(No Model.)

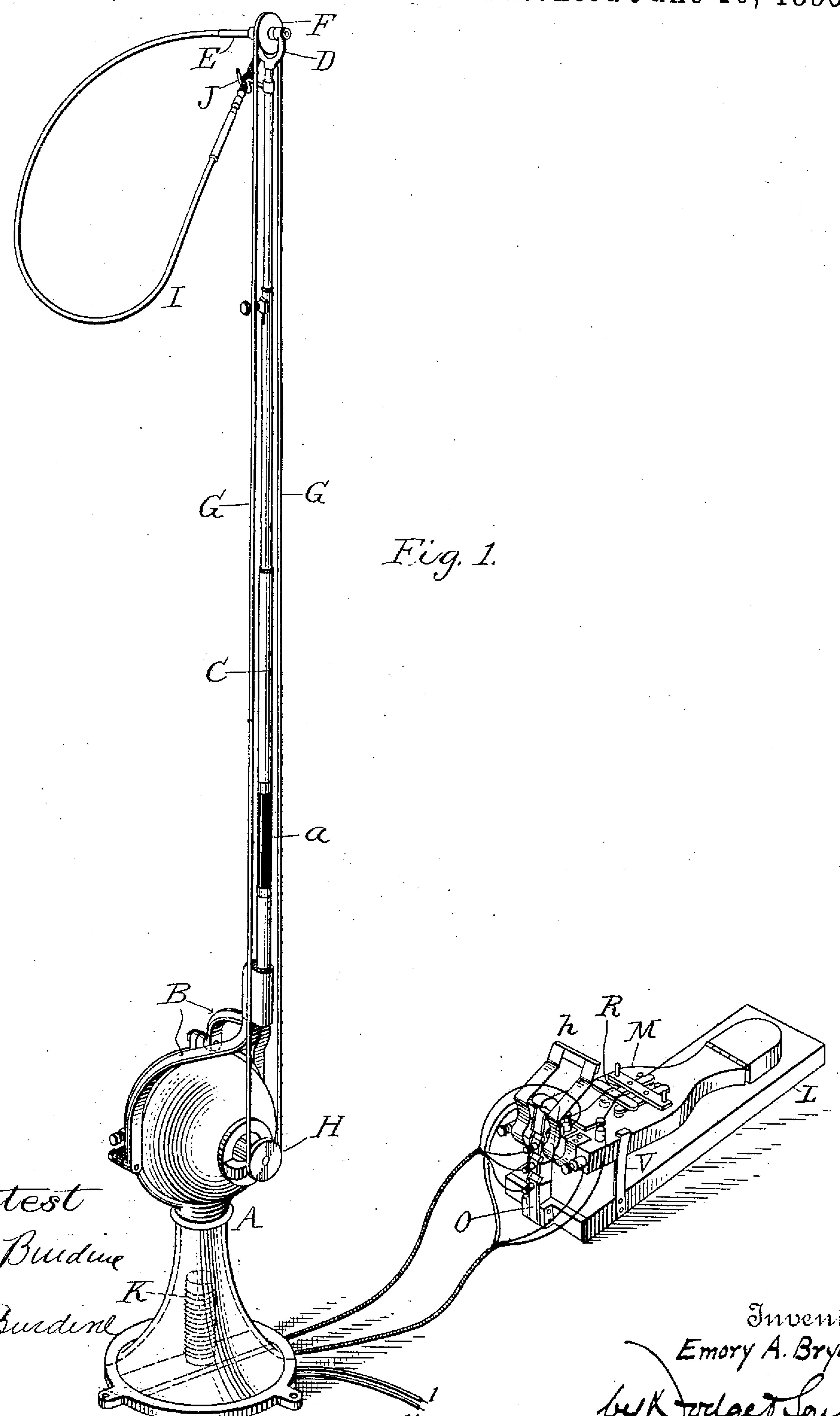
2 Sheets—Sheet 1.

E. A. BRYANT.

CONTROLLER FOR ELECTRIC MOTORS.

No. 562,116.

