each leaf spring is urged outwardly so as to break contact with the associated screw contact. Upstanding bosses **40**, **41**, **42** and **43** which are made of insulating material and which form an integral part with insulated disk **12** serve as mechanical stops for the springs in the event that the assembly is wired incorrectly into the electrical circuit.

The operation of the governor may be visualized as follows: The governor is mounted on the rotor shaft of a direct current motor and connected in series with a supply voltage. Electrical circuit connection to the governor construction is accomplished by means of a set of diametrically opposed stationary contact brushes, one

brush engaging half bushing **14** and the other brush engaging bushing **16**. As explained previously, bushing **14** is in electrical contact with block **21** and bushing **16** in contact with block **22**. Figure 4 illustrates the circuit connection and shows a source of direct current **45** connected in series with motor **46** and the governor. Numeral **47** represents the rotor winding of the motor. When fixed contact screw **31** engages contact **33** attached to the free end of leaf spring **26**, or contact **30** engages contact **34** attached to the free end of leaf spring **25**, the circuit from the source of energy is closed and motor winding **47** receives electrical power. As soon as preadjusted speed is reached, centrifugal force urges the free ends of contact leaf springs **25** and **26** away from engagement with the respective fixed contact screws, thus interrupting the circuit from the power source, causing the motor to slow down, until contact is reestablished. This cycle of events is repeated over and over again as is well known in the art.

It will be apparent that two sets of contact springs and corresponding contact screws are used whereas a single circuit making and breaking arrangement would suffice. The provision of double contact means increases the life of the governor and, furthermore, assures operation in the event of failure of one of the contacts. In this manner, reliability of operation of the motor is greatly improved and chances of failure due to governor fault are reduced. High impedance resistor **48** connected across the governor assembly provides arc suppression. Instead of the resistor, a capacitor quenching circuit may be used with substantially the same results.

The speed of the motor is depending upon the setting of the screw contacts and will increase the farther the screws are adjusted in the direction toward the free end of the opposing leaf spring. Both contact halves must be set for the same speed, a condition which can readily be met by first adjusting one set of contacts and then the other set while using a small piece of insulating material to alternately disable one or the other set of contacts.

It will be noted that each leaf spring has been provided with a formed portion **50** which is disposed intermediate the fixed end and free end of the leaf. This provision serves to increase the developed length of the leaf spring thereby rendering the leaf spring more compliant. More important, however, this formed or fluted portion causes the leaf spring under the influence of centrifugal force, to vary its distance between the two ends thereby producing a wiping action of contacts **33** and **34** with respect to the associated opposing fixed contacts. This lengthwise expansion of the leaf spring under the influence of centrifugal force is depicted in a somewhat exaggerated manner by the dashed lines in Figure 5 wherein its is shown that the distance of the spring between the end which is secured to the mounting block and the free end which is in engagement with the rigid contact of the opposing mounting block will increase and decrease as the centrifugal force exerts its effect. Obviously, the spring rate of the leaf material itself must be of such order as to permit the lengthwise flexing motion to take place.

Instead of the design shown in Figure 5 it will be apparent that the leaf springs may be designed in an alternate manner, Figure 6, to include a curved, bowed, corrugated or similar formed section, either concave or convex, in order to increase the resiliency of the leaf spring and produce flexing motion along the longitudinal direction.

In copending application for U.S. Letters Patent, Serial No. 785,593, there is disclosed an arrangement for providing a governor assembly which will operate with accuracy of speed regulation in either direction of rotation. In general, it can be stated that the assembly must be constructed in such a way that the free end of the leaf spring is disposed at the trailing edge of rotation in order that the moments of force due to acceleration and deceleration together with centrifugal force aid the opening and closing of the leaf spring contact.

In the present design the two governor halves and the corresponding contact leaf springs are designed in an identical and interchangeable manner to permit the governor to be assembled for either clockwise or counterclockwise rotation to meet the above stated condition. The assembly depicted in Figure 1 is assembled for clockwise rotation. It will be noted that the leaf spring contact assemblies and adjusting screws **30** and **31**, respectively, can be reversed to attain the same accuracy of speed regulation in counter-clockwise rotation.

The governor construction described herein, due to its shaped contact leaf springs provides extremely reliable operation. Many hours of testing have shown that adhesion or fusion of interrupting contacts has been substantially eliminated thereby providing speed regulation with utmost accuracy, reliability and long life.

While there have been described certain embodiments of the instant invention, it will be apparent to those skilled in the art that various other modifications may be made without departing from the spirit of the present invention which should be limited only by the scope of the appended claims.

What is claimed is:

1. A speed governor for motors of the type described comprising: supporting means having a center of rotation; a pair of mounting means disposed substantially diametrically opposite one another on said supporting means; a pair of contact leaf springs; each spring secured with one end to one of said mounting means and the free end of each spring extending toward the opposite mounting means; adjustable contact means disposed in each of said mounting means and protruding therefrom to engage the free end of the leaf spring extending thereto, and each of said leaf springs having a formed portion which increases the developed length of the spring between the secured and free ends to cause the free end of each spring under the influence of centrifugal force to change its distance with respect to the secured end.

