(No Model.) 2 Sheets—Sheet 1.

C. H. BENTON.

DYNAMO ELECTRIC MACHINE.

No. 307,261. Patented Oct. 28, 1884.

Fig. 1.

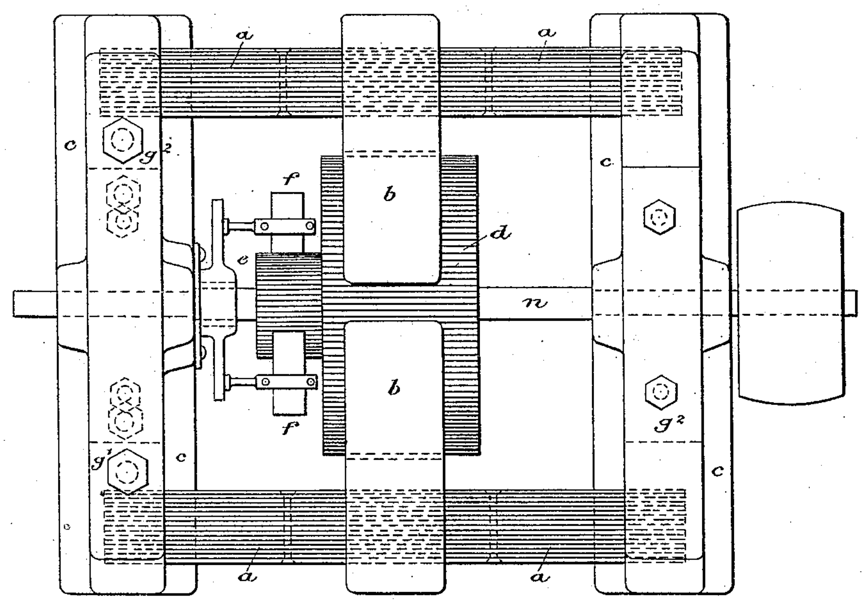


Fig. 2.

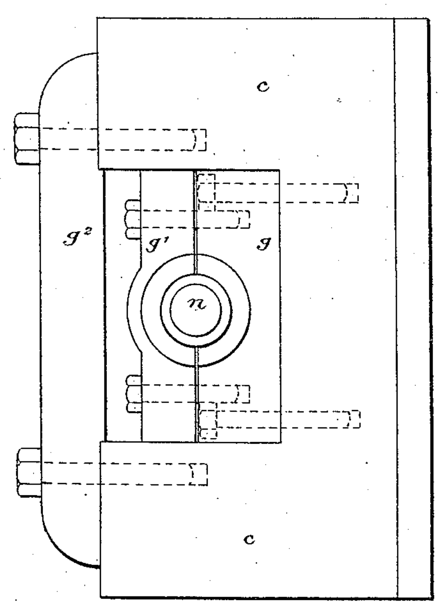


Fig. 5.

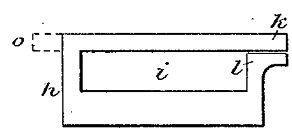


Fig. 6.

Fig. 7.

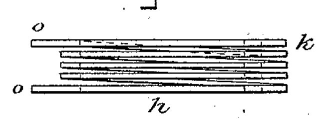
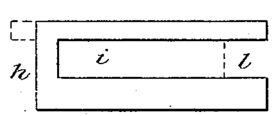


Fig. 10.



WITNESSES:

E.B. Bolton

Geo. Bainton

INVENTOR:

Chas. H. Benton.

By his Attorneys,

Burke, Fraser & Connett

(No Model.) 2 Sheets—Sheet 2.

C. H. BENTON.

DYNAMO ELECTRIC MACHINE.

No. 307,261. Patented Oct. 28, 1884.

Fig. 3.

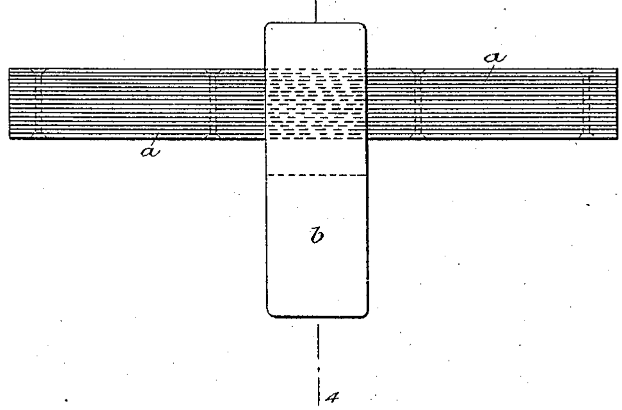


Fig. 4.

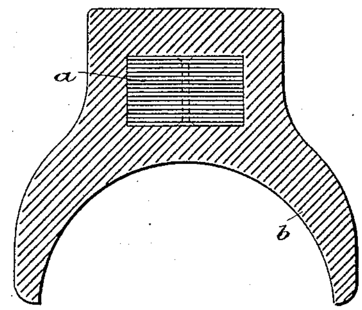


Fig. 8.

