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# MOTOR CONTROLLING MEANS

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2 Sheets-Sheet 1

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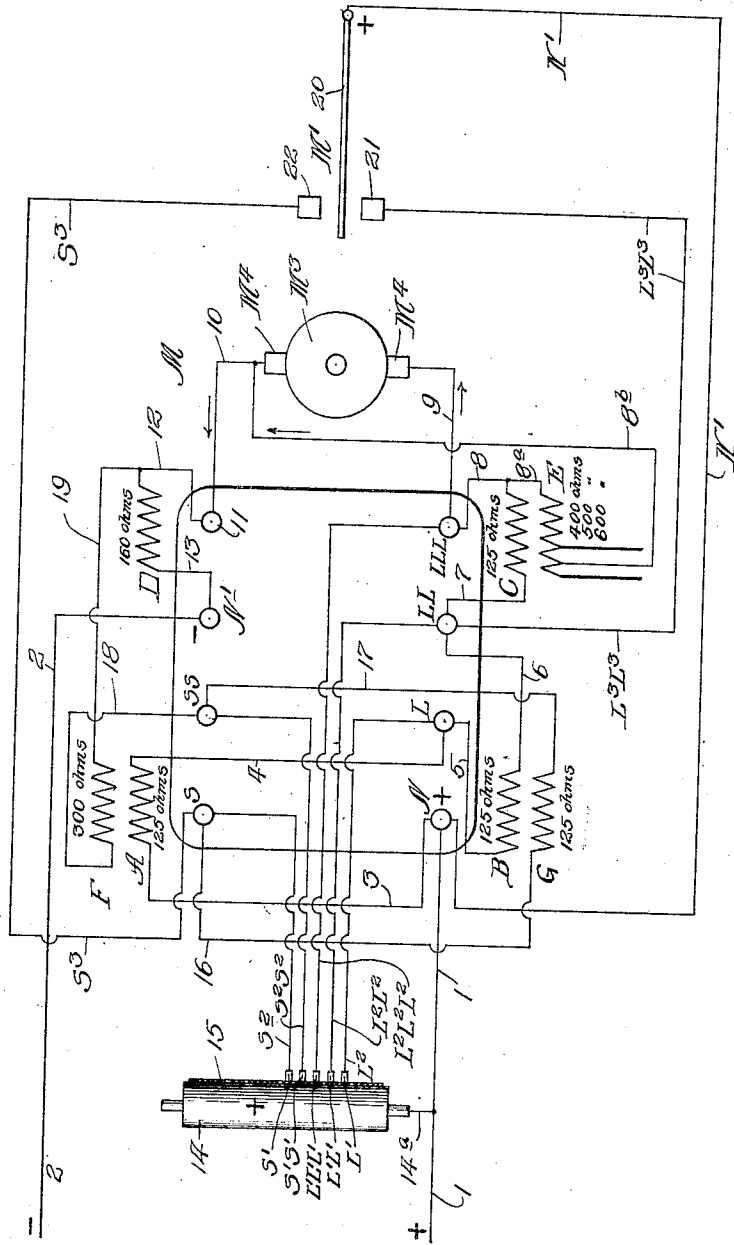
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Fig. 1



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## UNITED STATES PATENT OFFICE.

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## MOTOR-CONTROLLING MEANS.

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*To all whom it may concern:*

Be it known that I, BERTIE E. MILLS, a citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented a new and useful Motor-Controlling Means, of which the following is a specification.

This invention relates particularly to motor controlling means adapted for use in controlling the speed of a bow-actuating motor for a stringed instrument musical machine.

Machines of the character referred to are disclosed, for example, in various United States Patents granted to Mills Novelty Company, many of such patents having been granted upon the applications of Henry K. Sandell.

In the Mills type of machine, during the playing of the stringed instrument, the rotating bows are driven continuously by an electric motor, and the notes are sounded by depressing the bows and actuating the fingering devices associated with the strings of the instrument. The depression of the bows in contact with the strings and the actuation of the fingering devices are controlled by electric circuits. These circuits may be controlled by a music sheet which passes between a metal roll, or tracker-bar, and associated contacts, in a well known manner; or said circuits may be controlled by means of keys mounted on a console and operated like the keys of a piano. Ordinarily, however, in the commercial machines, the tracker board control of the playing of the notes is employed.

The music sheet may also be provided with a series of slots adapted to control the expression of the instrument. In such case, the music sheet has associated therewith a series of contacts which control the expression-circuits. However, if desired, the expression-circuits may be controlled from a console by means of suitable pedals.

The primary object of the present invention is to associate with the expression circuits governor-controlled circuits which may modify the action of the expression-circuits.

