W. W. DEAN.

APPARATUS FOR GOVERNING THE SPEED OF MOTORS.

APPLICATION FILED OCT. 19, 1903.

1,107,914.

Patented Aug. 18, 1914

4 SHEETS—SHEET 1.

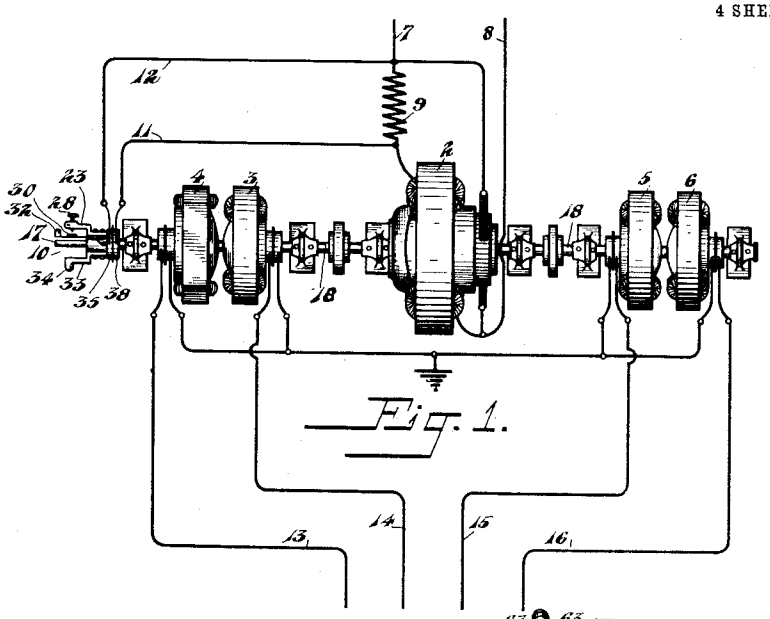

Fig. 1.

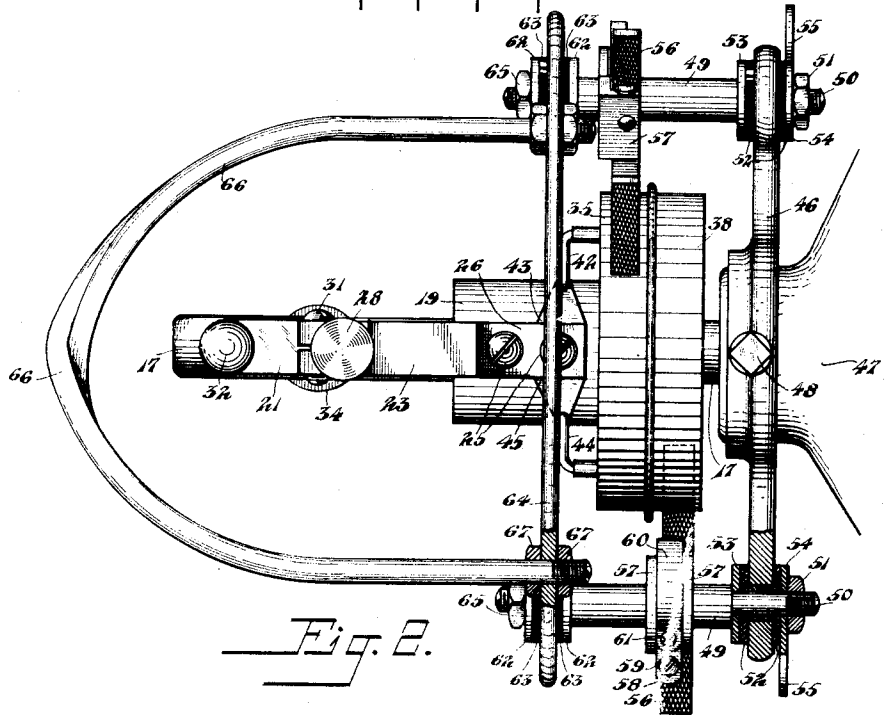

Fig. 2.