Patented June 16, 1896.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

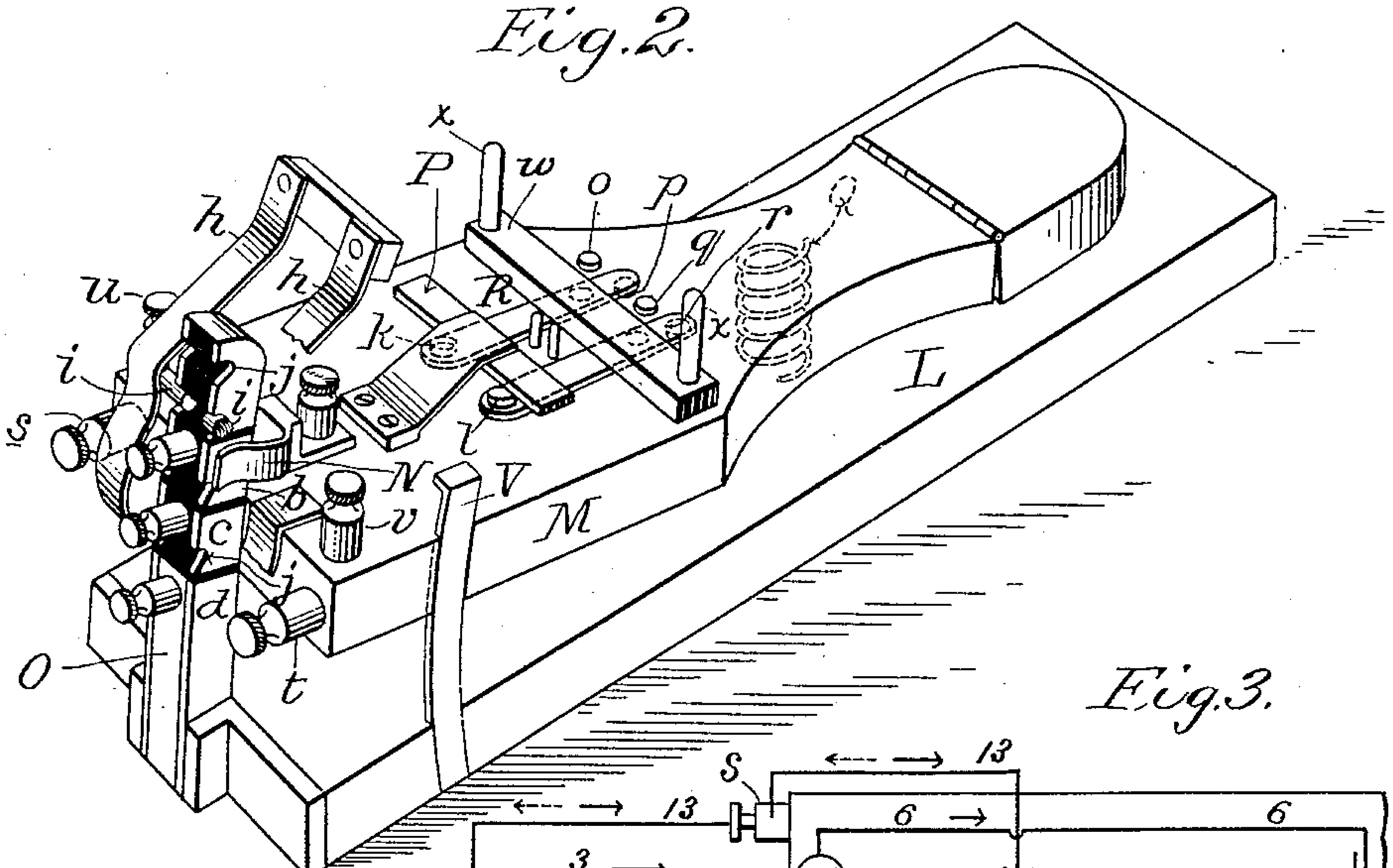
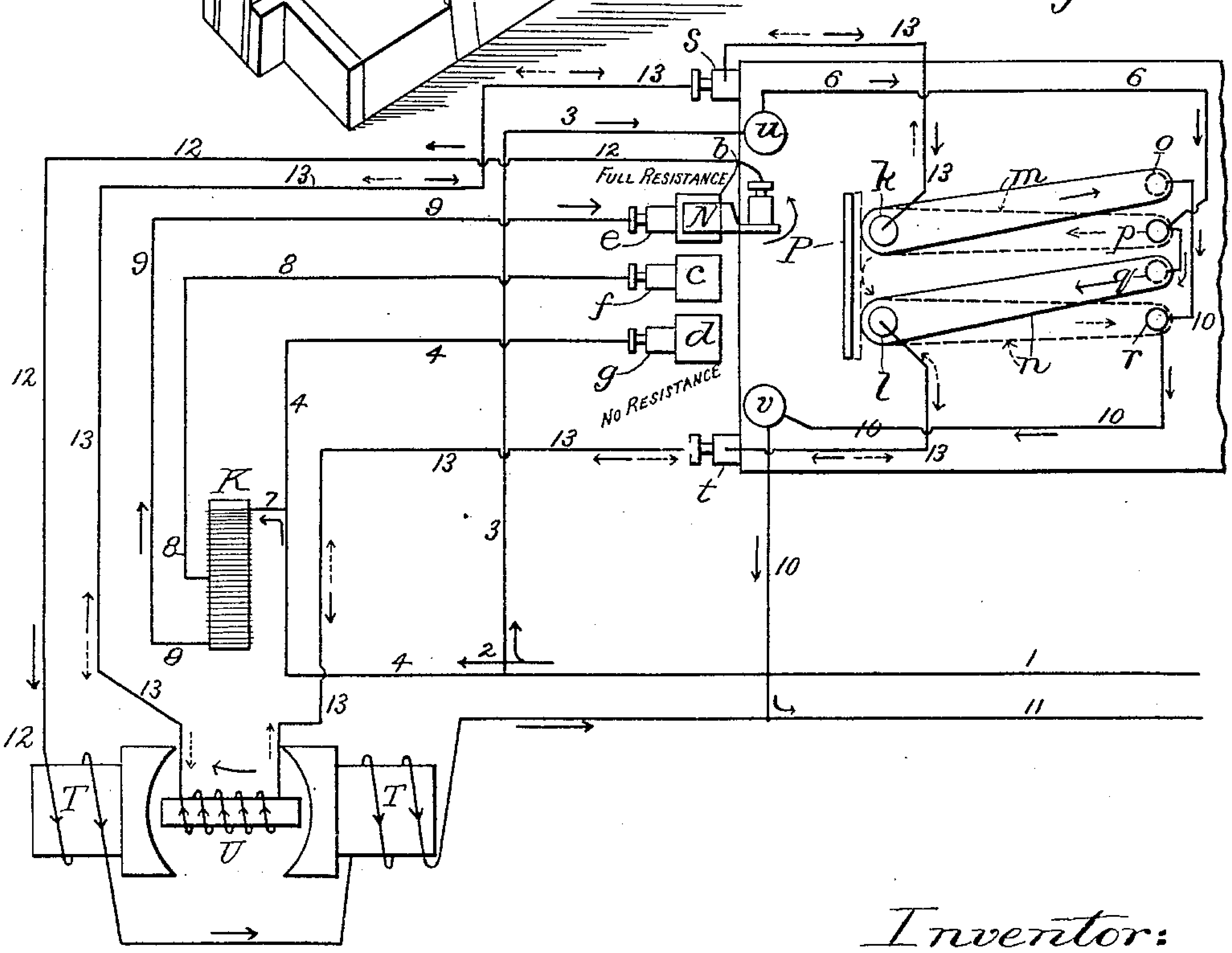


