(No Model.)

C. F. BRUSH.

Current Governor for Dynamo Electric Machines.

No. 239,313. **Patented March 29, 1881.**

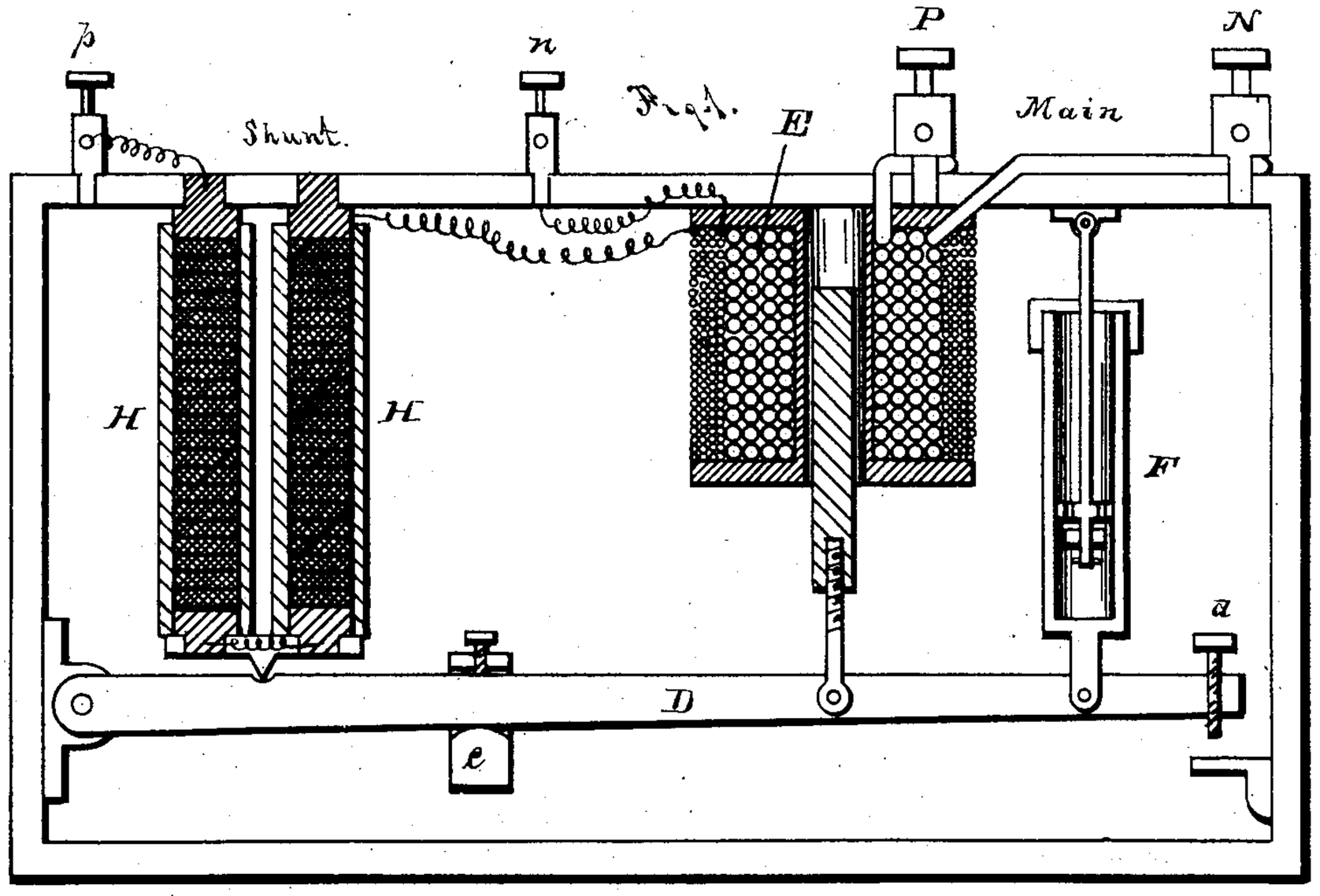
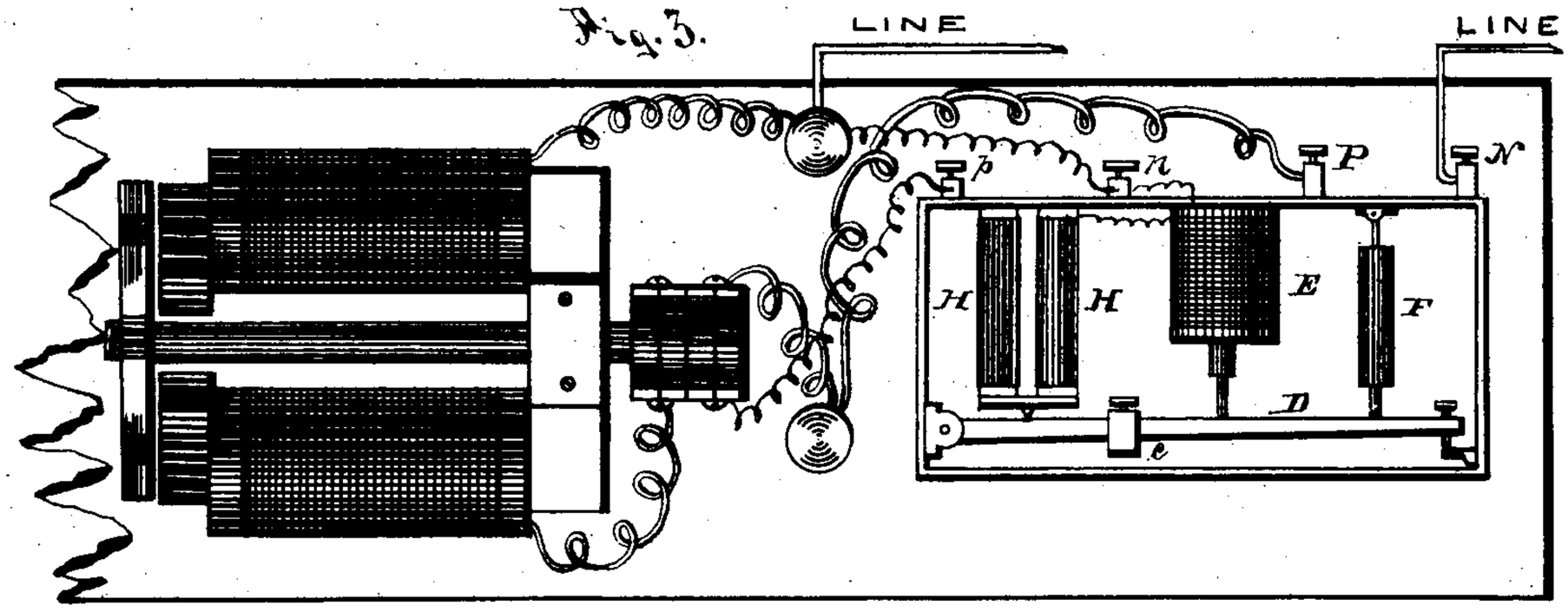