Witnesses.

P. H. Burfind

E. A. Hurlock

Inventor:

William W. Dean,

by Robert Lewis Ames,

Attorney.

W. W. DEAN.

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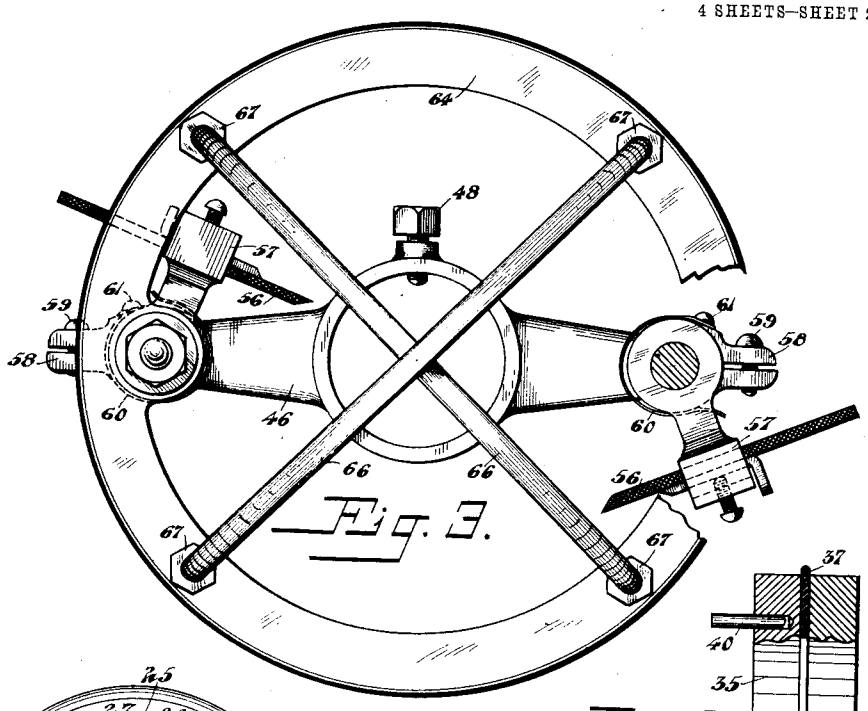

Fig. 3.

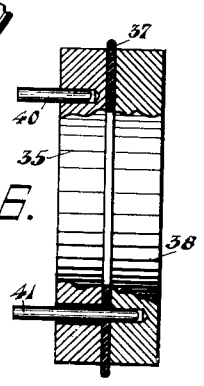

Fig. 6.

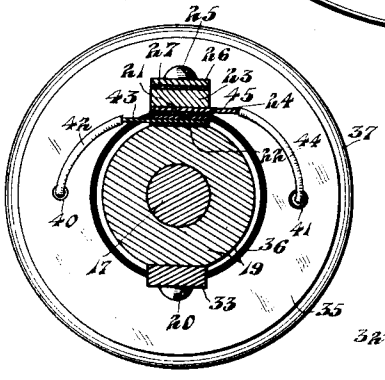

Fig. 5.

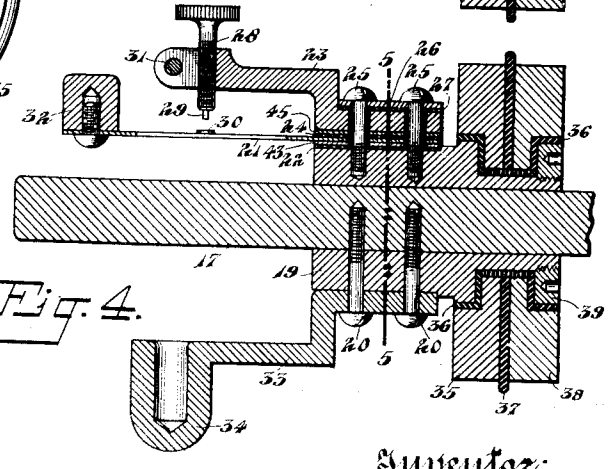

Fig. 4.