A further object is to provide an improved centrifugal governor which can be usefully employed in controlling the speed of an electric motor.

It is usual, in the Mills type of machine,

to vary the expression of the stringed instrument by varying the speed of the motor which actuates the bows. In the normal playing of the instrument, the motor operates continuously, the circuit being closed in any suitable manner. In the coin-controlled machines, the main circuit is closed by introducing a coin into the machine. The changes in speed of the motor occur when the expression-circuits act to vary the speed, as by cutting in, or cutting out, resistance coils with which the field of the motor is equipped.

The invention is illustrated in its preferred embodiment in the accompanying drawings, in which—

Fig. 1 shows an elevational view of a bow-motor and the attendant parts, the mechanism being shown mounted upon a bracket (shown brokenly); Fig. 2, a sectional view taken as indicated at line 2—2 of Fig. 1 and showing the centrifugal governor employed; Fig. 3, a broken sectional view taken as indicated at line 3—3 of Fig. 2; and Fig. 4, a diagrammatic view illustrating the motor circuits, the expression circuits, and the governor-control circuits which serve to modify the action of the expression circuits.

In the illustration given, provision is made for varying speeds of the bow-motor to obtain effects, as follows: extra soft, soft, normal, loud, double loud, triple loud.

As indicated above, the normal speed is independent of the expression-circuits. On the other hand, the expression-circuits control the expression effects listed, and the governor-controlled circuits modify the effect of the expression-circuits.

In the drawings, M designates a bow-motor; M', a centrifugal governor associated therewith; and M<sup>2</sup>, the bow-actuated shafts operated by the motor. The armature of the motor is designated M<sup>3</sup>, and the commutator brushes are designated M<sup>4</sup>.

The motor is provided with exciting coils, or field coils, which preferably are in the nature of four spools, two of which are located on each side of the armature. Each of three of the spools is provided with two distinct field coils, and the fourth spool is provided with a single field coil. These coils are used in various combinations to vary the excitation of the fields.

In Fig. 4, the inner windings of the three spools mentioned are designated A, B and

C, respectively, and the winding of the fourth spool is designated D. The outer windings of the three spools are designated F, G and E, respectively.

5 The motor is operated through a main circuit comprising a positive line 1 and a negative line 2, which are connected, respectively, with a positive binding post N and a negative binding post N'. The circuit may be closed, in any suitable manner, to cause the motor N to run at normal speed. For example, the circuit may be closed by coin-controlled means. In the normal operation, the current passes to the binding post N, thence through a conductor 3 to the inner coil A, thence through a conductor 4 to a binding post L, thence through a conductor 5 to the inner coil B, thence through a conductor 6 to a binding post L, thence through a conductor 7 to the coil C, thence through a conductor 8 to a binding post L L L, thence through a conductor 9 to the armature, thence through a conductor 10 to a binding post 11, thence through a conductor 12 to the coil D, thence through a conductor 13 to the negative binding post N'. After the current passes through the coil C, a portion passes through a conductor 8<sup>a</sup> to the coil E, and thence through a conductor 8<sup>b</sup> to the conductor 10. Thus, a shunt circuit is maintained through the coil E and across the armature.

While the various coils may be given any desired resistance, it may be stated, as an example, that the coils A, B, C and G may have a resistance of 125 ohms each; the coil F may have a resistance of 300 ohms; the coil D may have a resistance of 160 ohms; and the coil E may have a resistance of 400, 500, or 600 ohms. In the illustration given, the line 8<sup>b</sup> is taken from the intermediate lead of the coil E, and so the coil may be said to have a resistance of 500 ohms. The lower the ohmic resistance of the coil E, the slower the speed of the armature. If the resistance of the coil E be increased, the effect is to cause more of the current to go through the armature and so increase the speed.

50 In the illustration given in Fig. 4, the expression-circuits are controlled by a metal roll, or tracker-bar, 14, which is connected with the line 1 by a conductor 14<sup>a</sup>, a music sheet 15, and a series of contact brushes S', S' S', L', L' L', and L' L' L'. The expression-circuits are connected with the contacts, or brushes, just mentioned. Thus, the contact S' is connected by a conductor S<sup>2</sup> with the binding post S; the contact S' S' is connected by a conductor S<sup>2</sup> S<sup>2</sup> with the binding post S S; the contact L' is connected by a conductor L<sup>2</sup> with the binding post L; the contact L' L' is connected by a conductor L<sup>2</sup> L<sup>2</sup> with the binding post L L; and the contact L' L' L' is connected by a

conductor L<sup>2</sup> L<sup>2</sup> L<sup>2</sup> to the binding post L L L.

