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W. BAXTER, Jr.

GOVERNOR FOR ELECTRIC MOTORS.

No. 384,117. Patented June 5, 1888.

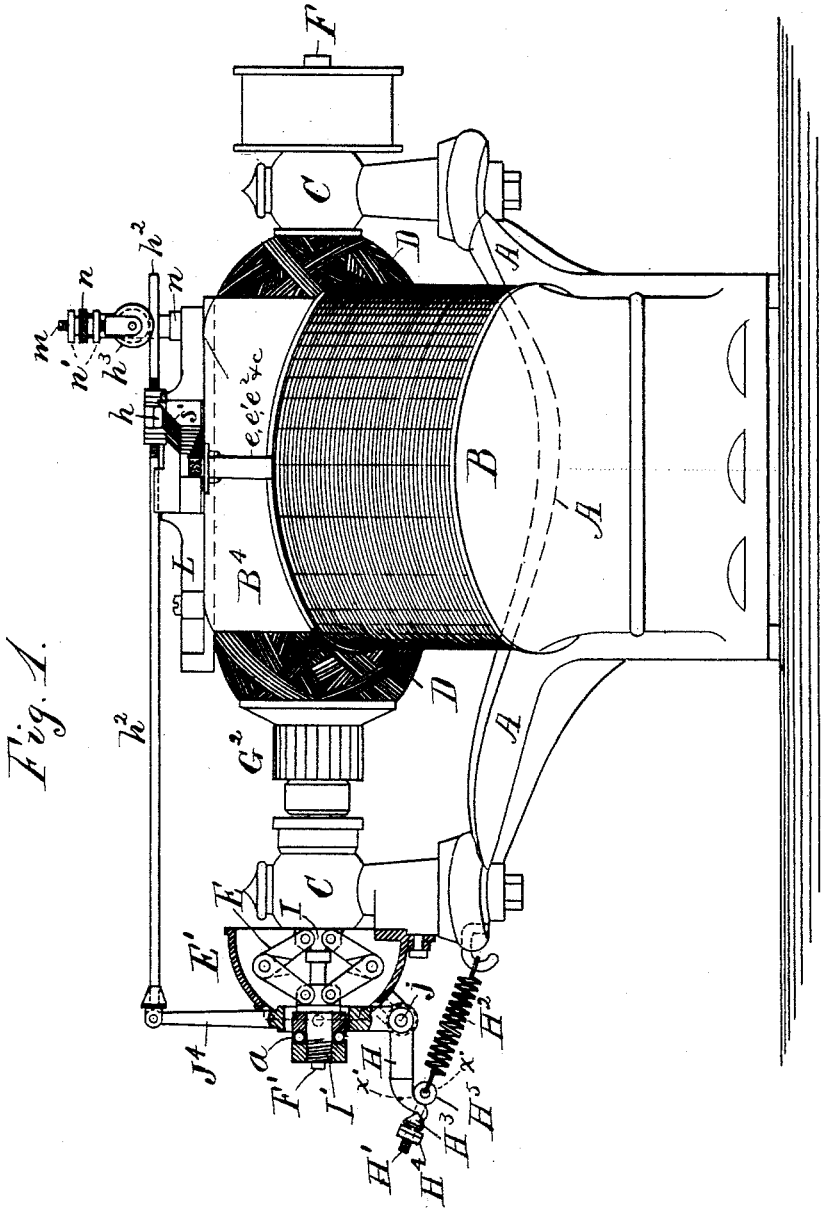

Fig. 1.

Attest:
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F. C. Fischer.

Inventor.
William Baxter, Jr.
per Crane & Miller, attys.

(No Model.) 5 Sheets—Sheet 2.

W. BAXTER, Jr.

GOVERNOR FOR ELECTRIC MOTORS.