Witnesses.

R. H. Burfinde

E. A. Harlock

Inventor:

William W. Dean,

by Robert Lewis Ames,

Attorney.

W. W. DEAN.

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4 SHEETS—SHEET 3.

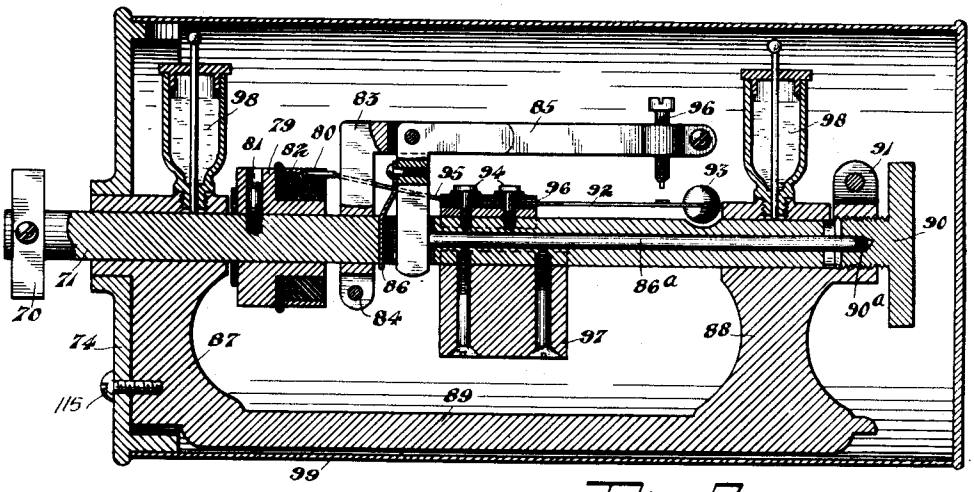

Fig. 7.

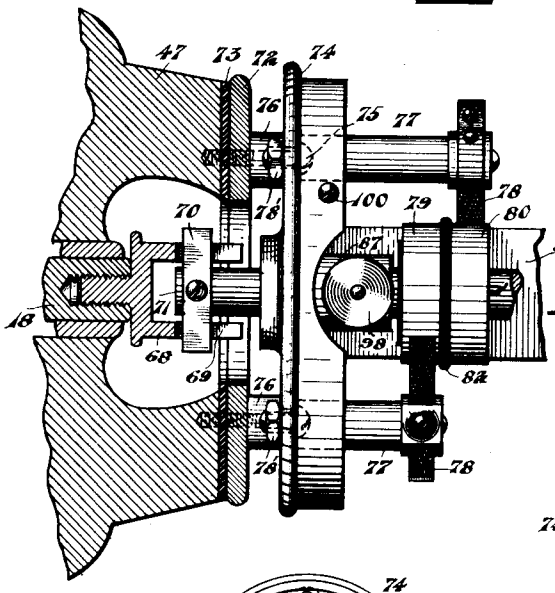

Fig. 8.

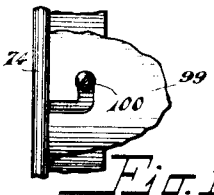

Fig. 10.

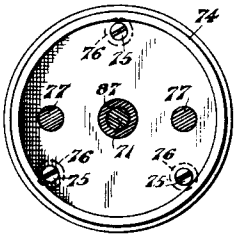

Fig. 9.

Witnesses.

R. H. Burpins

E. A. Garlock

Inventor:
William W. Dean,
by Robert Lewis Ames,
Attorney.

W. W. DEAN.

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APPLICATION FILED OCT. 19, 1903.

1,107,914. Patented Aug. 18, 1914.