Fig. 3.



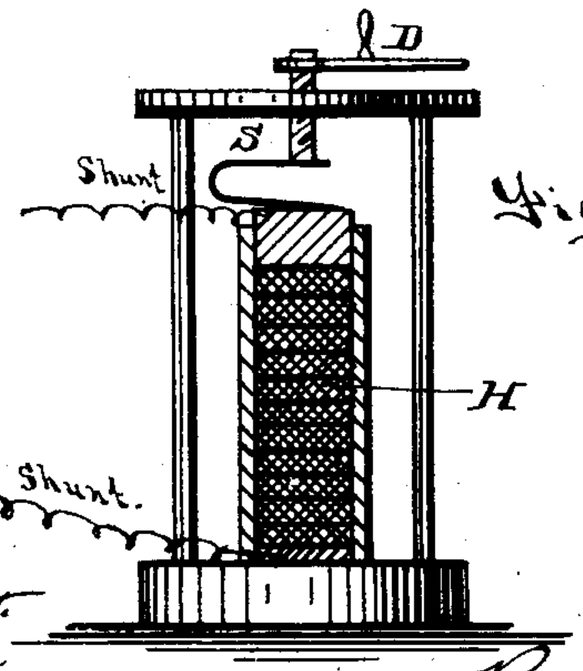
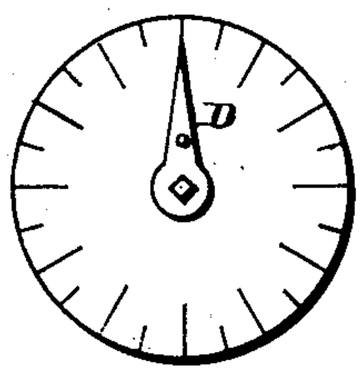


Fig. 2



WITNESSES

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CURRENT-GOVERNOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 239,313, dated March 29, 1881.