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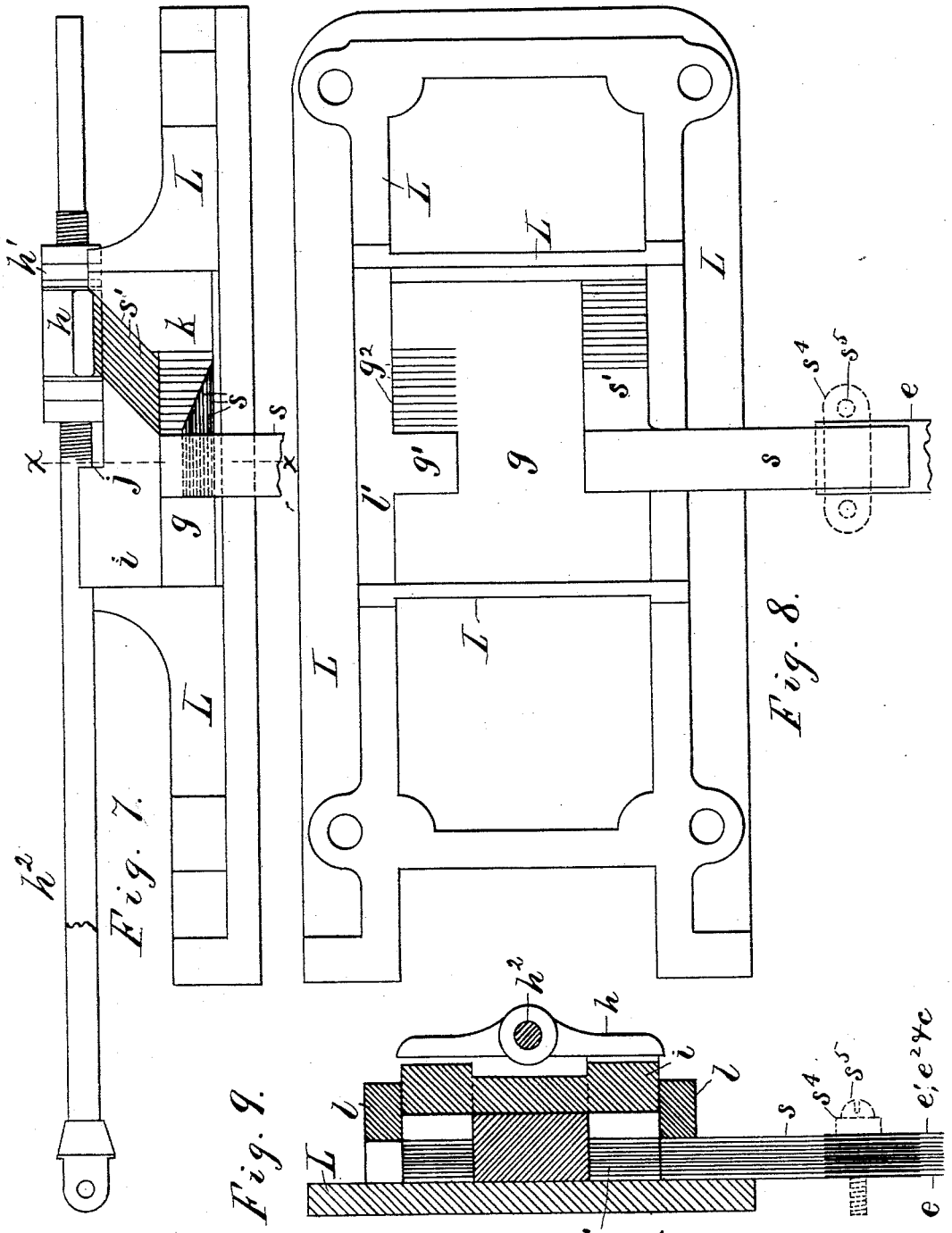

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William Baxter, Jr.,
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W. BAXTER, Jr.

GOVERNOR FOR ELECTRIC MOTORS.

No. 384,117. Patented June 5, 1888.

Fig. 2.

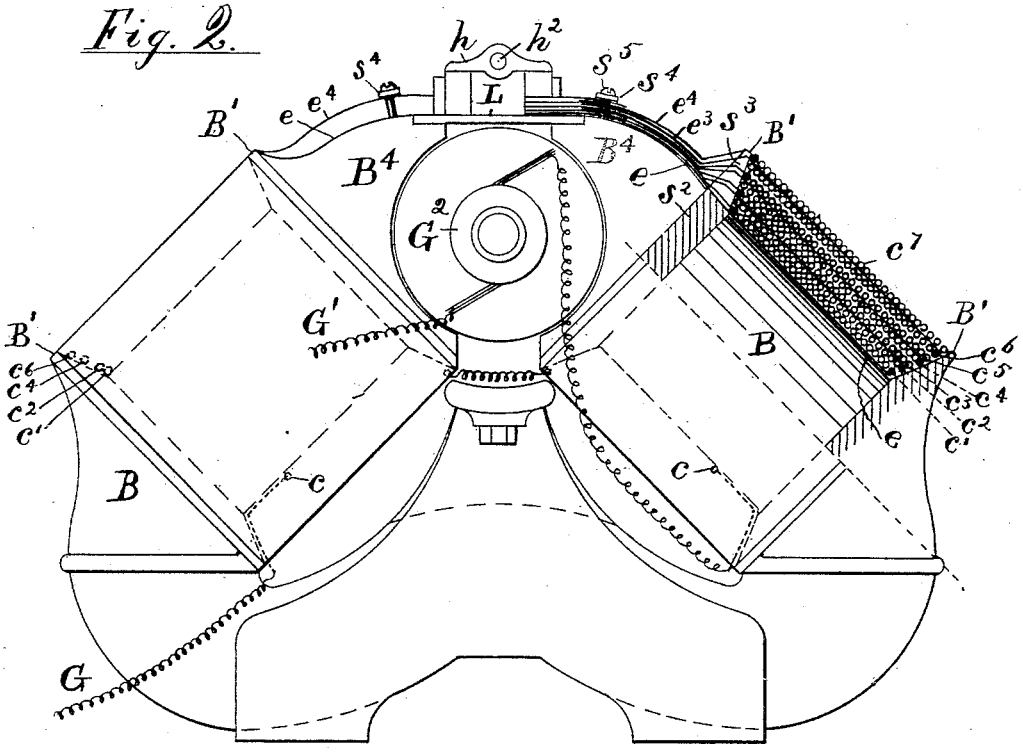

Fig. 6.