4 SHEETS—SHEET 4.

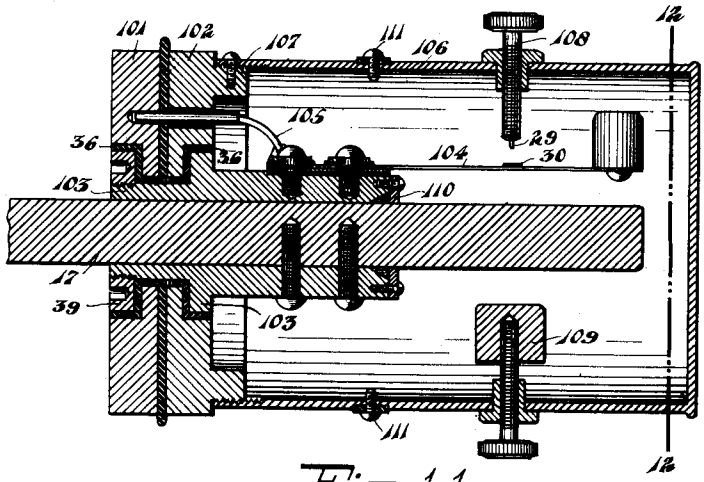

Fig. 11.

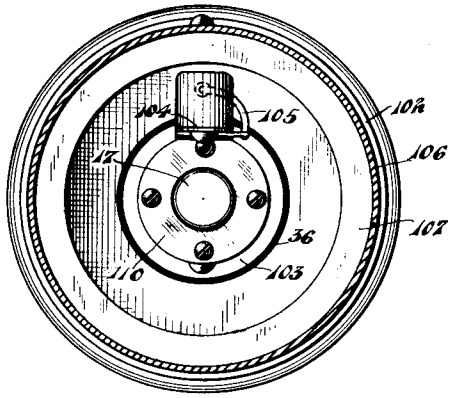

Fig. 12.

Witnesses.
R. H. Binsfield
E. A. Garlock.

Inventor:
William W. Dean,
by Robert Lewis Ames,
Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

APPARATUS FOR GOVERNING THE SPEED OF MOTORS.

1,107,914. Specification of Letters Patent. Patented Aug. 18, 1914.

Application filed October 19, 1903. Serial No. 177,527.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Apparatus for Governing the Speed of Motors, of which the following is a specification.

My invention relates to means for controlling the speed of dynamo electric machinery, and more especially of the direct current motor type. The power circuits with which motors are connected are subject to variations in the voltage of the current carried thereby, such variations on a 110 volt circuit amounting oftentimes to 20 volts. For certain classes of work the variation in speed of the motors caused by such variations of voltage is too great, and some means must be provided to govern them so that their speed will be practically constant. Among such classes of service may be mentioned the operation of the ringing generators in party telephone line selective ringing, where the bells to be rung thereby are adapted to respond to current of a particular and distinctive frequency only. In such systems it is evident that the generator must at all times be capable of sending out over the telephone lines to the call bells at the substations ringing currents having the proper frequencies.

In carrying out my invention I prefer to adjust the motor so that under normal conditions and without the governor resistance in circuit it will run too slow upon the highest voltage that it could ever receive from the power circuit, and run too fast, with the governor resistance in circuit upon the lowest voltage that it could ever receive therefrom. I then arrange the governor so that a resistance is adapted to be very rapidly and continuously thrown into and out of series with the field of the motor when the speed of the motor is between certain limits, this resistance being adapted to be maintained entirely in series with the field when the motor falls below a certain speed, or to be entirely shunted when the speed of the motor rises above a certain limit. At the operative speed my governor is adapted by the rapid vibration of its flexible member to very rapidly close and open a shunt about the resistance in series with the field and thereby to establish a resultant or effective resistance which is considerably increased or decreased by the minute changes in the speed of the motor. With this arrangement the said resistance is being constantly cut in and cut out of the circuit and the speed of the motor is maintained practically constant.