Application filed May 26, 1880. (No model.)

To all whom it may concern:

Be it known that I, CHARLES F. BRUSH, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Current-Governors for Dynamo-Electric Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to dynamo-electric machines, and has for its object the adaptation of such machines to variable external conditions without variation of the speed at which their armatures are rotated, but by variation of the intensity of the magnetic field, and this by means not directly depending on the volume of current circulating in the external circuit. In Letters Patent No. 224,511, granted to me February 17, 1880, I have shown and described several methods for effecting this object, and it is the improvement or further development of some of these methods which forms the subject of this my present invention.

I shall assume that the broad principle of shunting away a portion of the current employed to excite the field-magnets of a dynamo-electric machine for the purpose of weakening the magnetic field has been sufficiently well enunciated in the Letters Patent above referred to to require no further explanation; also, that the function of the main or external current in operating the automatic forms of the apparatus has been clearly shown.

In the improvement of the apparatus shown in Fig. 3 of the drawings forming part of the Letters Patent No. 224,511, I use two or more piles of carbon plates, H, connected in series, so that the shunt-circuit includes them successively. This is to render the apparatus more compact by obviating the necessity of an inconveniently long pile of carbon. I further employ the shunt-current itself to assist the main current in operating the magnet E, and thus render the apparatus more sensitive in its operation. I also employ a dash-pot to prevent sudden movements of the magnet-armature, and thus avoid abrupt variations of resistance in the carbon pile.

Figure 1 of the present drawings shows these modifications of and additions to my former device. Fig. 2 shows a form of apparatus wherein a pile of carbon plates, H, or similar resistance, is employed in a manual apparatus. Fig. 3 represents my present device as connected and applied to a dynamo-electric machine.

In Fig. 1 of the drawings, H H are piles of carbon or other suitable plates, inclosed loosely within glass, porcelain, or other suitable insulating tubes or supports. The piles rest upon blocks of carbon or metal electrically connected, carried by a bar of wood or metal, which is pivoted to and supported by the lever D. The upper ends of the insulating-tubes are loosely closed by plugs of carbon or metal supported by the frame of the apparatus and insulated from each other. Obviously three or more piles, H, may be employed, all connected in series, as are the two shown, and this is advisable when a compact apparatus of high resistance is required. The tubes or supports inclosing the piles H may be of metal (to absorb and radiate the heat generated) lined with mica or other insulator.

The magnet-helix E consists of two separate coils of wire—one located in the shunt-circuit, the other in the main circuit, both as shown. These two coils or helices may be arranged in various manners in relation to each other. Either may occupy the outer position, or may cover exclusively one end of the spool. Two compound helices, E, with corresponding cores of iron, may be employed to increase the effect.

Within the helix E is a movable iron core pivoted to the lever D. This lever, pivoted at one end, as shown, also carries a movable, and therefore adjustable, weight, *c*. (An adjustable spring may be substituted.) The free end of the lever D also carries the body of a dash-pot, F, and a thumb-screw, *d*, by which the downward movement of the lever is adjusted. The piston of the dash-pot F is attached to the frame-work of the apparatus by means of its rod, as shown, and is provided with a valve opening downward. When the dash-pot is filled with glycerine or other suitable liquid, its piston and valve allow the lever D to move downward freely, but retard its upward movement. The valve in the pis-

ton is not essential, but is desirable, as will be shown later.

