No. 653,725. Patented July 17, 1900.

D. C. WOODWARD.

ELECTRIC MOTOR.

(Application filed Sept. 6, 1898.)

(No Model.)

Fig: 1.

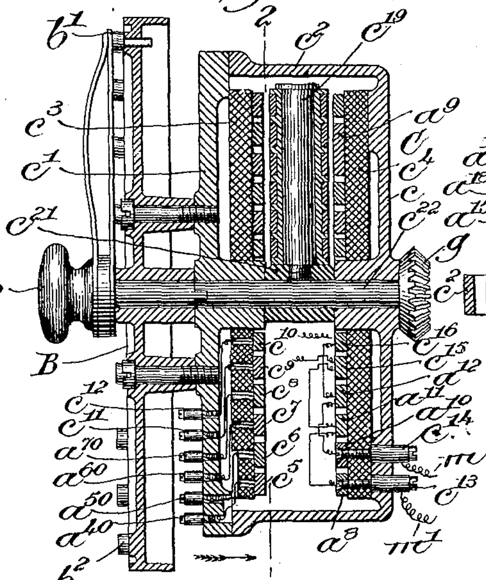


Fig: 2.

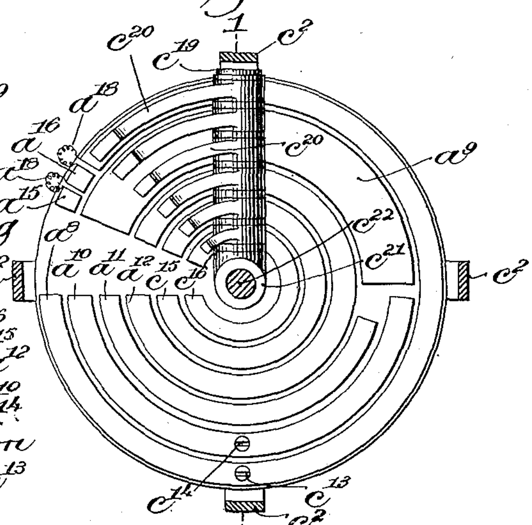


Fig: 3.

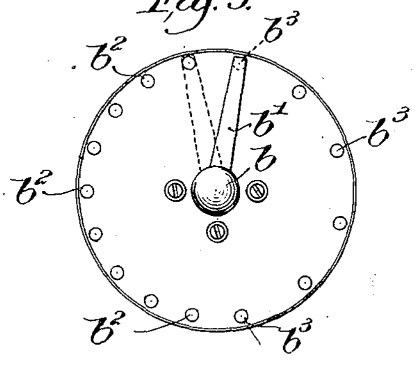


Fig: 4.

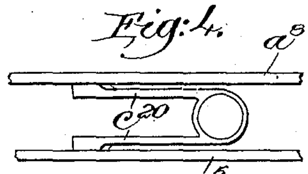
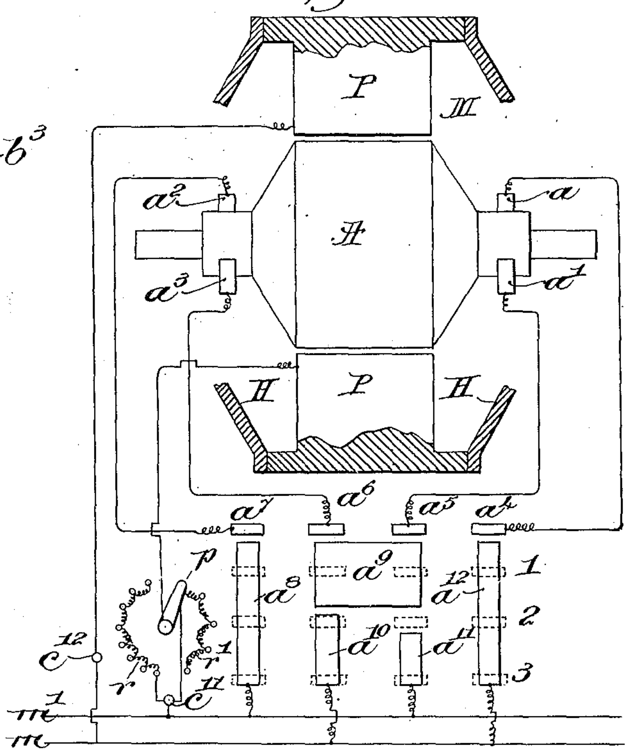


Fig: 5.



Witnesses.
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UNITED STATES PATENT OFFICE.

DANIEL C. WOODWARD, OF HARTFORD, CONNECTICUT.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 653,725, dated July 17, 1900.

Application filed September 6, 1898. Serial No. 690,253. (No model.)