My invention is illustrated in the accompanying drawings, in which the same reference characters are used throughout to designate like parts, and in which—

Figure 1 is a diagram of a system employing my improvements; Fig. 2 is a side view of the governor applied to the motor shaft; Fig. 3 is an end view of said governor removed from the motor shaft; Fig. 4 is a sectional view through the contacts of the governor; Fig. 5 is a transverse section on the line 5, 5, of Fig. 4; Fig. 6 is an edge view of the slip rings of the governor, parts being broken away to show the arrangement of the connecting pins; Fig. 7 is a longitudinal sectional view of a form of the governor which may be adjusted during operation; Fig. 8 is a detailed view of the latter type of governor, and showing the connection of the same with the motor shaft as well as the location of the slip ring brushes; Fig. 9 is a detail view showing the method of securing the governor supporting plate to the journal bearing; Fig. 10 is a detailed view showing the method of holding the inclosing cap in place; Fig. 11 is a longitudinal sectional view of a modification in which the contacts of the governor are inclosed in oil to prevent sparking, and Fig. 12 is a transverse sectional view on line 12, 12, of Fig. 11.

Referring to Fig. 1, the numeral 2 indicates a direct current motor mounted upon a common shaft with the generators 3, 4, 5 and 6. The motor is connected in the power circuit 7 and 8 which includes the field windings of said motor, and the resistance 9 is placed in said path of current through the field windings, and is adapted to be short circuited by the governor 10, located upon the end of said common shaft and controlling the continuity of said short circuit which is composed of conductors 11 and 12. Thus when the speed of the motor increases beyond that for which the governor is adjusted, the said resistance 9 is short circuited

and a greater current flows through the field windings of the motor, and causes its speed to decrease. If the speed falls below the desired limit, the resistance 9 is thrown into series with the field winding, thus decreasing the current passing through the same and causing the speed of the motor to increase. When the governor is accurately adjusted, the resistance 9 is being constantly cut in and cut out of the field circuit so that the speed of the motor 2 remains practically constant, even though the voltage upon the power circuit varies within wide limits. The conductors 13, 14, 15 and 16, leading from the ungrounded brushes of said generators, serve to carry the generator current to any point desired.

In Fig. 1 the governor is indicated only diagrammatically and on a small scale, but the remaining figures show its construction more clearly. As seen in Fig. 4, the end 17 of the motor shaft 18 is reduced in diameter and upon the same a sleeve 19 is secured by suitable screws 20. At one point of said sleeve 19 and longitudinal of the end 17 of the shaft, a leaf spring 21 is secured and is insulated from said sleeve 19 by suitable insulating material 22, a rigid arm 23 being placed outside said spring 21 and likewise supported from said sleeve and separated from the spring 21 by insulation 24, said arm 23 and said spring 21 being clamped in position upon said sleeve 19 by screws 25 passing therethrough and threading into said sleeve 19. The said screws pass first through a clamping plate 26 which is separated by insulation 27 from the said arm 23. The end of the arm 23 carries an adjustable contact 28 provided with a thumb nut for adjusting the apparatus and with a platinum contact 29 at its inner end adapted to engage with a similar platinum contact 30 mounted upon the spring 21 when the latter is moved outwardly from the position shown by the centrifugal force of the rotating shaft. A clamping screw 31 passes through the split end of the arm 23 to clamp said adjustable contact 28 in position. A weight 32 is secured by a suitable screw to the outer end of the spring 21.

It is obvious that when the shaft is rotated above a certain speed that contact 30 and spring 21 will be brought into engagement with contact 29 carried by the screw 28 and that when the speed falls below a certain amount said contacts will be separated. In order to balance these parts which are located upon one side of the shaft 17, the screws 20 are arranged to also clamp an arm 33 into position upon the shaft opposite said contacts, the arm being provided with an enlargement 34 at its outer end.

The inner end of the sleeve 19 is reduced in diameter and carries the slip ring 35 separated therefrom by suitable insulation 36, an insulating disk 37 and a second slip ring 38, said rings and disk being clamped in position against the shoulder of said reduced end of the sleeve by means of the ring or circular nut 39 threading upon the end of said sleeve 19. As pointed out these slip rings are insulated from each other, and pin 40 (see Fig. 6) is connected with the ring 35, while a second pin 41 passes through an insulating bushing in said ring 35 and is connected with the rings 38. As shown in Fig. 5 the pin 40 is connected by means of a suitable conductor 42 soldered thereto with the plate 43 placed just beneath and in electrical contact with the spring 21; and the pin 41 is connected by a similar conductor 44 with the plate 45 placed immediately beneath and in electrical contact with the arm 23. Thus the electric connections of the spring 21 and the arm 23 are extended respectively to the slip rings 35 and 38.