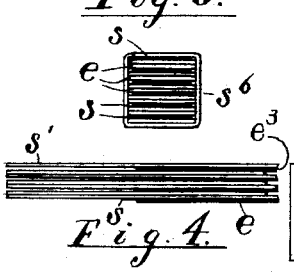

Fig. 4.

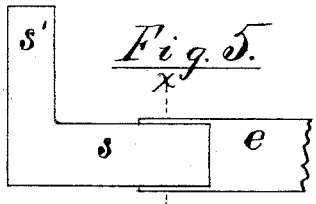

Fig. 5.

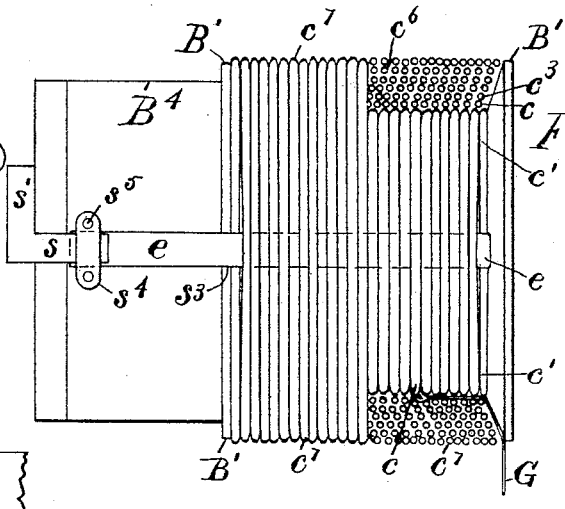

Fig. 3.

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L. Lee.
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GOVERNOR FOR ELECTRIC MOTORS.

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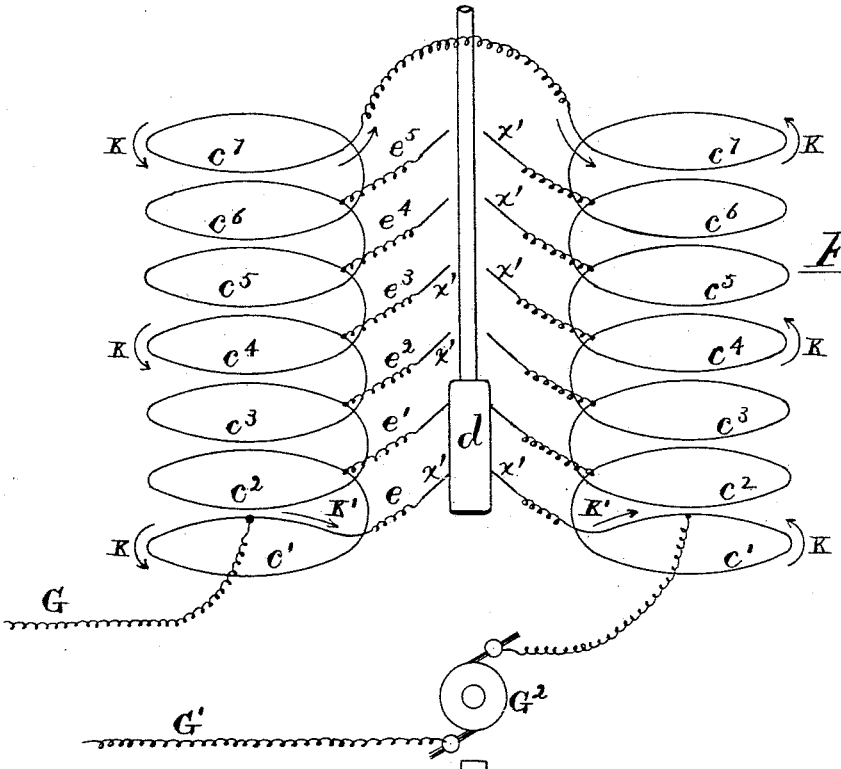

Fig. 24.

