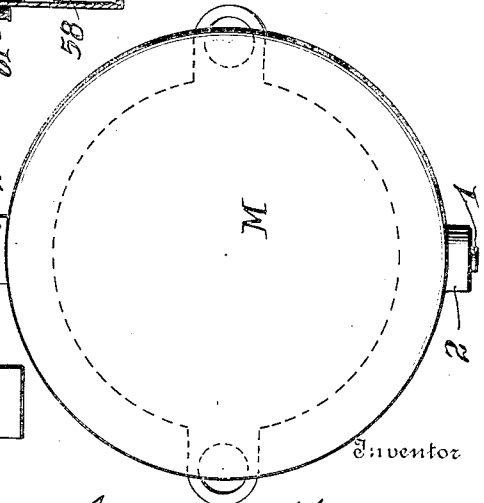
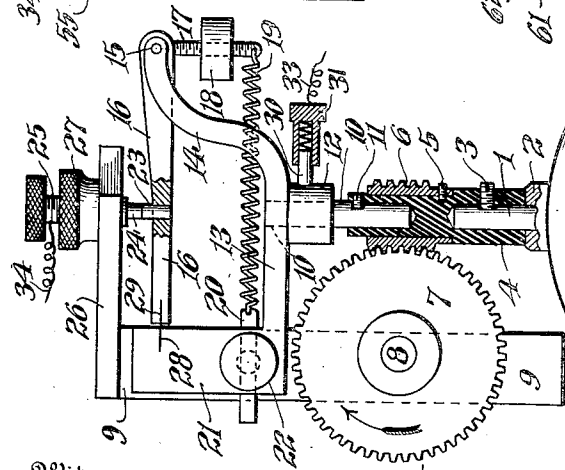
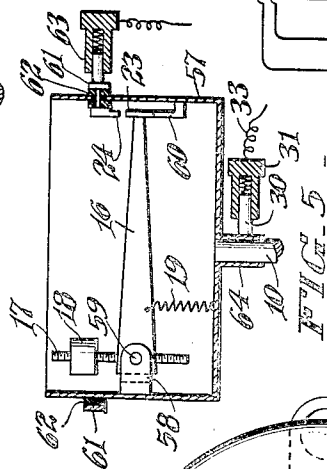
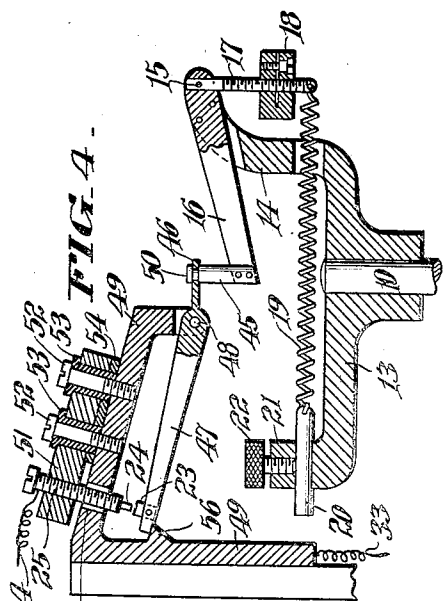
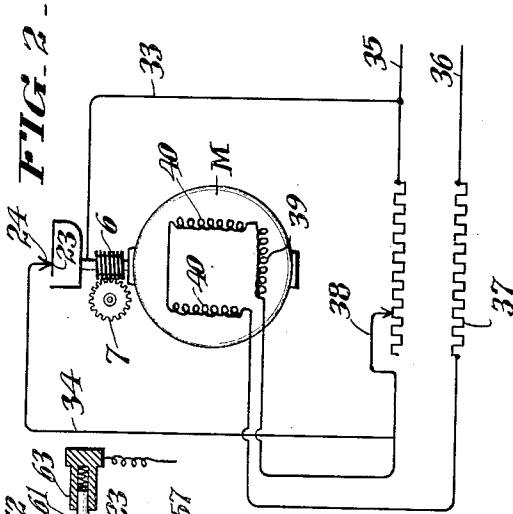


**1,057,436.**



384 Morris E. Leeds  
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# UNITED STATES PATENT OFFICE.

MORRIS E. LEEDS, OF PHILADELPHIA, PENNSYLVANIA.

## SPEED-CONTROL APPARATUS.

1,057,436.

Specification of Letters Patent.

Patented Apr. 1, 1913.

Application filed September 11, 1911. Serial No. 648,649.