The brushes that engage with the slip rings are, as usual, carried upon the stationary part of the machine. This arrangement is shown more clearly in Figs. 2 and 3. A rocker arm 46 is secured to a stationary part 47 of the shaft bearing by means of a suitable set screw 48, and carries at its opposite ends posts 49 which have reduced ends 50 to receive the nuts 51, suitable insulating washers or bushings 52 being provided between the metallic washers 53 and 54 upon the ends of the rocker arm and said ends 50. The washers 54 have projections 55 to which the conductors 11 and 12 are adapted to be connected. The brushes 56 are preferably of gauze as is usual and are clamped in the brush holders 57 by means of set screws as shown most clearly in Fig. 3, said holders being journaled upon the posts 49 and are held longitudinally in place by split clamping rings 58 and set screws 59. The pressure of the brush upon the slip ring is controlled by a spring 60 encircling said clamping ring 58 and secured thereto at one end by a screw 61 while the other end passes between the arms of the brush holder 57 and engages said holder to cause the brush to press against the slip ring. The amount of tension imparted to this spring may be varied by circumferentially adjusting the clamping ring 58. As shown in Fig. 2, one brush is in contact with ring 38 and the other with ring 35. The electric circuits of said rings are therefore completed through the brushes 56 to the posts 49 and thence by washers 54 and projections 55 to the circuit conductors 11 and 12 as shown in diagram in Fig. 1. The outer ends of said posts 49 are also shouldered and are provided with metallic and insulating washers 62 and 63 upon opposite sides of a guard ring 64, nuts 65 serving to clamp said ring 64 and the insulating and metallic washers

together on the ends of said posts 49. This guard ring supports the guard wires or rods 66 which are extended over the contacts of the governor and are secured at their inner ends by the nuts 67 to said ring 64. These guard rods or wires serve to prevent things coming into contact with the rapidly rotating contacts of the governor. It will be observed that the guard ring, together with wires 66 and the rocker arm 46, are insulated from the electric circuits of the governor, and, as hereinbefore pointed out, the motor shaft itself is likewise insulated therefrom.