To all whom it may concern:

Be it known that I, DANIEL C. WOODWARD, of Hartford, county of Hartford, State of Connecticut, have invented an Improvement in Electric Motors, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The progress of modern machine-shop practice has been so rapid and the special machines so numerous that in large shops it is no longer practicable to use the ordinary line-shafting and counter-shafting, and it has become desirable to provide an independent motor for each machine, or at least for the larger special machines, and the universal use of electricity has now made this entirely feasible, making it possible to do away almost entirely with the usual expensive and power-consuming shafting and belt or rope transmission of power. Such motors have, however, been already provided; but, so far as I am aware, these have not been capable of the range of speed and adjustment which is desirable, and accordingly I have produced the herein-described invention, whereby an electric motor may be given such variable speed as the operator may require for his work, any speed thereof being maintained constant for all loads so long as necessary.

The details of construction of my invention will appear more fully in the course of the following description, reference being had to the accompanying drawings, in which I have shown a preferred embodiment of my invention, and the latter will be more particularly defined in the appended claims.

In the drawings, Figure 1 is a central transverse sectional view taken on the line 1 1, Fig. 2. Fig. 2 is a horizontal section taken on the line 2 2, Fig. 1. Fig. 3 is a front elevation looking at Fig. 1 toward the right. Fig. 4 is an enlarged end view of the spring switch-contact employed. Fig. 5 is a view, largely diagrammatic, illustrating the motor and its connections, which together constitute my invention, showing a preferred arrangement thereof.

The purpose of my invention will perhaps be more readily understood by taking as an example the requirements in turning down a piece of material in a lathe, where it is of course desirable that the same peripheral speed should be maintained from the start to the finish; but inasmuch as the size of the work is constantly decreasing, thereby bringing the cutting-tool to a shorter and shorter distance from the center, it follows that in order to maintain constant peripheral speed at the cutting-point the speed of the motor must be gradually increased.

It is the object of my invention to provide an electric motor to accomplish the above results.

Referring to Fig. 5, M designates a shunt-wound motor, herein shown in fragmentary and partly-diagrammatic form for convenience of illustration, it being understood that any suitable motor may be employed, inasmuch as the particular motor itself does not constitute my invention. The motor M has an armature A arranged to revolve within pole-pieces P, supported by usual heads H. The armature must be wound to present a plurality of distinct circuits capable of running either in series or in parallel, as required, and I have herein indicated the armature A as wound with two distinct circuits, the respective pairs of commutator-brushes thereof being located at the opposite ends of the armature at a a' and a^2 a^3.

The feed-wires for the conveyance of power to the motor are indicated for convenience at m m', and the contact-springs of the switch-circuits from the commutator-brushes are indicated at a^4 a^5 a^6 a^7.

a^8 designates a relatively-long contact-plate connecting with the wire m'. a^9 designates a short and relatively-wide contact-plate separate from shorter contact-plates a^{10}, a^{11} connecting, respectively, with the wires m m', and a^{12} designates a long contact-plate similar to a^8, but connecting with the wire m.

The field-windings of the motor have two resistances r r', arranged to be introduced into the circuit by means of a contact p.

My invention proceeds upon the well-known principle that cutting down the strength of the field increases the speed of the motor and that increasing or decreasing the turns of the armature-winding correspondingly decreases or increases its speed, and accordingly, viewing the diagrammatic view, Fig. 5, it will be seen that when the contacts a^4 to a^7

are moved into the position 1 that thereby the two windings of the armature are placed in series, inasmuch as the contacts a^5 a^6 both rest on the plate a^9, whereas when the contacts are placed in the position 2 the left-hand circuit only is active, the right-hand circuit being then cut out, and when the contacts are in the position 3 the two circuits of the armature are in parallel. The field is varied by introducing the resistances r r', the former being greater than the latter, as is indicated in Fig. 5. My reason for this feature of the invention will be obvious by considering the requirements—for example, in a boring-mill, where as the center is being approached the speed must be increased at a geometrical ratio to keep the cutting speed constant, and therefore I likewise increase the successive resistances of the two series r' r. As, however, the controller-lever brings the contact into the position 2, (referring to Fig. 5 for convenience,) as will presently be explained, both series of resistances are cut out, inasmuch as at that time only one of the armature-circuits is being used; but the moment that position 3 is occupied the series r is then introduced into the field-circuit, it being understood that this occurs as the supposed cutting-tool of the boring-machine approaches the center of the work.