Fig. 3.



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UNITED STATES PATENT OFFICE.

EMORY A. BRYANT, OF WASHINGTON, DISTRICT OF COLUMBIA.

CONTROLLER FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 562,116, dated June 16, 1896.

Application filed April 18, 1896. Serial No. 588,096. (No model.)

To all whom it may concern:

Be it known that I, EMORY A. BRYANT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Controllers for Electric Motors, of which the following is a specification.

My invention pertains to apparatus for regulating and controlling electric motors, and comprises means for starting, stopping, reversing, and varying the speed of such motors, as hereinafter explained.

The invention is applicable generally to the regulation and control of motors, but is more particularly intended and is peculiarly suited for small motors, requiring very nice regulation and prompt control—such, for instance, as are used in running dental engines, sewing-machines, and the like.

It is obvious that in dental work particularly the motor and the tool driven by it must be under absolute control, since a very slight overmovement might produce serious results.

The details and the form of the device may be somewhat modified without departing from the scope of my invention; but I have represented in the drawings the preferred construction, and one which I have found in practical tests to work satisfactorily.

Figure 1 is a perspective view of a dental engine comprising an electric motor, an upright, and a flexible shaft belted to the motor and provided with the usual tool-holder, together with the controlling device; Fig. 2, a perspective view of the controller on a larger scale; Fig. 3, a diagrammatic development of the circuits and connections.

For convenience of illustration, and because I have successfully used such a motor in developing the invention, I have represented a well-known direct-current shunt-wound motor, which is built with a resistance-coil in its base or standard, designed to give variable speed through its inclusion or exclusion in varying degree.

A indicates the motor as a whole, to the frame or body of which is bolted or otherwise secured a bracket B, carrying an upright standard C, preferably of tubular form and telescopic, to permit it to be lengthened or shortened at will, as is done with the standard of the ordinary dental engines now in use.

At the top of the standard C there is mounted in a suitable fork or bearing D an arbor E, carrying a band-pulley F, to which rotation is imparted by a belt G, passing about said pulley F and about a second pulley H on the shaft of motor A.

I indicates a flexible shaft, one end of which is made fast to the arbor E, so as to rotate therewith, and the other end of which is furnished with a tool stock or holder J, as usual.

In the use of electric motors for the operation of dental engines, drills, and the like it has been found that a current is occasionally transmitted from the motor to the operator or the patient through the flexible shaft, and it is manifest that such an occurrence is liable to produce serious consequences when performing a delicate operation or working upon a sensitive tooth. To preclude such transmission, I introduce into the standard C an insulating or non-conducting section *a* of vulcanized fiber, gutta-percha, or other suitable material, as shown in Fig. 1. This completely obviates the difficulty noted.

Fig. 2 shows a combined controlling and reversing switch, designed to be operated by the foot and to control the motor A, the same being shown on a smaller scale in Fig. 1. Its construction may be modified somewhat without departing from my invention, particularly in the matter of materials and form or design, though wood answers quite well for the body of the structure, and the design is mainly a matter of taste, not affecting the working of the device.

L indicates a base or bottom board, to which is hinged, either directly or indirectly, a foot-board or treadle M, carrying at its forward end a bifurcated spring contact-maker N, designed to clasp the sides of a post or standard O and make electrical contact with insulated metallic plates or blocks *b*, *c*, and *d*, with which the side faces of said post are provided. The contacts *b*, *c*, and *d* are electrically connected with binding-screws *e*, *f*, and *g*, as seen in Figs. 2 and 3.

The free or forward end of treadle M, which is elevated by a suitable spring Q, also carries a locking device, here represented as consisting of two spring-arms *h*, rising from the treadle or foot-board M and curving upward and backward over the treadle sufficiently to enable the operator to press them outward readily by the toe of his boot or shoe, said arms, carrying studs or pins *i*, to enter notches *j* in the front face of post or standard O. The notches have abrupt or slightly undercut upper walls, but are beveled on their lower sides, so that the treadle may not rise until the arms *h* are pressed outward by the operator, but may be moved downward freely, the pins or studs in such case riding out of the notches.

The locking device serves to hold the treadle at any desired adjustment, and thus relieves the operator of the necessity of retaining his foot thereon.

The contacts are so arranged under the embodiment here illustrated that when the treadle is at its highest point no current passes, and that as the treadle descends to successive contacts the current and the speed of the motor increase.

For the purpose of reversing the direction of flow of current through the armature or through the field, one in relation to the other, I provide a double-bar switch R, (shown in the several figures,) the drawings showing the switch arranged to reverse the current in the armature.

The bars *m* and *n* of switch R are arranged to swing laterally about their pivot-studs *k* and *l* and to make contact simultaneously with contacts *o* and *q* or *p* and *r*, the contacts *o* and *r* being electrically connected with each other and the contacts *p* and *q* being similarly bridged or connected. Bars *m* and *n* are mechanically connected by an actuating-bar *w*, having upright stems *x* at or near its ends, against which the shoe of the operator may press to move the switch to one or the other pair of contacts.

A binding-post *s* is electrically connected with the bar *m*, and a like binding-post *t* is electrically connected with bar *n*. A binding-post *u* is electrically connected with studs *p* and *q*, and a similar post *v* is electrically connected with posts *o* and *r*.