2. A speed governor for motors of the type described comprising: supporting means having a center of rotation; a pair of mounting means disposed substantially diametrically opposite one another on said supporting means; a pair of contact leaf springs; each spring secured with one end to one of the said mounting means and the free end of each spring extending toward and being in contact with the opposite mounting means when the speed of the motor is below a predetermined rate, and each of said leaf springs having a formed portion intermediate its fastened and free ends, said formed portion increasing the developed length of the spring between its two ends and permitting the free end of each spring under the influence of centrifugal force to change its distance with respect to the secured end.

3. A speed governor for motors of the type described comprising: supporting means having a center of rotation; a pair of mounting means disposed substantially diametrically opposite one another on said supporting means; a pair of resilient contact leaf springs disposed to straddle said center of rotation; each spring secured with one end to one of the said mounting means and the free end of each spring extending toward and being in contact with the opposite mounting means when the speed of the motor is below a predetermined rate, and each of said leaf springs having a formed portion intermediate its secured and free ends, said formed portion increasing the developed length of the spring between its two ends and permitting the free end of the spring under the influence of centrifugal force to change its distance with respect to the secured end.

4. A speed governor for motors of the type described comprising: supporting means having a center of rotation; a pair of mounting means disposed substantially

diametrically opposite one another on said supporting means; a pair of contact leaf springs made of resilient material straddling said center of rotation; each spring secured with one end to one of said mounting means and the free end of each spring extending toward the opposite mounting means; adjustable contact means disposed in each of said mounting means and protruding therefrom to engage the free end of the leaf spring extending thereto, and each of said leaf springs having a formed portion which increases the developed length of the spring between its secured and free ends, thereby causing the free end of each spring under the influence of centrifugal force to change its distance with respect to the secured end.

5. A speed governor for motors of the type described comprising: supporting means having a center of rotation; a pair of mounting blocks fastened to said supporting means and disposed opposite one another on an axis through said center of rotation; a pair of contact leaf springs made of resilient material straddling said center of rotation; each spring secured with one end to one of said mounting means and the other end of each spring being free and extending toward the opposite mounting means; contact means disposed in each of said mounting means which are adapted to engage the free end of the leaf spring extending thereto when the rotational speed of said supporting means is below a predetermined value, and each of said leaf springs having between the secured end and free end an undulated portion which increases the developed length of the spring thereby causing the free end of each spring under the influence of centrifugal force to change its distance with respect to the secured end and this change in distance producing a wiping action between the free end and the associated contact means when the speed of the governor approaches the predetermined value.

6. A speed governor for motors of the type described comprising: supporting means having a center of rotation; a pair of mounting blocks fastened to said supporting means and disposed opposite one another on an axis through said center of rotation; a pair of substantially identically shaped contact leaf springs made of resilient material straddling said center of rotation; each spring secured with one end to one of said mounting means and the other end of each spring being free and extending toward the opposite mounting means; contact means disposed in each of said mounting means which are adapted to engage the free end of the leaf spring extending thereto when the rotational speed of said supporting means is below a predetermined value and breaking said engagement when the speed is above said value, each of said

leaf springs having between the secured end and free end a formed portion which increases the developed length of the spring thereby causing the free end of each spring under the influence of forces effective during rotation of said supporting means to change its distance with respect to the secured end and this change in distance producing a wiping action between the free end and the associated contact means when the speed of the governor approaches the predetermined value.

7. A speed governor for motors of the type described comprising: supporting means having a center of rotation; a pair of mounting means disposed opposite one another on said supporting means; a pair of contact leaf springs straddling said center of rotation; each spring secured with one end to one of the said mounting means and the free end of each spring extending toward and being in contact with the opposite mounting means when the speed of the motor is below a predetermined rate, and each of said leaf springs having a formed portion intermediate its fastened and free ends, said formed portion increasing the developed length of the spring between its two ends and permitting the free end of each spring under the influence of centrifugal force to change its distance with respect to its secured end.

8. A speed governor for motors of the type described including a rotatable body comprising: a pair of flanges electrically insulated from one another; a mounting means disposed on each of said flanges; each of said mounting means provided with a rigid electrical contact; a pair of contact leaf springs straddling the center of rotation of said body; each spring secured with one end to one of said mounting means and the free end of each spring extending toward and being in engagement with the rigid contact of the opposite mounting means when the speed of the motor is below a predetermined rate and being free of said engagement when the speed is above said rate; each of said leaf springs having a formed resilient portion intermediate its fastened and free ends, and said formed portion increasing the developed length of the spring between its two ends thereby permitting the free end of each spring under the influence of centrifugal force to change its distance with respect to the secured end to produce a wiping action between the free end and the associated rigid contact as the speed of the body approaches the predetermined value.

References Cited in the file of this patent

UNITED STATES PATENTS

2,761,031	McDonald	Aug. 28, 1956
2,846,541	Evans et al.	Aug. 5, 1958
2,886,666	Chichester	May 12, 1959