When, in the playing of the instrument, the contact L' encounters a slot in the music sheet and comes into contact with the positive energized roll 14, the current passes through the conductor L<sup>2</sup> directly to the binding post L, and thus cuts out the coil A, causing the motor speed to increase above the normal; similarly, when a circuit is established through the conductor L<sup>2</sup> L<sup>2</sup>, the current passes directly to the binding post L L, and so cuts out the coils A and B from the field, thus causing a greater increase in the speed of the motor; and similarly, when the circuit is established through the conductor L<sup>2</sup> L<sup>2</sup> L<sup>2</sup>, the current passes directly to the binding post L L L, and so cuts out the resistance coils A, B and C from the field, thus causing the motor to operate at highest speed. On the other hand, when the circuit is established through the conductor S<sup>2</sup>, the current passes directly to the binding post S, and thence through a conductor 16 to the coil G, thence through a conductor 17 to the binding posts S S, thence through a conductor 18 to the coil F, thence through a conductor 19 to the coil D, thence through the conductor 13 to the negative binding post N', and thence to the return line 2. Thus, the coils F and G are cut into the field circuit, it being noted that the coil D always remains in the field circuit. Again, when the circuit is established through the conductor S<sup>2</sup> S<sup>2</sup>, current passes to the binding post S S, thence through the conductor 18 to the coil F, thence through the conductor 19 to the coil D, and thence to the return line 2. Thus, the 300 ohm coil F is cut into the circuit in series with the 160 ohm coil D. This allows more current to pass through the field windings than when the conductor S<sup>2</sup> is in circuit; hence, the slowest speed of the motor is obtained when the conductor S<sup>2</sup> S<sup>2</sup> is in circuit. This corresponds with the softest tone of the instrument, due to the slowest rotation of the bow.

It may happen that the bow-motor will run too fast, or too slow, due to a variation in load, for example. The centrifugal governor M' operates as a crash in such case. In the illustration given, a conductor N' leads to a vibratory contact member 20, so that the member 20 is positively energized. This member vibrates between a pair of contacts 21 and 22. The contact 21 is connected by a conductor L<sup>2</sup> L<sup>2</sup> with the binding post L L; and the contact 22 is connected by a conductor S<sup>2</sup> with the binding post S. The vibrator contact member 20 is controlled by a centrifugal governor M'. It is carried by a bell-crank lever 23 which is insulatively supported on a pivot 24 carried by a depending arm 25 of a bracket member

26 which is mounted on the motor frame. A spring 27 connected by means of an insulating fibre link 28 with the bell-crank lever 23 tends to move the arm 23<sup>a</sup> towards the motor. This is opposed by a plunger 29 which is mounted to move freely in a longitudinal direction in one end of a hub, or sleeve, 30, whose opposite end is secured, as by a set screw 31 to the motor shaft 32. The inner end of the plunger 29 bears against a lever 33 which is connected with a pivot 34 eccentrically carried by the sleeve 30. The sleeve is slotted and the lever extends through and works in the slot. The sleeve is equipped with laterally extending hubs, or arms, 35, which register with bearings 36 with which a wheel-rim 36<sup>a</sup> is provided at diametrically opposite points. Screws 37 are threaded through the supports 36, and are provided with reduced inner ends 37<sup>a</sup> on which the arms 35 are journaled. A spring 38 connects the rim, or the lever, near its point of attachment with the rim with the inner end of the sleeve 30. This spring tends to move the wheel, or rim, to an oblique position and bring a stop-shoulder 33<sup>a</sup> of the lever against the circumferential surface of the inner portion of the sleeve 30. When the motor shaft is in rotation, centrifugal force tends to move the rim, or wheel, 36<sup>a</sup> to a plane perpendicular with respect to the shaft. When this occurs, the wheel-rim, swinging about the pivots 37<sup>a</sup>, moves the lever 33 and causes it to push the arm 23<sup>a</sup> of the bell-crank lever 23 to the right, as viewed in Fig. 1. The motor may attain sufficient speed to bring the wheel 36<sup>a</sup> to a perpendicular position, in which position the vibratory contact member 20 comes into engagement with the contact member 22. When this occurs, current may pass through the branch S<sup>3</sup> to the binding post S, thus operating to cut in the coils G and F and place them in series with the field coil D, thus tending to slow down the motor. The member 20 may make vibratory contact with the member 22 in such manner as to keep the motor substantially at constant speed.

On the other hand, should the motor operate too slowly, the member 20 will make contact with the member 21, and thus energize the branch L<sup>3</sup> L<sup>3</sup> which leads to the binding post L L. When this occurs, the coils A and B will be cut out of the circuit, and the speed of the motor will be increased. The member 20 may vibrate close to the member 21, and keep the motor substantially at constant speed.