*To all whom it may concern:*

Be it known that I, MORRIS E. LEEDS, a citizen of the United States, residing in the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Speed-Control Apparatus, of which the following is a specification.

My invention relates to speed control apparatus, and particularly to the control of the speed of mechanism driven by an electric motor, and relates to the control of circuit contacts by a centrifugal device or governor, the circuit contacts controlling any desired circuit, but preferably a circuit controlling the speed of the motor or other mechanism upon which the centrifugal device or governor depends for its speed.

My invention resides in the features hereinafter described and claimed.

For an illustration of some of the forms my invention may take reference is to be had to the accompanying drawing, in which:

Figure 1 is an elevational view, parts in section, illustrating contact control by a centrifugal governor driven by an electric motor. Fig. 2 is a diagram of one system of circuits which may be employed for a series wound motor. Fig. 3 is a diagram of a system of circuits which may be employed for a shunt wound motor. Fig. 4 is a cross sectional view, some parts in elevation, of a modified form of centrifugal contact governor. Fig. 5 is a cross sectional view, parts in elevation, of a further form of centrifugal contact governor.

Referring to Fig. 1, M represents an electric motor whose armature or rotor is mounted upon and drives the shaft 1 mounted in the usual bearings 2, 2. Secured to the shaft 1 by screw 3 is the coupling 4 of insulating material upon which is secured by screw 5 the worm 6 meshing with and driving the gear 7 mounted upon and driving the shaft 8 having a bearing in the member 9. The shaft 10 coaxial with the motor shaft 1 is secured to the insulating coupling 4 by the screw 11. The motor shaft 1 therefore drives both the worm 6 and the shaft 10. Secured upon the shaft 10 is the cylindrical hub 12 integral with or secured to the supporting member or bracket 13. At 15 on the arm 14 of the supporting member or bracket 13 is pivoted the lever 16 having secured thereto or integral therewith

the lever arm 17 preferably screw threaded, upon which is threaded or otherwise adjustably supported the governor weight 18. The lever arm 17 which with the lever arm 16 may be considered to form a bell crank lever, extends preferably substantially parallel with the axis of the shaft 10. To the lever arm 17 is attached one end of a spring 19, here shown under tension, whose other end is secured to the rod 20 passing through an arm 21 of the bracket 13, different tensions being put upon the spring 19 according to the position of the rod 20 which may be secured in any of its adjusted positions by the screw 22. The lever arm 16 carries the movable contact 23 adapted to engage the stationary contact 24 adjustable by screw 25, the latter carried by the arm 26 which may be upon the member 9. A lock nut 27 may be provided to keep the screw 25 in its adjusted position. The contacts 23 and 24 are at the axis of rotation, the contacts 23 and 24 being coaxial with the shaft 10. By this arrangement of the contacts at the axis of rotation their wear is very slight, and, furthermore, one of the contacts may be stationary and thus avoid a sliding contact for maintaining electrical communication therewith from an external circuit or device.

The lever arm 16 is here shown as extending beyond the contact 23 into close proximity to the arm 21, which latter is provided with an indicating mark or device 28. The arm 16 carries at its end an indicating mark or device 29 which by adjustment of the screw 25 may be brought exactly opposite the indicating device or mark 28 to determine the normal position of the contacts 23 and 24. In other words, as the contacts 23 and 24 wear away the speed at which they are separated by the centrifugal governor may change as the wear goes on. The wear is taken up by adjusting the screw 25 downwardly and the normal position is determined by bringing the indicating device 29 exactly opposite the indicating device 28, in which position the weight 18 is at proper distance from the axis of rotation.

The parts 13, 18, 16, 23, etc., driven by the shaft 10 rotate freely without contacting with the member 9 or any of the stationary parts, and these rotating parts are insulated by the insulated coupling 4. To afford electrical communication with the contact 23 a carbon or other brush 30 bears

upon the cylindrical hub 12, of metal, which is in electrical communication through the metal parts 13, 14 and 16 with the contact 23. The brush 30 is mounted in a socket in the conducting member or brush holder 31, the spring 32 keeping the brush 30 in contact with the hub 12. One circuit wire, as 33, is connected to the brush holder 31, while the other circuit wire, as 34, is connected to contact 24 through screw 25.