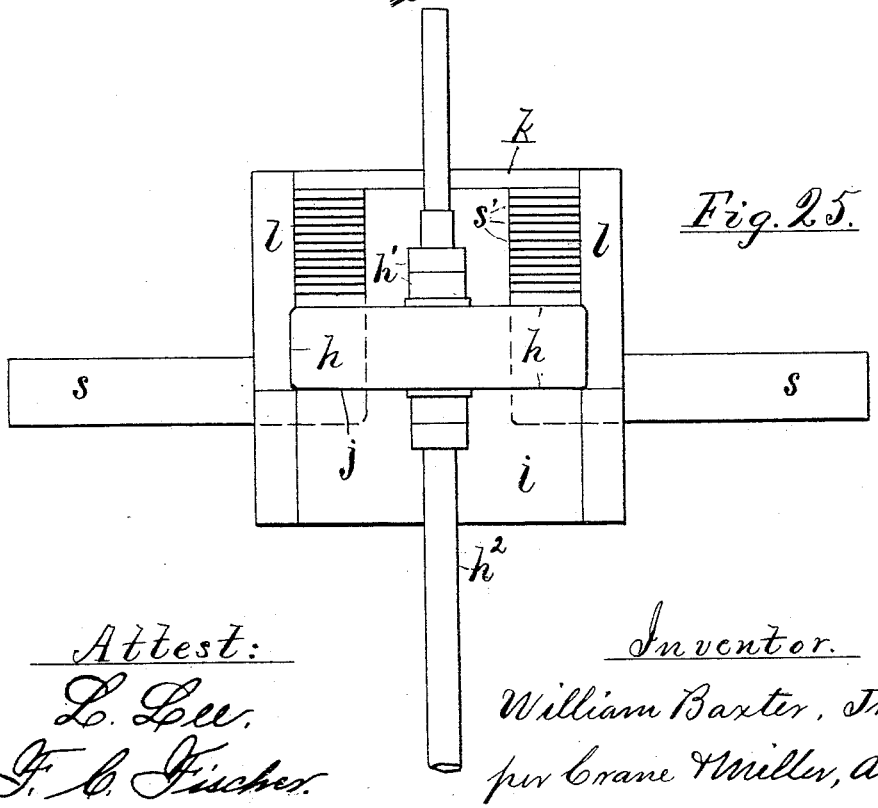

Fig. 25.

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GOVERNOR FOR ELECTRIC MOTORS.

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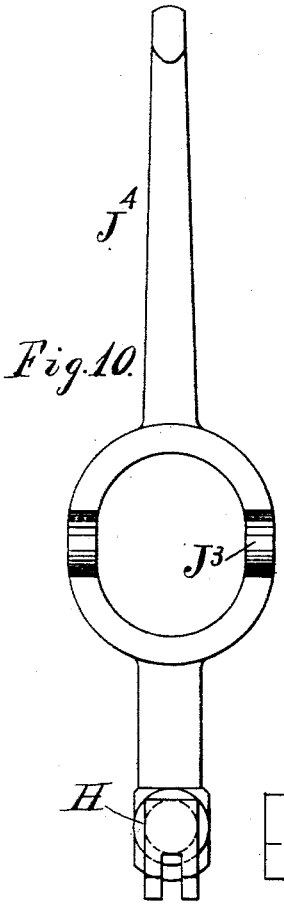

Fig. 10.

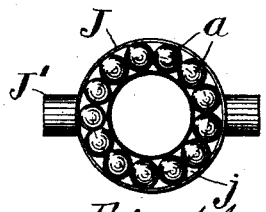

Fig. 11.

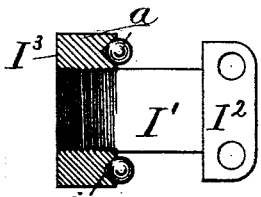

Fig. 12.

Fig. 14.

Fig. 13.

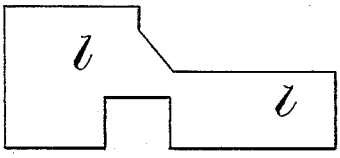

Fig. 16.

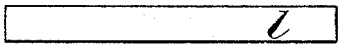

Fig. 15.

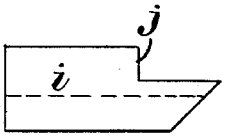

Fig. 21.

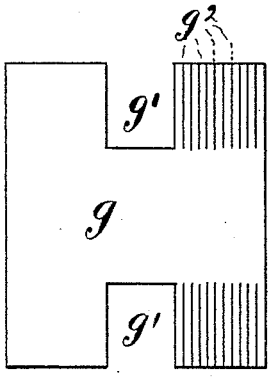

Fig. 17.

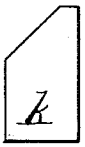

Fig. 23.

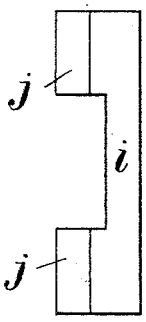

Fig. 20.

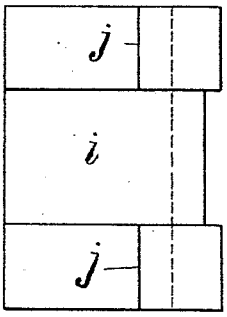

Fig. 19.

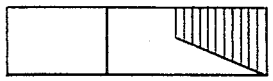

Fig. 18.

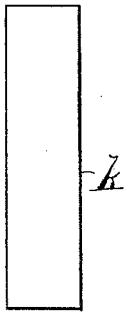

Fig. 22.

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F. B. Fischer.

Inventor.
William Baxter, Jr.,
per Crane & Miller, attys.

UNITED STATES PATENT OFFICE.

WILLIAM BAXTER, JR., OF BALTIMORE COUNTY, ASSIGNOR TO THE BAXTER ELECTRIC MANUFACTURING AND MOTOR COMPANY, OF BALTIMORE, MARYLAND.

GOVERNOR FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 384,117, dated June 5, 1888.

Application filed August 26, 1887. Serial No. 247,907. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM BAXTER, JR., a citizen of the United States, residing in the Ninth election district of the county of Baltimore, State of Maryland, have invented certain new and useful Improvements in Electric Motors with Governors, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The object of this invention is partly to furnish a more compact and durable construction for the shunt-connections from the field-coils to a shunt-box, for which purpose I place the shunt-box upon a bridge connecting the pole-pieces of the field-magnet and conduct the shunt-connections from the same point upon the coils over the pole-piece directly to the shunt-box. By extending all the connections from the nearest point upon the coils to the shunt-box in such a location, and wrapping the connections firmly together and securing them to the pole-piece, I form a very direct conjunction of the coils and the contacts in the shunt-box and protect the connections in the most effective manner from accidental derangement or injury.