It will be noted that in the arrangement shown, the effect of establishing a circuit through the branch L<sup>3</sup> L<sup>3</sup> to the binding post L L, momentarily, is the same as feeding current from the roller 14 through the conductor L<sup>2</sup> L<sup>2</sup>. In other words, there

may be a momentary boost in the speed of the motor as, for example, where the speed may be too slow when either the conductor S<sup>2</sup> or the conductor S<sup>2</sup> S<sup>2</sup> is in circuit. Also, the effect of momentarily establishing a circuit through a branch S<sup>3</sup> to the binding post S is the same as feeding current from the roller 14 through the conductor S<sup>2</sup> to the binding post S, which cuts in resistance as previously described. This action may occur under the influence of the governor when one of the loud expressions is operating.

In Fig. 1, the spools which form portions of the field windings and which appear in the view are the spools which contain the inner winding B and the outer winding G and which contain the inner winding C and the outer winding E. This is indicated on the spools, in the illustration. The connections between the coils and the binding posts are omitted from Fig. 1, for clearness of illustration.

The bow-actuating shafts M<sup>2</sup> are driven by the motor shaft 32 in any suitable manner. Usually this is by means of worm-gear connections.

From the description given, it will be understood that in the embodiment illustrated the expression-circuits automatically control the speed of the motor, but inasmuch as this control may not be sufficiently accurate, the control exercised by the expression-circuits is modified by the control exercised by the governor. The circuits controlled by the governor may operate to oppose the action of the expression-circuit. For example, when the loud expression is being used and the circuit is established through the conductor L<sup>2</sup>, the motor may run too fast, in which case the vibratory member 20 will engage the contact member 22 and close the circuit through the branch S<sup>3</sup>, thereby cutting in resistance and slowing down the motor, as described.

Ordinarily, in the normal operation of the motor, the vibratory contact member 20 remains in the intermediate position shown in Figs. 1 and 4. If, for any reason, the speed of the motor should drop sufficiently, the member 20 will engage the member 21 and thus cut out the coils A and B, causing the motor to speed up. On the other hand, should the speed of the motor increase unduly for any reason, the member 20 will engage the member 22 and cut in the resistance coils G and F, thus causing the motor to slow down.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible, in view of the prior art.

What I regard as new, and desire to secure by Letters Patent, is:

1. In motor mechanism for violin players and the like, the combination of a motor provided with field coils normally in the main circuit of the motor, expression-circuits adapted to be closed to cut out one or more of said coils, a governor-controlled circuit adapted to cut out one or more of said coils and thus modify the action of said expression-circuits, and a centrifugal governor actuated by the motor and controlling said last-named circuit.
2. In motor mechanism for violin players and the like, the combination of a motor provided with a series of field coils which are normally in the main circuit of the motor and provided also with coils which are normally out of circuit, expression-circuits adapted to cut out one or more of said first-named coils and to cut in one or more of said second-mentioned coils, and governor-controlled mechanism equipped with circuits adapted to modify the action of said expression-circuits.
3. In motor mechanism for violin players and the like, the combination of a motor provided with a plurality of field coils which are normally in the main circuit of the motor and provided also with a plurality of coils which are normally out of said circuit, a plurality of expression-circuits adapted to be closed to cut out said first-named coils or some of them and to cut in said second-named coils or some of them, a governor device actuated by the motor, and circuits controlled by said governor device and adapted to cut out one or more of said first-named coils or to cut in one or more of said second-named coils, for the purpose set forth.
4. In motor mechanism for violin players and the like, the combination of a motor provided with a field coil normally in the main circuit of the motor and provided with a field coil normally out of said circuit, expression-circuits adapted to be closed to cut out said first-named coil or to cut in said second-named coil, a governor device actuated by the motor, and circuits so controlled by said governor device as to be operative to cut in said second-named coil while said first-named coil is cut out through the medium of the expression-circuit which controls it, and vice versa.
5. In motor mechanism for violin players and the like, the combination of a motor provided with a plurality of field coils which are in circuit in the normal operation of the motor and provided with a plurality of field coils which are out of circuit in the normal operation of the motor, a plurality of expression-circuits controlling the cutting out of said first-named coils and the cutting in of said second-named coils, said expression-circuits being equipped with contacts and a co-acting energized tracker-bar, a governor actuated by the motor, and governor controlled circuits, one of which is adapted to cut in one or more of said second-named coils at a time when one or more of said first-named coils are cut out, and the other of which is adapted to cut out one or more of said first-named coils at a time when one or more of said second-named coils are cut in.

BERTIE E. MILLS.