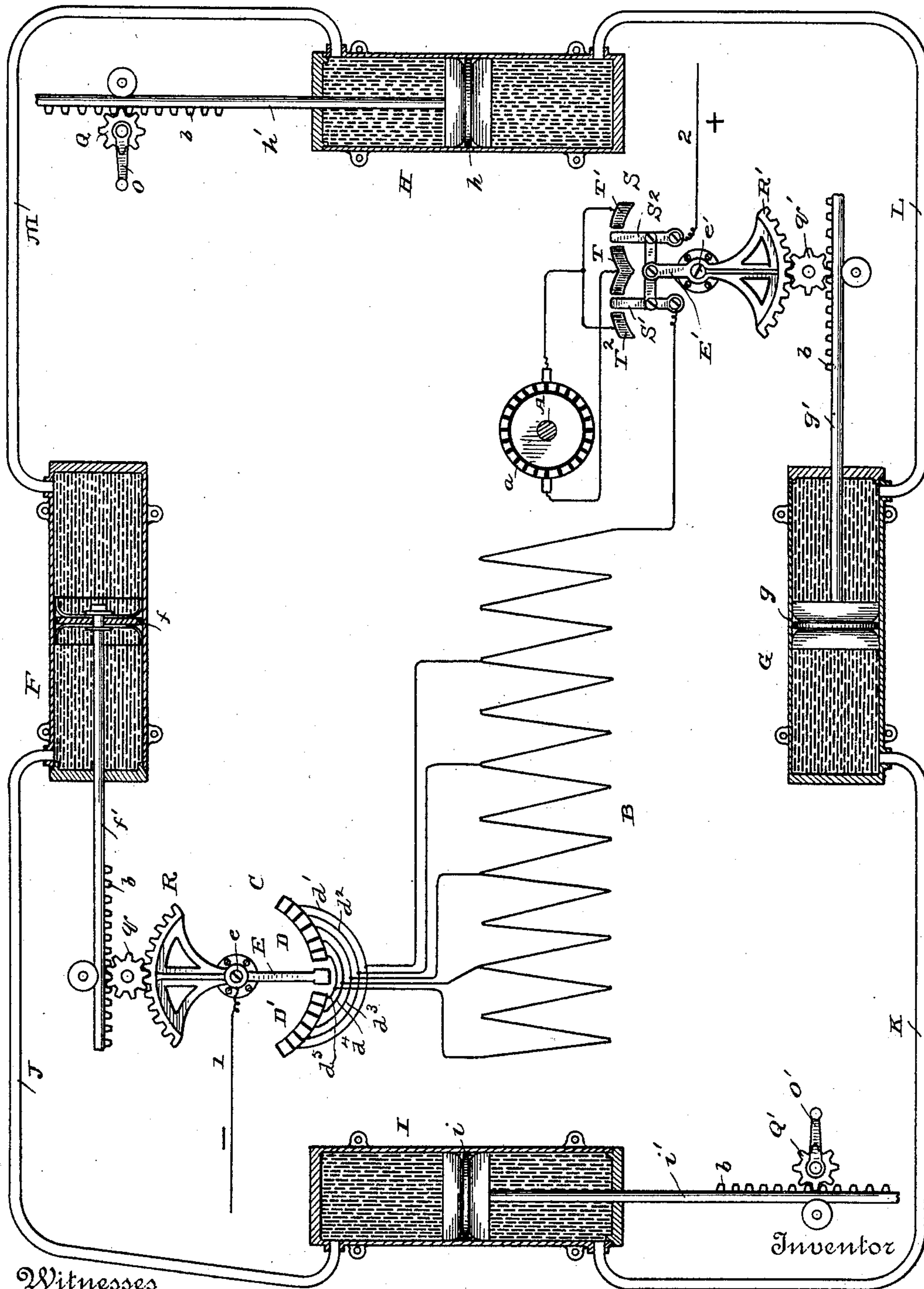


(No Model.)