I have shown in Figs. 1 to 4 the details of my switch or regulator, having shown the same embodied in connection with an ordinary circular rheostat, such as is manufactured by the American Heating Company. B indicates the rheostat, whose operating knob or handle b carries a contact-arm b', arranged to be brought successively into contact with the resistance plugs or buttons b^2 b^3, the former being shown in Fig. 3 as on the left-hand side of the rheostat and the latter on the right-hand side thereof, it being understood that these two sets of resistances correspond to those indicated, diagrammatically, at r r'. I have not deemed it necessary to show herein the details of construction of this rheostat, inasmuch as my invention does not require any special rheostat, but is intended to be used in connection with any rheostat. In a frame C of any suitable construction and herein shown as comprising opposite disks or supports c c', joined by peripheral struts c^2, are mounted opposite backings c^3 c^4, of stone or other insulating substance, and on the former of these is secured a plurality of contact-rings c^5 c^6 c^7 c^8 c^9 c^{10}, which are severally connected to binding-posts, as shown, and which I have lettered a^{40} a^{50} a^{60} a^{70}, as they receive the wires indicated in Fig. 5 at the contacts a^4 to a^7, the rings c^9 c^{10} connecting to the binding-posts c^{11} c^{12} in the field-circuit, as indicated in Fig. 5. The slab c^4 carries a plurality of segmental contact-rings, (shown in detail in Fig. 2,) said rings being connected, as shown, to the binding-posts c^{13} c^{14} for the mains m m' and which I have marked for convenience of understanding with the same reference-letters as in the diagrammatic illustration thereof in Fig. 5, the two inner rings c^{15} c^{16} serving merely to connect the opposite rings c^9 c^{10} to the mains. The ring a^8 is preferably provided at one end with two insulated portions a^{15} a^{16}, between which are interposed resistances a^{17} a^{18} for preventing injury to the armature upon starting the motor, as will presently be described. Between the opposite sets of contact-rings described I mount an arm c^{19}, which carries the necessary complement of contact-springs c^{20}, one of which is shown in elevation in Fig. 4, said arm and springs being shown in section in Fig. 1 and in plan in Fig. 2. The arm c^{19} is secured in a hub c^{21}, carried by a shaft c^{22}, connected to be rotated by the handle b of the rheostat or by a gear g on the end of the shaft.

I have preferred above to describe my invention in connection with the particular arrangement shown in diagram in Fig. 5 in order that my invention might be more clearly understood without the possibility of confusing it with other embodiments; but I wish it understood that my invention is not limited to the arrangement shown.

As the work being done by the motor progresses and it is desired to gradually increase the speed of the motor, this is accomplished by cutting down the field by throwing into its circuit successively one resistance after another of the rheostat, thereby cutting down the strength of the field of the motor and correspondingly increasing the speed of the armature. This movement brings the contact-springs c^{20} around to the right, Fig. 2, in line with the end of the plate a^9, in which position the arm b' is in contact with the end of the series of resistances b^3, we will suppose. A slightly-farther movement thereof cuts out one of the armature-windings by reason of the gap between the plate a^9 and the plate a^{11}, and at the same time the field is restored to its original strength, so that notwithstanding the fact that the armature is cut down this effect is counterbalanced by the increase in the strength of the field, leaving the speed of the motor the same as immediately before. The continued forward movement of the arm b' puts successive resistances b^2 into the field-circuit, thereby gradually increasing the speed of the motor, and although the two circuits of the armature are again brought into action, as will be evident viewing Fig. 2, yet it will be observed, Fig. 5, that the windings are no longer in series, but are now in parallel, and therefore the speed of the armature remains the same as if only one of its circuits were in action. When the arm b' has been moved around the circle to the position shown by dotted lines in Fig. 3, the motor is then at its highest speed, for the reason that the armature-windings are running as one, being then in parallel, and the greatest amount of resistance is introduced into the field-circuit.

While I have herein shown my invention in its preferred embodiment, I wish it understood that I am not restricted thereto, but that many changes may be resorted to without departing from the spirit and scope of my invention.

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

1. An electric shunt-wound motor having a plurality of series of resistances interposed in the field-circuit, and means for placing said resistances successively in said circuit, substantially as described.

2. An electric motor, having its armature-windings and its field-windings independently connected to the source of current-supply, the armature being wound with a plurality of circuits, means for placing said circuits in series upon starting the motor, a resistance device, said resistance device being automatically placed in said series circuit upon starting the motor, means for thereafter cutting out said resistance device, and means for putting said armature-windings in parallel, substantially as described.

3. In a shunt-wound motor, an armature having a plurality of circuit-windings, field-windings, means to place said armature-windings at times in series and at other times in parallel, and a plurality of series of resistances interposed in the field-circuit, one of said series being greater than the other, the latter being introduced into the field-circuit when the said armature-windings are in series, and the former of said series being placed in the field-circuit when the said armature-windings are in parallel, substantially as described.

4. In a shunt-wound motor, an armature having a plurality of circuit-windings, field-windings, means to place said armature-windings at times in series and at other times in parallel, and at other times cutting out one of them, and a plurality of series of resistances interposed in the field-circuit, one of said series being introduced into the field-circuit when the said armature-windings are in series, and the other of said series of resistances being introduced into the field-circuit when the armature-windings are in parallel, and said resistances being cut out from the field-windings when one of said armature-windings is cut out, substantially as described.

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

DANIEL C. WOODWARD.

Witnesses:
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FREDERICK L. EMERY.