My invention also consists, partly, in connecting with the field-coils an auxiliary coil wound in an opposite direction and connected with a contact in the same shunt-box as the connections from the various sections of the field-coils, so that the same means may be employed to first close the circuit through the shunt-connections of the main coils and then through the auxiliary coil to react upon the residual magnetism of the field when the motor is very lightly loaded. By this construction the motor is prevented from running away (attaining an excessive velocity) when the motor is working under a very light load.

My improvement also consists in the combination, with the motor, of a governor-lever having a tension-spring applied to the lever-arm at an acute angle to operate with a diminishing leverage upon the arm as the speed of the motor increases, and in the combination, with the motor armature-shaft having a governor applied thereto and acting upon an arm provided with such an opposing spring, of a revolving thrust-ring connected with the governor-weights and provided with anti-friction balls fitted to a groove in such ring and to a collar upon the governor-arm, to diminish the frictional resistance imposed by the spring upon such thrust-ring.

My improvements are especially adapted to motors which use a constant current such as is employed in arc-light circuits, and the speed of the motor is regulated by modifying the strength of the magnetic field automatically by the action of the governor.

My invention will be understood by reference to the annexed drawings, in which—

Figure 1 is a side elevation of a motor provided with my improvements, certain parts of the governor being shown in section on their central line where hatched. Fig. 2 is an end view of the motor-frame and magnet-poles with the coils upon one magnet-core cut away to the center line of the core and the wires blacked which connect with the strips c c' c'', &c. Fig. 3 is a plan, with coils outside the first, in section, of one of the magnet-cores detached from the motor-frame and viewed at right angles to its axis, with the elbow-pieces for connecting the coils to the shunt-box. Fig. 4 is an edge view, and Fig. 5 a plan, of the elbow-connections from the coils to the shunt-box; and Fig. 6 is a transverse section of the elbow-connections on line x x in Fig. 5. Fig. 7 is a side view of the shunt-box with its connector and governor-rod. Fig. 8 is a plan of the same with the elbow connections at one side omitted, as well as the cover to the spring-holder and the connector and governor-rod; and Fig. 9 is a transverse section of the same on line x x in Fig. 7. Fig. 10 is an end view of the governor-lever. Fig. 11 is an end view of the governor-collar; Fig. 12, a side view of the governor-sleeve; Figs. 13 and 14, a plan and end view of the shunt-block connector; Figs. 15 and 16, a plan and side view of the cheek-pieces for the shunt-box; Figs. 17 and 18 are a plan and side view of the spring guide or holder. Figs. 19 and 20 are a plan and end view of the cap for the spring-holder; Fig. 21, an end view of the same, and Figs. 22

and 23 are a plan and end view of the spring abutment. Fig. 24 is a diagram showing the magnet-coils with their shunt-connections. In Fig. 8 the cap *i*, cheek-pieces *l*, and shunt-block *h* are removed; and Fig. 25 shows a plan of such parts with the springs *s'* and abutment *k*.

A is the frame of the motor, forming the bridge between the magnet-cores B and provided with bearings C for the arbor of the armature D. These parts, as well as the governor-links E and their guard E', are similar to those shown in my United States Patent, No. 361,116, issued April 12, 1887. The governor is mounted upon a shaft, F', extending from the end of the arbor F. The inner ends of the links are pivoted to rotate with a collar, I, affixed to the shaft, and the outer ends of the links are pivoted to a sleeve, I', (shown detached in Fig. 12,) and furnished at its inner end with a head, I^2, and at its outer end with a nut, I^3. A collar, J, is fitted to the sleeve between the head and the nut, and provided with pivots J', which operate in sockets J^3 in a governor-lever, J^4. The nut I^3 and the collar J are each formed with an angular groove, *j*, and balls *a* are inserted in the groove (being shown in Figs. 11 and 12 both) to diminish the friction between the nut and collar when the sleeve is drawn inward by the expansion of the governor-links. The lever is pivoted at *j* upon the guard E' and is furnished with an arm, H, having a tightening-bolt, H', fitted in its outer end and connected with a spring, H^2. The bolt is connected with the spring by an eye, H^5, and is provided with a wedge-shaped block, H^3, having sharp edges fitted to a forked bearing in the end of the arm H and adjustable by a nut, H^4, to vary the tension of the spring. The spring is extended from the bolt at an acute angle with the arm H past the pivot *j*, and is attached to the frame A in such position that an increased speed of the governor-links operates to extend the spring.

The links are shown in Fig. 1 in the position assumed at their greatest velocity, and the spring operates, when the velocity is diminished, to draw the arm H downward and the sleeve I' outward, thus drawing the mass of the links nearer to the shaft F'.