In the modification shown in Figs. 7, 8, 9 and 10, the shaft of the governor is separate from the motor shaft, but is coupled thereto when the governor is connected with the motor. As before, 47 designates the stationary part of the bearing of the motor shaft, and 18 the end of the shaft which has a screw threaded socket into which the stem of a cup 68 is threaded, slots 69 being formed in the outer edge of said cup to receive the transverse member 70 carried by the inner end of the shaft 71 of the governor. A ring 72 is separated from the end of the bearing 47 by the insulation 73 and is secured thereto by means of suitable screws. A disk 74 is secured to said ring 72 by means of screws 75 threaded through said disk and through spacing blocks 76, which are adapted to space said disk a short distance away from said ring 72, and thence through said ring 72 and into the end of the bearing. Upon the inner face of said disk 74, the posts 77 are secured by the nuts 78′ and at their outer ends carry the brushes 78, 78 of substantially the same type as described with reference to the previous figures except they are somewhat smaller. These brushes engage the slip rings 79 and 80 mounted upon the governor shaft 71, the former being secured to said shaft by screw 81, and carrying a sleeve upon which an insulating ring 82 is mounted and which carries the other slip ring 80. An arm 83 is clamped upon said shaft 71 by the screw 84 and supports in its outer slotted end the contact lever 85 corresponding to the fixed contact of the previous figures. A spring 86 engages in a slot in said shaft 71 and tends to move said contact lever 85 outwardly, while an adjusting rod 86ª extends through a hole in said shaft 71 to its outer end and bears at its inner end against the other side of the transverse arm of said contact lever 85. The shaft 71 is carried in suitable bearings 87 and 88, preferably formed integrally with the longitudinal member 89 and likewise either formed integrally with or otherwise secured rigidly to said disk 74, as by screws 115. In the outer end of the bearing 88 is threaded an adjusting thumb screw 90 which engages the outer end of the adjusting rod 86ª and moves it longitudinally to vary the position of the contact lever 85. A clamping member 91 serves to secure said adjusting screw to prevent its movement after being once adjusted. A rubber cushion 90ª is placed in the screw 90 to form a yielding bearing for the end of rod 86ª whereby a yielding pressure is exerted upon both sides of the transverse arm of contact lever 85. Contact spring 92 having the weight 93 at its outer end is insulated from but is secured to the shaft 71 by the screws 94, and a conductor 95 extends from the contact plate 96 above said spring 92 to the slip ring 80. The lever 85 carries an adjustable contact screw 96 as in former instance which engages a platinum contact upon the spring 92. A balancing weight 97 is secured upon the opposite side of the shaft 71. Suitable oil cups 98 are provided for the bearings 87 and 88 and an inclosing shell 99 is adapted to be placed over the whole device and to fit upon an outwardly extending flange of said disk 74, and to be secured thereto by a bayonet slot and the screw 100 (see Fig. 10). With this arrangement it is seen that the contact lever 85 carrying contact 96 may be adjusted by the thumb screw 90 without stopping the motor. The electric circuit of the contact 92 is through said conductor 95 to the slip ring 80, while the circuit of contact lever 85 is through the shaft 71 to the ring 79.

In Figs. 11 and 12 the governor is again placed upon the reduced end of the motor shaft and the slip rings 101 and 102 are insulatingly mounted upon a suitable sleeve 103 as in the first form of the invention. The contact spring 104 is secured to said sleeve 103 but insulated therefrom also as in Fig. 1. A conductor 105 connects said spring by means of a suitable pin insulated from ring 102 with the ring 101. An inclosing shell 106 is threaded upon a flange 107 upon the outer face of said commutator ring 102 and is adapted to be secured in position thereon by suitable screws. This shell carries the adjustable contact 108 forming one terminal of the governor. A weight 109 is mounted upon the opposite side of the shell 106. A washer 110 secures suitable packing around the end of the sleeve 103 to prevent the escape of oil. The interior of the shell 106 is filled with oil which prevents sparking at the contacts 29 and 30 of said screw 108 and spring 104. The arrangement of the brushes may correspond to that of Figs. 1 to 6 and is not described in connection with this figure. 111 is a suitable vent to aid in the filling of the shell with oil.

While I have illustrated and described my invention as embodied in certain forms of commercial structures, it is apparent that many changes and modifications thereof may be made and I do not wish to be limited to such structures as illustrated and described,

but aim to cover all such changes and modifications thereof as come within the spirit and scope of the appended claims.

I claim:—

1. The combination with an electric motor, of a centrifugal governor adapted to be attached to the shaft thereof, a pair of switch points on said governor adapted to come into vibrating contact when the governor has reached a pre-determined speed of rotation, a flexible member having a weighted free end and a fixed end and a rigid member, one of said contacts being carried at an intermediate point upon said flexible member, and the other being carried upon said rigid member, a resistance permanently connected in series with the field of the motor, and conductors leading from said points to the terminals of said resistance, substantially as described.

2. The combination with an electric motor, of an external resistance permanently connected in series with the field of the motor, a centrifugal speed governor carried upon the shaft of the motor armature, a rigid contact, and a resilient member carried by said governor having a weighted free end and a fixed end, a contact carried at an intermediate point between said weighted and fixed ends upon said resilient member, said contacts being adapted to rapidly close and open a circuit in shunt to said resistance when the speed of the armature is between certain limits, the duration of each connection between said contacts increasing as the speed of the armature increases, one of said contacts being adjustable, whereby any desired uniform speed of the armature may be maintained, substantially as described.