The operation is as follows: The motor drives the shaft 10 and rotates the bracket or supporting member 13; the spring 19, weight 18, levers 16 and 17 and contact 23 all rotate together with the shaft 10. When the speed of rotation exceeds a predetermined limit the centrifugal force exerted by the weight 18 causes it to move outwardly from the axis of rotation, thereby moving the lever arm 17 slightly in a counter-clockwise direction about the pivot 15, as viewed in Fig. 1, in opposition to the spring 19, a stop 16<sup>a</sup> on arm 21 limiting the movement of lever 16. The weight 18 is on a short lever arm, while the contact 23 is on a long lever arm, and, in consequence, a slight movement of the weight 18 is accompanied by a relatively greater movement on the part of the contact 23. Therefore, upon a slight increase of speed above a predetermined limit the slight outward movement of the weight 18 withdraws the contact 23 from engagement with the contact 24, breaking the circuit in which they are included. The circuit including the contacts 23 and 24 may be any circuit, and, as above stated, is opened upon an increase of speed on the part of the shaft 10. Upon decrease of speed on the part of the shaft 10 the centrifugal force decreases and the spring 19 is able to return the contacts 23 and 24 into engaging position as shown in Fig. 1, in which condition they continue until a later increase of speed above a predetermined limit.

As shown in Fig. 1, the motor shaft 1 and the shaft 10 are vertical, the weight 18, contact 23 and associated parts rotating about a vertical axis. It is to be understood, however, that the axis of rotation may be in other positions according to requirements.

By way of example, the shaft 8 driven by gear 7 through worm 6, may in turn drive the paper-feeding mechanism of any suitable type of recorder, and may also drive the continuously rotating shaft 15 of a recorder such as illustrated in my prior Patent No. 965,824, granted July 26, 1910.

The construction of governing device illustrated in Fig. 1 is my preferred form because of the slight wear upon the contacts due to their axial arrangement; because a very slight movement of the weight serves to separate the contacts a sufficient distance for practical purposes; and be-

cause, due to the arrangement of weight and spring, there is very slight friction at the pivot 15.

The contacts 23 and 24 may control the motor M itself, so as to cause such motor to rotate at practically constant speed even when the motor windings are hot or cold and with wide fluctuations in the potential impressed upon the motor windings.

When the motor is a series wound motor the control circuits may be arranged as shown in Fig. 2. The current supply conductors are represented at 35 and 36, the current supplied thereto being either direct current or alternating current. A resistance 37 of suitable magnitude may be included in the motor circuit as occasion may require. And an adjustable resistance 38 is included in series with the motor windings, and for the purpose illustrated in Fig. 2 the resistance 38 is employed but the resistance 37 may be omitted. The adjustable resistance 38, and the resistance 37 when employed, is in series with the motor windings of which 39 is the motor armature winding and 40, 40 the motor field winding. The one contact, as 24, of the governing device is connected through conductor 34 to one terminal of the resistance 38, while the other contact, as 23, is connected through conductor 33 to the other terminal of the resistance 38.

When the motor M is running below or at normal speed, the contacts 23 and 24 are in engagement thus short circuiting the resistance 38. When, however, the speed of the motor M rises above the desired or critical speed, the contacts 23 and 24 separate, as previously described, thus cutting into the circuit of the windings of the motor M the resistance 38, which causes the motor to slow down. With the resultant reduced speed the contacts 23 and 24 again come into engagement and short circuit the resistance 38, allowing the motor to run at the normal or desired speed, and when it again rises in speed these contacts separate again to again cut in the resistance 38. In the continuous operation of the apparatus the contacts 23 are closed and separated from time to time to short circuit and to cut in the resistance 38, so that the motor runs at a quite constant speed, and, indeed, by this arrangement, I have maintained the speed of the motor and the apparatus driven thereby so constant that the paper in a recorder has been driven by the motor at a rate so constant as to be comparable with the rate of travel of the paper when driven by clockwork; which, by this arrangement, may be dispensed with.

In Fig. 3 I have illustrated a shunt wound motor as controlled by the centrifugal governor. Here the supply conductors are again represented by 35 and 36. The shunt field winding 41, 41 is at all times subjected

to the potential of the supply conductors 35 and 36, the field strength being adjustable if desired by the adjustable resistance 42. The motor armature 39 is connected as usual by the brushes 43, 43 with the supply conductors 35 and 36. Bridged across the armature terminals is the adjustable resistance 44 in series with which are the governor contacts 23 and 24. In this case when the motor is rotating below or at normal speed the contacts 23 and 24 are separated. But when the speed increases beyond the desired limit the contacts 23 and 24 are brought into engagement, thereby affording a path through the resistance 44 for current generated in the armature 39 now running as a generator and this current consumed in the resistance 44 electromagnetically brakes the motor reducing its speed to normal or slightly below, when the contacts 23 and 24 are again separated.