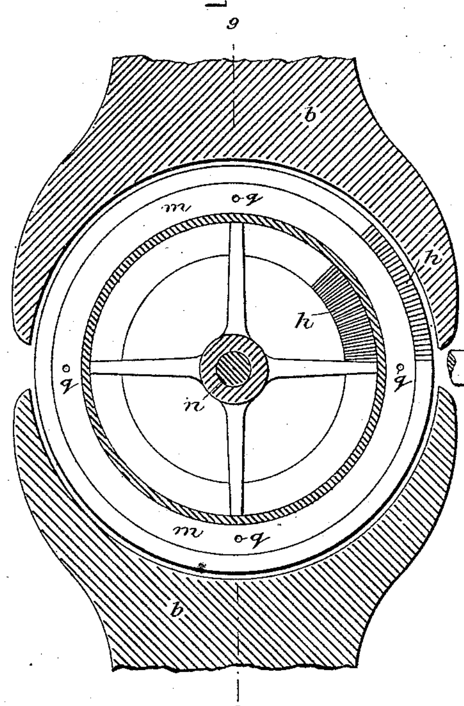


Fig. 9.

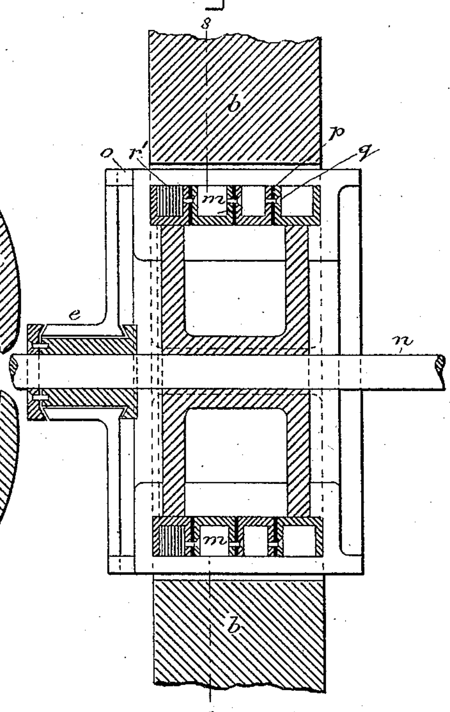


Fig. 12.

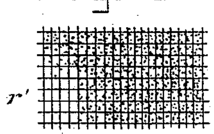
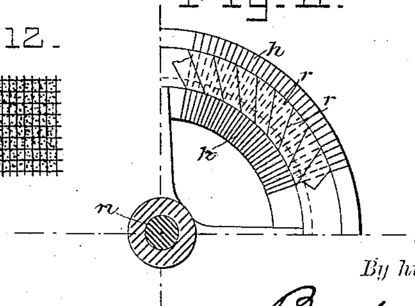


Fig. 11.



WITNESSES:

E. B. Bolton

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INVENTOR:

Chas. H. Benton.

By his Attorneys,

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UNITED STATES PATENT OFFICE.

CHARLES HORACE BENTON, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF TO HUBERT HENRY GRUBBE, OF SAME PLACE.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 307,261, dated October 28, 1884.

Application filed November 15, 1883. (No model.) Patented in England October 13, 1883, No. 4,885.

To all whom it may concern:

Be it known that I, CHARLES HORACE BENTON, of London, England, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a specification.

The objects of my invention are to economically increase the ratio of the actual magnetization of the exciting-magnets to the magnetic force of the magnetizing-helices in dynamo-electric machines, to more completely utilize the field of force thus economically obtained for the production of an electric-current, and generally to improve the construction of the the machine.

The invention consists in constructing dynamo-electric machines with the cores of the exciting-magnets composed of thin bars possessing good magnetic conductivity, secured together, forged, or otherwise fixed to pole-pieces, and having cast upon them end pieces which form the neutral parts of the magnetic system, and may also constitute the bearings for the armature-shaft, the whole forming a single piece.

The invention also consists in mounting one of the journals of the armature of dynamo-electric machines in a plumber-block which can be removed so as to allow the armature-shaft to be drawn out until the armature itself is clear of the pole-pieces, when it can be lifted perpendicularly from the machine.

The invention also consists in constructing the armature of dynamo-electric machines with its coil composed of plates of copper, the form of which in section is wedge-shaped or tapered, the said plates having a hole in the middle to fit over the soft-iron core of the armature, and having a division or opening extending from said hole to one end of the plate, and the said plates being coupled together by connecting the upper portion of every plate on one side to the lower portion of the adjacent plate, whereby a continuous helical-like circuit is produced.

The invention also consists in constructing the armature of dynamo-electric machines with its soft-iron core in the form of a drum made of rings of soft steel or other suitable magnetic material, of trough section, insulated from each other and fastened together, and with iron-wire-gauze ribbon having its meshes filled with iron filings wound edgewise in the troughs.