3. In a governor for electric machines, the combination with a motor having a resistance in a circuit of the machine, of a rigid contact, a resilient member having a fixed end and a weighted free end, a contact carried by said resilient member between said fixed end and said free end adapted to make connection with the rigid contact in its vibration, said contacts shunting said resistance, the duration of connection between said contacts depending upon the speed of the machine, whereby a resultant resistance is produced and the speed of the machine is controlled, substantially as described.

4. In a governor for electric machines, the combination with a motor having a resistance in series with the field thereof, of a vibratile contact in a shunt circuit about said resistance and automatically operated to open and close said shunt circuit a plurality of times for each revolution of the motor, the period of closure varying by steady increments and decrements as the speed of the motor changes.

5. In a governor, the combination with a rotating shaft, of a rigid contact carried by the shaft, a flexible member also carried by the shaft and having a weighted free end, a contact carried at a point between the weighted free end and the secured end of said flexible member, said contact being adapted to rapidly vibrate and intermittently engage with the rigid contact in the vibration of the flexible member and speed controlling means affected by said contacts, substantially as described.

6. In a governor, the combination with a rotating member, of a rigid contact carried by said member, a spring having a weighted free end and a fixed end also carried by said rotating member and carrying a contact adapted to engage with the rigid contact, said contact being located at an intermediate point between said weighted free end and said fixed end on said spring, and means to govern the speed of the rotating member by the periodic connections between the vibratory and rigid contacts, substantially as described.

7. In a governor, the combination with a rotating member, of a resilient member having a weighted free end and a fixed end carried by said rotating member and having a definite rate of vibration independent of the speed of rotation of the shaft, a contact carried by said resilient member at a point intermediate of said weighted end and said fixed end, a rigid contact carried by the rotating member in position to be engaged by the first contact in the vibration of the resilient member, the duration of connection between said contacts being adapted to govern the speed of the rotating member, substantially as described.

8. In a governor, the combination with a rotating shaft, of a rigid contact carried by the shaft, a flexible leaf spring having one end secured to the shaft, a weight secured to the other end of said spring and a contact carried by said spring adapted to engage with the rigid contact, said spring being adapted to vibrate at its own periodic rate during the rotation of the shaft, means to adjust the position of the rigid contact with respect to the position of the vibratory contact and speed controlling means affected by said contacts, substantially as described.

9. In a governor, the combination with a rotating shaft, of a rigid contact carried by the shaft, a flexible leaf spring having one end secured to the shaft, a weight secured to the other end of said spring, and a contact carried by said spring adapted to engage with the rigid contact, said spring being adapted to vibrate at its own periodic rate during the rotation of the shaft, means to adjust the position of the rigid contact with respect to the position of the vibratory contact while the shaft is in rotation, and speed controlling means affected by said contacts, substantially as described.

10. In a governor, the combination with a rotating member, of a rigid contact carried by said member, a vibrating spring also carried by said member, a contact carried by said spring and adapted to engage with the rigid contact, means to adjust the position of the rigid contact while the rotating member is in motion, and means to govern the speed of the rotating member by the periodic connections between the vibrating and rigid contacts, substantially as described.

11. The combination with an electric motor, of an external resistance permanently connected in series with the field of the motor, a centrifugal speed governor carried upon the shaft of the motor armature comprising a resilient member mounted substantially parallel to said shaft and carrying a weight at the free end, the other end being secured, a contact carried upon said resilient member at a point intermediate of said free and secured ends, and a rigid contact, the resilient member being adapted to vibrate and rapidly close and open a circuit in shunt to said resistance when the speed of the armature is between certain limits, the duration of each connection between said contacts increasing as the speed of the armature increases, one of said contacts being adjustable, whereby any desired uniform speed of the armature may be maintained, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this twenty-first day of July, 1903.

WILLIAM W. DEAN.

Witnesses:
GAZELLE BEDER,
ROBERT LEWIS AMES.