C. J. VAN DEPOELE.
CONTROLLING APPARATUS FOR ELECTRIC MOTORS.

No. 467,449.

Patented Jan. 19, 1892.



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CONTROLLING APPARATUS FOR ELECTRIC MOTORS.

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To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in the Controlling Apparatus for Electric Motors, of which the following is a description, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon.

My invention relates to mechanism for controlling the action of apparatus at a point distant from the operator, the medium of communication being a practically incompressible liquid which, being operated upon at one point, communicates movement to other points of the system by acting against movable parts contained within suitable chambers—as, for instance, fixed elastic diaphragms or movable pistons contained within suitable cylinders.

The invention is illustrated in connection with the current-regulating and the current-reversing apparatus of an electrically-propelled vehicle which in practice is required to be operated from either end, according to the direction of travel.

The accompanying drawing is a diagrammatic view, partly in sectional elevation, showing an electric-motor-controlling apparatus embodying the invention.

In the figure, A represents the armature-shaft and *a* the commutator of an electro-dynamic motor. The armature-shaft A is to be connected in any suitable or desired manner to perform useful work—as, for instance, in rotating the axle or axles of a vehicle, suitable gearing being in such instance provided.

B are the coils of the field-magnets of the motor.

C is a duplex switch provided with two oppositely-arranged sets of insulated contacts DD', which are connected by loops $d' d^2 d^3 d^4 d^5$ at intervals with the coils of the field-magnet B. The details of the construction of the motor may, however, be varied without affecting the essential features of the present invention.

E is a contact-arm pivoted at *e* and adapted to be moved over either of the sets of contacts DD'.

One terminal of the circuit of the motor is

indicated by conductor 1, which conductor is connected to the switch-lever E.

Four hydraulic cylinders F G H I are provided, each cylinder having a piston $f g h i$, and the said pistons are each provided with a piston-rod $f' g' h' i'$, extending through a suitably-packed orifice in one of the cylinder-heads. The said piston-rods are each provided with means whereby motion may be transmitted to or from them, in the present instance a toothed rack *b* being shown as a convenient means of accomplishing this end.

The pistons are provided with suitable packing—such, for instance, as will tend to maintain a tight joint with the bore of the cylinder when the liquid in the cylinder is in motion. The cylinders are all filled with a substantially incompressible liquid, such as glycerine, linseed-oil, alcohol, or even water where there is no frost. The cylinders are connected by pipes, so that they form together one continuous series, the liquid forced out of the forward end of one cylinder passing into the rear end of the next, and so on. As indicated, the forward end of cylinder F is connected by pipe J with the rear end of cylinder I, the forward end of cylinder I by pipe K with the rear end of cylinder G, the forward end of cylinder G by pipe L with the rear end of cylinder H, and the forward end of cylinder H by pipe M with the rear end of cylinder F. The pistons are all normally in central position within their cylinders, and no outlets, air-spaces, or air-chambers are employed, so that the forcible movement of one of the pistons in either direction will force the liquid from cylinder to cylinder, causing a corresponding movement of all the pistons.

H and I are shown as the actuating-cylinders, hand-levers O O' and pinions Q Q' being shown in connection with the rack-bars upon the piston-rods thereof. Upon moving the hand-lever O and turning the pinion Q the piston-rod h' and piston *h* would be actuated, forcing the liquid out of the cylinder H in one direction and drawing it in in the other and producing similar movements in the other cylinders. Obviously the hand-lever O' would be moved simultaneously with the hand-lever O; but in the ordinary practice of operating electrically-propelled vehicles the

mechanism is controlled from one end at a time, and the same results would be produced whether the power were applied to the piston *h* or *i*.