The movement of the eye H^5 around the pivot *j*, as indicated by dotted line *x' x'*, is not in a line with the spring, and therefore operates, as the spring retracts, to move the axis of the spring gradually away from the pivot *j*, and to thus increase the leverage of the arm H. This increase in the force of the spring upon the arm H corresponds with the increased force of the governor when the links lie closer to the shaft. If the resisting force of the spring remained constant while the governor force decreased, (with the changed relation of the links to the shaft at higher velocities,) the governor would not operate as desired; but the decreasing tension of the spring enables the governor to move the lever J^4 through its whole range with a very slight increase of velocity, the spring being adjusted in practice to just about balance the force of the governor at the beginning of its movement above the normal velocity.

By properly proportioning the weight of the links and the strength of the spring to the normal velocity for which the motor is designed the resistance of the spring to the governor may be made nearly uniform throughout its whole range of movement, so that a very slight increase of the centrifugal force will produce a great movement of the lever. The spring is readily adjusted by a nut, H^4, and its tension may thus be varied and the governor rendered sensitive to any speed desired.

The velocity of the motor is regulated, as is sometimes done in constant-current motors, without varying the position of the commutator-brushes, the intensity of the magnetic field being changed when it is necessary to vary the power of the motor by cutting out more or less of the magnet-coils which are wound around the magnet-cores B. My invention differs, however, from other constructions for the same purpose in leading the different shunt-connections of the magnet-coils from the same point upon the surface of the coil, and extending the same directly to the shunt-box upon the bridge. By forming a notch in the flange at the inner end of the magnet-core the connections may all be conducted from the coils at the nearest point to the bridge, and may be bunched together and secured upon the pole-piece in a single band, which is thus wholly protected from injury or accidental derangement.

The wrapping of the magnet is formed of a continuous wire with its primary end connected with the circuit in any convenient manner.

c' is the first coil extending between the flanges B' of each magnet-core, and c^2, c^3, c^4, and so on are the exterior coils wrapped about the first, the terminal of the final coil being arranged to connect with the terminal of the opposite magnet-coil, or with the commutator-brushes, in the usual manner.

When operating with a full load, the current enters the first coil upon one side, and after traversing all the other coils passes through the coils upon the other side, and thence through the commutator and armature to line. To diminish the intensity of the magnetic field in any desired degree, I extend a shunt connection formed of a flat strip, *e e' e²*, &c., from each coil (or from any other preferred section of the magnet-helix) to a shunt-box, where a shunt block or connector, *d*, may operate to unite the similar coils upon the opposite magnet-cores, (and thus cut out part of the field-wires on both cores simultaneously,) or to short-circuit the layers of each coil individually, as may be preferred.

In Fig. 24 is shown by a diagram the operation of these shunt-connections, the lines *c'*, c^2, c^3, c^4, c^5, and c^6 representing an equal number of coils upon the opposite magnet-cores.

G represents the positive-current wire, G′ the negative, G^2 the commutator, and e', e^2, and so on, the strips or shunt-connections from the several coils, terminating in springs in the shunt-box.

A shunt-block, *d*, is arranged to move over the ends of the springs x' to unite electrically any of the similar connections, e' e^2, &c. The shunt-block *d* is made, in practice, long enough to cover all the springs x' at once, to prevent its rear end from catching upon their ends when the block is retracted. As the block may thus cover any number of the springs under one of its ends, it may operate, if such springs form the terminals of suitable circuit, to short-circuit either or both of the magnetic coils independently of the other. When the block is withdrawn from all the springs, the current passes through all the coils and produces a field of maximum intensity; but if the pair of coils farthest from the connection G are united by placing the block *d* in contact with the springs x' it is obvious that the coils c^6 would be entirely cut out of the circuit and the intensity of the magnetic field correspondingly diminished. In like manner, if the block be placed in contact with the springs attached to the connections e^4, two coils would be cut out of the circuit, and if the block be placed in contact with the springs attached to the connections *e* the current would pass directly to the commutator through such block, and all the magnet-coils would be cut out. The motor would then be destitute of power and motion, but for the residual magnetism in the metal of the poles, which in practice is sufficient to rotate the armature at a high velocity when propelling a very light load, or when the belt is suddenly thrown off.

To maintain a constant speed when the work to be done is less than the power which the residual magnetism will develop, I provide means to send an electric current around the magnet-cores in a reverse direction, the neutralizing effect of such current balancing the difference between the force required and that which the residual magnetism can develop. The line-wire is not, therefore, connected with the first turn of the coil c', but to a point, *c*, several turns distant from its beginning. Such turns are therefore wholly outside of the circuit on its passage through the coils c' c^2 c^3, and so on, but afford a means of throwing a reverse current directly around the magnet-cores by connecting the first of such turns through the sections *e* with the shunt-box, where they may be connected by the block *d* when it is desired to thus reverse the current.

In Fig. 24 the normal movement of the current is shown by the arrows K, while the movement of the reverse current is clearly indicated by the arrows K′, applied to that portion of the coil c' which is connected with the springs *e*. The connection of such springs by the block *d* furnishes a short circuit for the current by cutting out the remainder of the coil c' and the coils c^2 c^3, &c, and the magnetic field is thus not only deprived of its normal magnetism, but its residual polarity is reduced or reversed in the degree required to maintain a constant armature velocity. The number of turns required upon a given magnet to produce this effect is readily determined in practice, and the practical construction for making the connections *e* e', &c., is shown in Figs. 2 and 3 applied to the magnet-cores, and in Figs. 7, 8, and 9 connected with the shunt-box.