As above suggested, it is often desirable to stop the motor instantly and without regard to the speed or direction of rotation. For this purpose I provide a metallic bar P, carried by a spring arm or plate secured to the treadle or foot-piece M in such position that by rocking the foot over switch-bar *w* the bar P may be pressed into contact with the pivot-studs *k* and *l* of switch R. As will presently be seen, this effects a short-circuiting or cutting out of the armature, while leaving the field energized, and as a consequence the armature will be promptly brought to rest and held against rotation. With small motors, such as used with dental engines, I find it practicable to stop the armature in from a quarter to a half revolution, though running at full speed.

Referring now to Fig. 3, the circuits and connections will be explained. A feed wire or conductor 1 leads from any convenient source of electric energy to a point 2, where it divides, one branch, 3, going thence to binding-post *u* and by wire or line 6 connecting with studs *p* and *q*, the second branch, 4, going to binding-post *g* of contact *d*. At a point between the dividing-place 2 and the binding-post *g* branch 4 divides, one portion, 7, going to one end of resistance-coil K, from different points in the length of which latter conductors 8 and 9 pass to the binding-screws *f* and *e*. A conductor 10 connects studs *o* and *r*, passes thence to binding-post *v*, and finally to return wire or lead 11. A conductor 12 passes from the binding-screw of spring contact-yoke N to the field-coils T of the motor, which coils are at their other end connected with the return-line 11. Lastly, a conductor 13 connects the binding-posts *s* and *t* with the commutator brushes or contacts of the motor, so that said posts are included in circuit with the armature, and it also connects the post *s* with pivot-stud *k* of bar *m*, and post *t* with pivot-stud *l* of bar *n* of the switch R.

Assuming the parts to be at the adjustment indicated in Fig. 3, the current will pass from the leading-in wire 1 to point 2, by branch 3 to binding-post *u*, and by branch 6 and stud *q* to bar *n* of switch R, thence by conductor 13 to the armature-winding U of the motor, thence by the continuation of said conductor 13 to binding-post *s*, to bar *m*, stud *o*, and conductor 10 to stud *r* of switch R, thence by conductor 10 to binding-post *v*, and back to outgoing or return wire 11, as shown by the full-line arrows. From point 2 the current goes by branch conductors 4 and 7 to the resistance-coil K, and passing through the entire length of said coil goes by conductor 9 to binding-post *e* and contact *b*, thence by contact-spring N and conductor 12 to the field-winding of the motor and finally back by return-wire to the source of electric energy. The field and armature being thus energized or excited the motor will rotate, but at a relatively slow speed owing to the introduction of the full resistance. If higher speed be desired, the treadle is depressed sufficiently to carry contact-spring N to contact *c*, whereupon the circuits will continue the same, except that the current will leave the resistance-coil by conductor 8, going thence to binding-screw *f* and contact *c*, and consequently including but half of the resistance K. By further depressing the treadle or foot-board contact-spring N may be made to rest upon contact *d*, whereupon the full current will pass by conductor 4 to the binding-post *g* and contact *d*, wholly omitting the resistance K. This will of course give the maximum speed.

If at any time, and with any desired resistance in circuit or with the resistance wholly cut out, it be desired to reverse the motor, it is only necessary to move the foot laterally and thus carry bars *m n* of switch R to the studs *p* and *r*, whereupon the armature-current will take the path indicated by dotted arrows in Fig. 3, thus changing its direction through the armature-winding, and consequently reversing the direction of its rotation. Obviously the same result may be attained by reversing the direction of the current through the field-winding, while maintaining that of the armature.

If it be desired at any instant to stop the motor, it may be done by merely depressing toe-piece or spring-plate P, thus causing the current to pass from conductor 1, by branch 3, binding-post u, conductor 6, bar n, stud l to bar or plate P, thence by said plate to stud k and bar m, and by conductor 10, binding-post v and continuation of conductor 10, back to line-wire 11 without going to the armature, the field-circuit remaining closed as before. So, too, by moving the toe of his shoe forward the operator may at any time release the catch or locking device h i, whereupon the spring Q will throw the treadle or foot-piece upward until contact N passes above the several contacts b c d and rests upon an insulated portion of the post or standard, thus preventing any current from passing through the switch or the motor, which will in such case come to rest gradually.