The operation of the whole device is as follows: The binding-posts *p n*, forming the terminals of the shunt-circuit, are connected with the field-magnets of a dynamo-electric machine in the manner explained in the previous Letters Patent referred to. The course of the shunt-current is then from the post *p*, through the piles H H, outer portion of helix E, to post *n*. The binding-posts P N are put in the main or working circuit of the machine, as was also explained in my said prior patent, but in such a manner that the main current shall pass through the helix E in the same direction as the shunt-current. The weight *c* is so adjusted that when the machine is working to its full capacity, and the normal working-current is passing through its portion of the helix E, the inclosed iron core, lifted by the axial magnetism developed in the helix, shall just sustain the lever D, and parts connected therewith, while subjecting the piles H to little or no pressure. Since in this condition of affairs the piles H H perform no function, the circuit through them may be entirely broken by dropping the lever D sufficiently. This, however, is not essential. The office of the thumb-screw *d* is now apparent. If, now, the resistance of the working-circuit of the dynamo-machine be lessened from any cause, the current will be correspondingly increased in the helix E, and the inclosed core will be drawn upward, raising the lever D and subjecting the resistance-piles H to a pressure corresponding to the increase of current in the main circuit. Current will then be shunted from the field-magnets of the dynamo-machine until the main current is reduced to nearly its original strength. Some increase of current strength is, however, required, in order to maintain a suitable pressure in the piles H H. It is in order to render this necessary excess of main current as small as possible that the shunted current is made to pass through a portion of the helix E. The shunted current thus assists in maintaining a suitable pressure on the resistance-piles H H, and the apparatus is thereby enabled to respond to very much smaller variations in the strength of the main current than it otherwise could do. When the carbon piles H H are subjected to pressure their conducting power increases less rapidly than the pressure applied. Hence the apparatus is not liable to get into the condition of "unstable equilibrium."

The office of the dash-pot F has already been described; but the function of the valve in its piston has not been indicated. Suppose a number of voltaic-arc lamps are operated in the main circuit, and the latter, as often occurs in practice, becomes for an instant broken, then, owing to the valve in the piston-rod of the dash-pot, the lever D drops at once, and the shunt resistance increases, so that when the carbons in the lamps have come together and completed the main circuit again the full power of the dynamo-machine will be available to separate the carbons in the lamps, and, owing to the slow upward motion of the lever D allowed by the dash-pot, sufficient time is given for the carbons in the lamps to become fully separated before the shunt can act; but if the lever D had not been allowed to fall materially during the instant the main circuit was broken, the abnormally-great current developed when the circuit was closed, and before the carbons in the lamps had time to separate, would further raise the lever D and unfit the dynamo-machine for developing its normal current. An appreciable length of time would then be required for the resistance apparatus and the lamps to again adjust themselves. Again, if the resistance of the main circuit is suddenly increased, the valve in the dash-pot allows the lever D to fall at once, and thus the dynamo-machine is quickly adapted to the new condition of circuit.

Instead of the piles of carbon plates H H, other forms of resistance capable of being varied by the movement of the lever D may be employed; also, in place of the helix E and movable core, an ordinary electro-magnet, with fixed core and movable armature, may be used, with or without the compound helix or helices.

Fig. 2 shows a method whereby a pile of carbon plates, H, or similar resistance, may be employed in a manual apparatus. Pressure is applied to the pile by means of a screw actuated by the lever D, as shown. This lever moves over a graduated circle, and acts as an index of the pressure applied to the carbon pile H, so that a pressure suitable for a given condition of external resistance having been once determined, it may be found again without experiment.

A spring, S, may be interposed between the screw and the pile, as shown, to allow greater movement of the screw than might otherwise be admissible.

Obviously more than one pile H may be employed in this apparatus, as is done in Fig. 1.

From its function in determining and governing the current evolved by a dynamo-electric machine, I will call the device herein referred to a "current-governor."

What I claim is—

1. In a current-governor constructed to operate in connection with a dynamo-electric machine, an electro-magnet excited by two helices, one helix included within the main circuit and the other within a shunt-circuit, within which said shunt-circuit is placed an adjustable resistance, substantially as shown.

2. The combination, in an electric-current governor, of an adjustable or variable resistance, mechanism to vary said resistance, substantially as specified, and a dash-pot, or equivalent, for modifying the motion of said resistance-varying mechanism, substantially as shown.

3. In a current-governor constructed to operate in connection with a dynamo-electric

machine, as shown, a dash-pot or any equivalent device or mechanism that shall interpose a retarding influence or action in one direction only, substantially as shown.

4. In a current-governor constructed to operate in connection with a dynamo-electric machine, an arm or lever, D, in combination, first, with an adjustable resistance constructed to be varied through the movement of said lever; second, with an electro-magnet, through the influence of which motion is imparted to said arm or lever; and, third, with any suitable mechanism (such as the dash-pot or its equivalent) for governing or modifying the movements of said arm or lever, substantially as shown.

5. In a current-governor constructed to operate in connection with a dynamo-electric machine, two or more resistance-piles, H, or their equivalents, electrically connected in series, and a device associated with each pile for varying its electrical resistance, substantially as shown.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES F. BRUSH.

Witnesses:
LEVERETT L. LEGGETT,
JNO. CROWELL, Jr.