In Fig. 4 I have illustrated a form of governor device in which no contact rotates with the governor shaft. Here again 10 represents the governor driving shaft which has secured upon it a bracket or supporting member 13 having an arm 14 and an arm 21, the latter receiving the set-screw 22 to hold the rod 20 in adjusted position, one end of the spring 19 being secured to the rod 20 while its other end is secured to the lever arm 17 integral with or secured to the lever arm 16, thus forming what may be termed a bell crank lever, pivoted at 15 in the bracket arm 14. The weight 18 is again provided and is adjustable longitudinally of the arm 17. At its outer end the arm 16 has secured to it the axially extending member 45 which in its rotation runs freely in the arm 46 forming an extension upon the lever 47 pivoted at 48 to the stationary bracket 49. The member 45 carries a head 50 between which and the member 45 is disposed the arm 46. The lever arm 47 carries the contact 23 which is adapted to engage the contact 24 carried by the screw 25 engaging in the metal block 51 secured by screws 52 to the stationary bracket 49, but insulated from the latter by the insulation 53 and 54. The screw 25 passes freely through the hole 55 in the stationary bracket 49. One circuit wire, as 33, connects with the metallic bracket 49 and is, therefore, in electrical communication with the contact 23. The other circuit wire, as 35, connects with the insulated screw 25. The stationary bracket 49 is provided with a stop 56 for limiting the separation of the contacts 23 and 24.

In operation, when the speed increases beyond a desired limit the weight 18 carries the arm 17 outwardly thus depressing arm 16 and through the member 45 and the head 50 depresses the arm 46, with relation to which they are rotating, moving the lever

47 and its contact 23 in a clockwise direction about the pivot 48 in the stationary bracket 49, thus bringing the contacts 23 and 24 into engagement with each other. When the speed of the shaft 10 decreases the contacts 23 and 24 again separate. By this arrangement all sliding contacts, such as 30—12 of Fig. 1, are dispensed with. Furthermore, for a given outward movement of the weight 18, there is a relatively greater movement of the contact 23 due to the multiplication of distances due to the relations of levers 17, 16, 46 and 47.

A further form of governor is illustrated in Fig. 5. Here the governor shaft 10 carries a metallic cylinder 57 on the inside of which is a bracket 58 carrying the pivot 59 upon which are pivoted the lever arms 16 and 17, again secured to or integral with each other. Upon the arm 17 is the longitudinally adjustable weight 18. A spring 19 having one end connected to the lever 16 and the other end connected to the cylinder 57 biases the parts to the position shown. On the inner side of the cylinder 57 at the end of the lever 16 is provided a stop 60 for limiting the separation of the contacts 23 and 24, the contact 23 being carried by the lever 16 while the contact 24 is supported upon the cylinder 57 but insulated therefrom. The contact 24 is connected to the slip ring 61 insulated from the cylinder 57 by the insulating ring 62. Upon the slip ring 61 bears a carbon or other brush 63 and upon the hub 64 of the cylinder 57 bears the carbon or other brush 30 in an arrangement similar to that in Fig. 1. The brush 30 is in electrical communication through the cylinder 57, bracket 58 and lever 16 with the contact 23; and, as above stated, the contact 24 is in electrical communication with the slip ring 61 and, therefore, with the brush 63. Here again if the speed increases beyond a critical or desired speed the weight 18 in moving outwardly brings the contact 23 into engagement with contact 24 to close any desired circuit. Here again the contact 23 moves a relatively great distance compared to the weight 18.

The arrangements of Figs. 4 and 5 may, of course, control any circuit and may control the circuits as disclosed in Figs. 2 and 3, or their equivalents.

I have herein shown my centrifugal governor as applied to the control of speed of motors having both constant speed and variable speed characteristics.

The right angle bell crank lever whose short arm extends substantially parallel to the axis of rotation and carries the governor weight, is of advantage in that the adjustment of the weight on its arm varies the pull of the weight against the spring without, however, changing the radius of the circle in which the weight revolves. By

having the other arm of the bell crank substantially at right angles to the axis of rotation the centrifugal force of these parts has a minor influence, and the contact carried by this arm, may, in consequence, wear away without having an influence on the critical speed. These advantages flow from the construction of both Figs. 1 and 5.