The primary connection G is shown in Fig. 3 applied to the eighth turn *c* of the coil c', while the flat connection *c* is shown applied to the first turn, and carried along the magnet-core beneath the whole of the first layer, from which it is extended through a notch, s^3, in the flange B′ of the pole-piece to an elbow-piece, *s*, connected with the shunt-box.

The connections *e* are shown in the drawings formed of flat copper strips, which are readily arranged and insulated between the several coils, and are extended along the heads B^4 of the pole-pieces nearly to the shunt-box L, which is secured between the ends of the pole-pieces over the top of the armature.

The shunt-box is shown formed with a series of flexible springs connected in pairs with the opposed ends of the strips e' e^2, &c., and sustained adjacent to one another in a spring guide or holder, *g*, over which a shunt-block, *h*, is moved by the governor, as required.

The spring guide or holder is shown in Fig. 8, as also in the dotted view in Figs. 17 and 18, as a block of wood or analogous material, with notches g' in its opposite edges to receive elbow-connections from the springs, and formed with vertical slits g^2 in its opposite edges, through which the springs project upward into the path of the shunt-block *h*. A cap, *i*, beveled at its forward end adjacent to the springs, is fitted over the guide or holder *g* to support the block *h* when retracted from the springs, and is formed with stops *j* to then arrest the block.

An abutment, *k*, is inserted in the shunt-box in front of the springs, and caps *l* (shown only in Figs. 15 and 16) would be placed at each side of the pieces *g* and *i*, at the points indicated at *l*′ in Fig. 8, to keep the springs in the slits g^2.

The parts *g*, *i*, *k*, and *l* would be formed of wood or other insulating material, and would be secured in the spring-box by suitable fastenings.

The block *h* is insulated and secured by nuts h' adjustably upon a rod, h^2, connected with the governor-lever j^4, and moved thereby with the varying velocity of the armature.

To press the rod toward the springs to make a positive electrical contact therewith, a roller, h^3, is mounted upon the shunt-box *l* over a part of the rod h^2, and is provided with a screw-shank, *m*, fitted to a standard, *n*, upon the shunt-box and adjustable by means of threaded nuts n'.

The top of the abutment *k* is inclined, like

the end of the cap *i*, and the springs are bent to a similar angle, so as to yield readily as the block moves over them, and the last spring, which is connected with the strip *e*, is made longer than the others and laid upon the inclined face of the abutment, so that the shunt-block may press it hard upon the same to form a more perfect connection therewith when the operation of the governor is intended to cut off all the direct field-coils from the electrical circuit and to react on the polarity of the magnet to reduce the residual magnetism.

The motion of the rod h^2 when transmitted from the governor lever is parallel with the armature-arbor, while the shunt connections from the magnet-coils are conducted at right angles to the armature to reach the shunt-box by the shortest course. To join the shunt-connections with the springs, I therefore provide the latter with elbow-pieces *s*. The elbow-piece is formed integral with the spring *s'*, and while the springs extend in the direction of the armature-arbor the elbow-pieces extend at right angles thereto, and thus project directly over the heads of the pole-pieces toward the flange s^2, which holds the field-connections upon the pole-pieces in place. A notch, s^3, is formed in the flange in line with the elbow-pieces, and all the strips, *e'*, e^2, &c., which extend from the different field-wire coils, are thus brought directly into line with the elbow-pieces to make the shortest possible connection therewith.

As shown in Figs. 2 and 3, the strips e' e^2, &c., are clamped upon the head B^4 alternately with the elbow-pieces *s*, each strip making an electrical connection with one of the springs, with paper or equivalent insulation inserted between each pair of connections, as is shown in the edge view of a part of such connections in Fig. 4 and the section in Fig. 6.

The clamp s^4 is merely a plate pressed upon the group of connections by screws s^5, and the entire bundle or bunch of connections would be preferably enveloped with a non-conducting and waterproof coating, s^6, as shown in Fig. 6.

Heretofore it has been common in dividing the field-coils into different sections to form shunt-circuits, to extend the electrical connections from the different coils outward between the wires at different points upon the surface of the field-coils; but it will be noticed that my arrangement differs from such construction in the use of the flat strips e' e^2, &c., which enable me to extend all my shunt-connections from different points within the coils under or between the same to a single point, as the notch s^3 in the flange, which holds the coils in place, and to form the several shunt-connections into a compact bundle which may be thoroughly protected from accident or derangement, while its several conductors may be readily connected with a suitable shunt-box. I thus avoid the liability to damage and derangement which occurs when the various shunt-connections are extended separately from the coils at different points and require to be separately led to binding-posts or to a switch-board to form the desired shunt-connections.

I hereby disclaim the division of the field-coils into sections to form shunt-circuits and the regulation of the magnetic field by directing the current into more or less of such circuits, as I am aware that such a construction is old, and that the regulation has also been effected by shunting the current as required through reversing-coils, through which the current passes in a direction opposite to that in the field-coils.