A stop V may be provided to limit the rise of the foot-board or treadle.

I am aware that rheostats and reversing-switches are old, and that they have been constructed with controlling treadles or foot-pieces; but in prior constructions the resistance device, which is quite often bulky, has commonly been incorporated in the same structure with the treadle or foot-piece. Such construction is objectionable for the reason that it takes up considerable space, and is much in the way of an operator working about a dental chair, and in many other situations. The weight of prior devices and the mode of connecting them has also rendered it impracticable to shift them about readily, as must be done by a dentist, as his position is changed oftentimes from one side of the chair to the other.

My device is light and small and may be readily pushed from point to point by the foot of the operator without removing his hands from his tools or work.

It is obvious that instead of being placed upon the floor and operated by the foot, the device may be placed in position to be operated or controlled by the knee or by the arm, and the terms "treadle" and "foot-board" are therefore to be understood as meaning a lever of any suitable form and arranged in such position as circumstances may require or render expedient.

The spring-arm of plate P should offer less resistance to the foot than spring Q, so that it may be readily overcome without depressing the treadle or lever.

Having thus described my invention, what I claim is—

1. In combination with a suitable resistance coil or device, a treadle or lever provided with a contact arranged to vary the resistance included in circuit, as the lever is rocked; and a reversing-switch carried by the lever and adapted to be actuated by a lateral movement of the foot or limb of the operator without rocking the treadle.

2. In combination with a suitable resistance coil or device; a treadle or lever arranged to bring resistance into or remove it from circuit as the lever is rocked; and a short-circuiting switch or device mounted upon the lever and adapted to open or close a path for the circuit around the armature independently of any movement of the lever.

3. In combination with a suitable resistance coil or device, a lever or treadle serving to bring said resistance into or to remove it from circuit as the lever is rocked; a reversing-switch mounted upon and movable independently of the lever or treadle; and a short-circuiting device for cutting out the armature, also mounted upon and operable independently of said lever or treadle; substantially as set forth.

4. In a current-controller, the combination of a treadle or lever provided with a contact device; a post or standard provided with a series of contacts to be pressed upon by said contact device; a spring for moving the treadle or lever in one direction; and a catch or locking device adapted to positively lock the lever in position, relatively to the post or standard.

5. In combination with treadle or lever M provided with contact N; spring Q for moving said treadle or lever in one direction; post or standard O, provided with contact plates or blocks and with notches j; and spring-arm h carried by the treadle or lever M and having pins or lugs i to enter said notches; substantially as set forth.

6. In combination with an electric motor and with a resistance device; a post or standard having a series of contacts connecting with the resistance device at different points in its length; a treadle or lever provided with a contact to ride over those of the post or standard as the treadle or lever is moved; and a reversing-switch carried by the treadle or lever and having a movement independent thereof; whereby it is enabled to reverse the direction of a driven electromotor while the lever remains at rest and the current remains constant.

7. In combination with an electric resistance and with a lever movable in one plane to introduce or remove said resistance into or from circuit; a reversing-switch carried by said lever and movable in an intersecting plane; whereby either part may be moved by the same member without liability of moving the other.

8. In combination with an electric resistance and with a lever or treadle movable to vary the resistance included in circuit; a spring for moving the lever in one direction; a short-circuiting switch carried by said lever or treadle and movable relatively thereto; and a spring for normally opening said switch; the spring of the switch being arranged to

offer less opposition to pressure than does the lever or treadle spring; whereby the short-circuiting switch may be actuated without moving the lever or treadle.

9. The herein-described current-controller, consisting of a base or support; a treadle or lever M; a spring for elevating said lever; a contact device N carried by the treadle; a post or standard O provided with contact-blocks *b*, *c*, *d*, for contact N to bear upon, and with notches *j*; spring-arm *h* carried by lever M and provided with stud *i* to enter the notches; contact-studs *k*, *l*, and spring-plate P; contact-studs *o*, *p*, *q*, *r*; bars *m*, *n*; connecting-bar *w*; and electric connections between the parts, substantially as described and shown.

In witness whereof I hereunto set my hand in the presence of two witnesses.

EMORY A. BRYANT.

Witnesses:

HORACE A. DODGE,

WILLIAM W. DODGE.