5 The switch-lever *E* is provided with or connected to a segmental rack *R*, which meshes with pinion *q*, which also engages the rack-bar *b* or piston-rod *f'*, so that any movement of the piston *f* will be communicated to the
10 switch-lever, placing it in the desired position upon one or the other of the sets of contacts *D D'*. A similar segmental rack *R'* is connected by pinion *q'* with the rack *b* upon the piston-rod *g'*, said rack carrying or being con-
15 nected to a lever *E'*, controlling a two-point reversing-switch *S*. One of the switch-levers *S'* is connected with the field-magnet circuit, while the other lever *S²* is connected to the other terminal 2 of the motor-circuit. Three
20 somewhat extended contacts *T T' T²* are connected with the armature-circuit, so that the current will flow through said armature-circuit in one direction or the other, according to the position of the switch-terminals *S' S²*.
25 With the position shown the pistons are all central within their cylinders. The contact-lever *E* is between its two sets of contacts, as also are the switch-levers *S' S²*. Consequently, if either of the levers *O O'* be moved,
30 the operating-pistons *h i*, together with the pistons *f g*, will be caused to travel in one direction or the other, thereby closing the armature-circuit through switch-levers *S' S²* and terminals *T T'* or *T T²*, and at the same
35 time moving the contact-lever *E* onto the said contacts *D* or *D'*. The lever *E* will first engage one of the contacts connected by loop *d⁵* with the extremity of the field-magnet coils. Continued movement thereof will cause it to
40 engage successively the loops *d⁴ d³ d² d'*, thus gradually reducing the number of field-magnet coils in circuit to vary the power and speed of the motor. The switch-levers *S' S²* will move at the same time; but the terminals
45 *T T' T²* are sufficiently extended to permit this movement without interruption of the circuit. When, however, it is desired to reverse the direction of rotation of the armature of the motor, it will be noted that the
50 field-magnet coils then in circuit must first be cut out successively, then the motor-circuit entirely opened, and then connections made with the other set of contacts, the levers of the reversing-switch being simultane-
55 ously moved from one set of contacts to the other to cause the current to flow in reverse direction through the armature.

I am aware that it has been the practice to operate street-car motors by separate sets of
60 controlling apparatus, one set affecting the current, the other actuating a reversing-switch only. This is objectionable because of the injury liable to result to the motor from sudden reversal of its circuit while the current
65 is flowing, and, furthermore, because separate

movement of separate pieces of apparatus is required to produce the desired effect, and although my present invention is equally applicable to this system of operation by duplication of the parts I prefer the method herein
70 set forth, since it combines simplicity and economy with what I consider the best mode of procedure. Various minor changes and modifications may be made in the invention, and many such will doubtless suggest them-
75 selves to persons skilled in the art in view of the foregoing description.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A hydraulic controlling apparatus for electric motors, comprising a plurality of cylinders connected in continuous series by pipes
80 extending from the front end of one cylinder to the rear end of the next and filled with liquid, a piston for each cylinder normally located at the center thereof and provided with
85 an outwardly-extending piston-rod, mechanism for imparting motion to one or other of the pistons, thereby displacing the liquid and
90 actuating all the pistons simultaneously, and mechanical connections between the pistons of the actuated cylinders and work to be performed.

2. A controlling apparatus for electric motors, comprising primary and secondary cylinders, all connected in series, the cylinders
95 and their connections being filled with liquid, pistons normally located at the center of each cylinder, mechanism for imparting movement
100 in either direction to the piston of either of the primary cylinders, a current-controlling apparatus mechanically connected with the piston of one of the secondary cylinders, a
105 circuit-reversing apparatus mechanically connected with the piston of the other secondary cylinder, and means for imparting either forward or backward movement to one of the
primary pistons and thereby displacing the liquid in the circuit of the cylinders and moving
110 all the pistons in the desired direction to open or close or reverse the motor-circuits.

3. A controlling apparatus for electric motors, comprising a plurality of hydraulic cylinders connected in series and each provided
115 with a movable piston, mechanism for imparting movement to one or other of the pistons and thereby displacing the liquid and the pistons of the other cylinders, connections
120 between separate pistons and a motor-reversing switch, and a duplex current-controlling switch, whereby when the motor is to be reversed the motor is first cut out of circuit.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES J. VAN DEPOELE.

Witnesses:

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