My present invention, so far as it relates to the connection of the shunt-coils with the shunt-box, consists in the mechanical arrangements adopted for protecting the shunt-connections where they are extended from the coil to the shunt-box, and for uniting such shunt-connections with the contact-pieces in the shunt-box.

I am not aware that any one has heretofore connected a single auxiliary coil with the circuit-wires and wound it upon the cores in the opposite direction from the main coils and operated it when the connection was first shunted from the main coils to react upon the residual mechanism of the field in the manner described herein.

I am aware that it is common to use a spiral spring upon a governor-lever to oppose the centrifugal force of the governor, and my claim herein is therefore limited to the attachment of the spring to a governor-arm at an acute angle, so as to operate with a diminishing leverage upon the governor-arm as the speed of the motor increases.

Having thus set forth my invention, what I claim is—

1. In an electric motor having the pole-pieces united by a bridge, the combination, with a series of coils wound upon the field-magnet cores, of the shunt-connections *e* *e'* e^2, &c., united with the several coils at intervals and extended from the surface of the magnet-coils (at the same point) to the bridge from opposite sides thereof, a shunt-box upon the bridge between the pole-pieces, with contacts united to the said shunt-connections, a shunt-block or connector, and a centrifugal governor actuated by the motor for successively closing the circuit through the shunt-connections, as and for the purpose set forth.

2. In an electric motor, the combination, with the series of coils wound upon the magnet-cores, of a series of shunt-connections connected with the several coils at intervals, means, as a shifting block or piece, for closing successively the electrical circuit through the several shunt-connections, a centrifugal governor mounted upon the armature arbor or shaft, a lever actuated by such governor to operate the shunt-connector, an arm attached to such lever, and a tension-spring resisting the centrifugal force of the governor and arranged at an acute angle with the said arm to

operate with a diminishing leverage upon the arm as the speed of the motor increases, as and for the purpose set forth.

3. In an electric motor, the combination, with the main coils upon the magnet-cores, of an auxiliary coil connected with the line or circuit wires and wound upon the cores in the opposite direction from the main coils, a shunt-connection from the ends of such auxiliary coils, shunt-connections attached at intervals to the main coils, contact-pieces attached to such shunt-connections, and a moving contact operating in connection with the same to first close the circuit through the shunt-connections of the main coils, and to subsequently close the shunt-connections from the auxiliary coil to cause a reaction upon the residual magnetism of the field when the motor is very lightly loaded, substantially as herein set forth.

4. In an electric motor, the combination, with the first coil of wire wound upon the magnet-cores, of the line or circuit connection attached to the coil between its ends, an electrical connection from one end of the coil to the other coils, and a shunt-connection from the opposite end of such coil, and means for closing the circuit through such shunt-connection to react on the residual magnetism of the field, as and for the purpose set forth.

5. In an electric motor, the combination, with magnet-cores having poles at opposite sides of the armature, of the magnet-coils wound upon such cores, a shunt-box mounted upon a bridge between the ends of the poles, shunt-connections attached at intervals to the main coils and terminated in electrical connections adjacent to one another in the shunt-box, a governor mounted upon the armature-shaft, and a connector moved thereby to successively close the several shunt-circuits and thus cut out the successive sections of the main coils from the circuit, as and for the purpose set forth.

6. In an electric motor, the combination, with magnet-cores having poles at opposite sides of the armature, of the main coils wound upon such poles, a shunt-box mounted upon a bridge between the ends of the poles, shunt-connections formed of metallic strips attached at intervals to the main coils, with the latter wrapped over the same, and the said strips terminated in electrical connections adjacent to one another in the shunt-box, a governor actuated by the motor, and a connector moved thereby to successively close the several shunt-circuits and thus cut out the successive sections of the main coils from the circuit, as and for the purpose set forth.

7. In an electric motor provided with a bridge between the pole-pieces and a shunt-box mounted upon said bridge, the combination, with the cores, of flanges upon the same, field-coils wound between said flanges, shunt-connections attached at intervals to the field-coils, with the latter wrapped over the same, a notch, s^3, in one of the flanges, and the shunt-connections brought together and extended through such notch in a single band to the shunt-box, as and for the purpose set forth.

8. In an electric motor, the combination, with a bridge between the pole-pieces and a shunt-box mounted upon said bridge, of the magnet-cores, field-coils wound upon said cores, shunt-connections attached at intervals to the field-coils (with the latter wrapped over the same) and extended from the coils toward the shunt-box upon the bridge, elbow-pieces *s s'*, having each one arm fitted in the shunt-box to form a contact-surface and the other arms extended upon the pole-pieces between the several shunt-connections, insulating material between the several shunt-connections, and a clamp pressing such connections and elbow-pieces together, as and for the purpose set forth.

9. In an electric motor, the combination, with a bridge between the pole-pieces and a shunt-box mounted upon said bridge, of the magnet-cores, field coils wound upon said cores, and shunt-connections formed of flat strips of thin sheet metal attached at intervals to the field-coils and extended beneath the several layers of the field-coils to the same point upon the exterior of the latter and to the shunt-box upon the bridge and connected with contacts therein, as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WM. BAXTER, JR.

Witnesses:
C. R. GALLAGHER,
HENRY S. THOMPSON.