What I claim is:

- 10 1. In apparatus of the character described, the combination with a rotating member, of a weight pivoted thereto and disposed upon an arm substantially parallel with the axis of rotation of said member, means opposing
- 15 the movement of said weight, a contact disposed in said axis of rotation and in fixed relation with respect to said weight, and a cooperating rigid contact.
2. In apparatus of the character described,
- 20 the combination with a rotating member, of a weight pivoted thereto and disposed upon an arm substantially parallel with the axis of rotation of said member, means opposing
- 25 the movement of said weight, a contact disposed in said axis of rotation and in fixed relation with respect to said weight, and a cooperating rigid contact, said contacts being normally in engagement with each other.
3. In apparatus of the character described,
- 30 the combination with a rotating member, of a weight, a pivot supporting the same on said rotating member on an arm substantially parallel with the axis of rotation of said member, means opposing the movement of said weight, a contact disposed in fixed relation with respect to said weight rotating with and actuated by said weight through a distance greater than the movement of said weight, said rotating contact disposed in the axis of rotation, and a non-rotating contact adapted to be engaged by said rotating contact, engagement of said contacts by each other positively limiting movement of said weight by said means.
4. In apparatus of the character described, the combination with a rotating member, of a bell crank lever, a pivot supporting said bell crank lever upon said rotating member, one arm of said bell crank lever extending substantially parallel with the axis of rotation, a weight disposed upon said arm, a tension spring attached to said arm and to said rotating member and opposing the outward movement of said weight, a rigid contact actuated by the longer arm of said bell crank lever, and a cooperating rigid contact.
5. In apparatus of the character described, the combination with a rotating
- 60 member, of a bell crank lever, a pivot supporting said bell crank lever upon said rotating member, one arm of said bell crank lever extending substantially parallel with the axis of rotation, a weight disposed upon said arm, means attached to said arm and

opposing the outward movement of said weight, a rigid contact actuated by the other arm of said bell crank lever and disposed in the axis of rotation, and a cooperating rigid contact.

6. In apparatus of the character described, the combination with a rotating member, of a weight carried thereby on an arm substantially parallel with the axis of rotation and movable with respect thereto under the influence of centrifugal force, a spring secured at its one end to said rotating member and its other end to said arm opposing the outward movement of said weight, a rigid axial contact carried in fixed relation with said weight, and a cooperating rigid contact adapted to be engaged by said first named contact.

7. In apparatus of the character described, the combination with a rotating member, of a weight carried thereby on an arm substantially parallel with the axis of rotation and movable with respect thereto under the influence of centrifugal force, a rigid contact disposed in the axis of rotation of said member and carried in fixed relation with respect to said weight, and a rigid stationary contact adapted to be engaged by said rotating contact.

8. In apparatus of the character described, the combination with a rotating member, of a bell-crank lever pivoted upon said rotating member, one arm of said bell-crank lever extending substantially parallel with the axis of rotation of said member, a weight disposed upon said arm, means attached to said arm and opposing the outward movement of said weight, a rigid axial contact carried by the other arm of said bell crank lever, and a second rigid contact adapted to be engaged by said first named contact.

9. In apparatus of the character described, the combination with a rotating shaft, of a member secured thereto, a lever pivoted to said member, one arm of said lever extending substantially parallel with the axis of rotation of said shaft, a weight carried by said arm, a spring beyond the end of said shaft attached at its one end to said member and at its other end to said arm, another arm of said lever overhung beyond the end of said shaft, a rigid contact carried in fixed relation with said second lever arm, and a cooperating rigid contact adapted to be engaged by said first named contact.

10. In apparatus of the character described, the combination with a rotating shaft, of a bracket secured thereto, a lever pivoted to said bracket and having an arm extending substantially parallel with the axis of rotation of said shaft, a weight on said arm, a spring attached at its one end to said arm extending across said shaft

and secured at its other end to said bracket, said lever having a second arm extending to the axis of rotation of said shaft, a rigid contact actuated by said second arm, and a  
5 coöperating rigid contact adapted to be engaged by said first named contact.

11. In apparatus of the character described, a rotating shaft, a bracket secured thereon, a rigid member pivoted on said  
10 bracket, a rigid contact supported by said member in the axis of rotation of said shaft, a coöperating rigid contact, a weight

on said rigid member, and a spring opposing outward movement of said weight attached to said rigid member on the same  
15 side of the pivot with said weight.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

MORRIS E. LEEDS.

Witnesses:

MAUD SHARPLESS,  
MABEL H. MACMUNN.