In the annexed drawings, Figure 1 is a plan, and Fig. 2 an end view, of a dynamo-electric machine embodying the improvements. Fig. 3 is a plan, and Fig. 4 a section on line 4 4 of Fig. 3, of one of the exciting-magnets with its pole-piece. Fig. 5 is a face view, and Fig. 6 an end view, of one of the plates of copper of which the armature-coil is composed. Fig. 7 is a plan view showing five of these plates connected together. Fig. 8 is a transverse section, and Fig. 9 a longitudinal section, of the armature, these two figures also showing a portion of the pole-pieces. Figs. 5 to 9 are drawn to a larger scale than Figs. 1 to 4. Fig. 10 represents the form of the copper plates used in machines for large currents, in which the plates are connected together in groups "in quantity," and Fig. 11 is a fractional end view of an armature, showing the method of coupling the adjacent groups together. Fig. 12 is a view designed to illustrate the ribbon of wire gauze with its meshes filled with iron filings. To better show the gauze only a portion of its meshes are shown as filled.

As the coefficient of induced magnetism is greatest in soft iron free from carbon and in soft steel, or in those qualities of iron in which the molecules are more easily turned on their axes into polar directions, and as this latter quality is better attained in thin strips of iron than in solid masses, I employ thin bars of iron of the nature above referred to, and bolt or otherwise secure them together so as to form a solid thick bar, as seen at *a a* in Figs. 1, 3, and 4. I then forge, shrink, or otherwise fix onto the middle of this set of bars a pole-piece, *b*, of similar iron hollowed out on one side to conform to the form of the armature.

The use of soft iron for magnet-cores and pole-pieces is not new; but as hitherto applied its use has been attended with great expense in making the connections and joints with the cast-iron frame or in making a wrought-iron frame; but the active parts which form the cores and pole-pieces are all that need be of iron of good magnetic conductivity. I therefore place two sets of bars, *a a*, heated at their ends when thought necessary, with their pole-pieces *b b* in a mold, and then cast upon them the neutral parts *c c*, Figs. 1 and 2, these parts also forming the armature-bearings, as seen in the figures.

d is the armature, *e* the collector, and *f f* the brushes. By building up the active parts of the magnets and casting the neutral parts upon them, as above described, a substantial base is secured for the machine, and a machine as a whole free from the expense of mechanically shaping and fitting joints and from the danger of poor magnetic connections between the parts.

In order that the armature may, when required, be taken out of the machine, the armature-journal at the collector end is mounted in a plumber-block, *g*, which can be removed by taking out its securing-bolts, first removing the cap *g'*. The armature-shaft can then be drawn out longitudinally until the armature itself is clear of the pole-pieces, when it can be lifted perpendicularly from the machine.

It will be observed by reference to Fig. 1 that the space between the opposite pole-pieces *b b* is wide enough to allow the shaft to pass when lifted, and that the space between the pole-pieces and the end frame is wide enough to allow the armature to be displaced laterally; but before this can be done the plumber-block must be removed to allow space for the lateral displacement of the commutator and brushes.

g^2 is a cast-iron piece to continue the magnetic connection from one core *a* to the other, this being rendered desirable, owing to the liability of a break of continuity by the plumber-block not being screwed down sufficiently tight. This piece g^2 must of course be first removed when it is wished to remove the plumber-block.

h h, Figs. 5 and 6, represent one of the copper plates of which the armature-coil is composed. The form of these plates in section is wedge-shaped or tapered. (See Fig. 6.) In the middle of each plate is formed a hole, *i*, and at one corner of the plate is a projection, *k*, which is slit or divided, as seen at *l*, from the hole *i* to the end. A number of these plates *h* are placed on the armature-core *m* (see Figs. 8 and 9) by bending aside that part of the plate which is above the slit *l* sufficiently to allow it to be slipped onto the core. I then connect the plates one to another by soldering the upper portion of the projection *k* of every plate on the one side to the lower portion of the projection of the adjacent plate, and in this manner a continuous helical-like circuit extending the whole circumference of the core *m* is produced. Fig. 7 shows five of these plates thus connected; but of course there will be a large number—say four hundred, for example—similarly connected to complete the circuit on the core *m*.

By constructing the armature as above described, the interior of the conductor is strongly induced by the polarity in the core, while the armature is not liable to have its magnetism decreased by the induction of its own coil, as is the case when the armature is at a greater distance from the pole-pieces and a strong current is flowing through the induced conductor, and as the space between the shaft *n* of the armature and the core is not of the same value as that between the core and the fixed magnet, the interior part of the plates *h h*—that is to say, the part of the plates inside the core *m*—can be as wide as the mechanical construction will allow, and it should be at least as large in section as the section of the exterior part which forms the conductor—that is to say, the part of the plates *h h* which is outside the core *m*. The plates should be insulated from each other by suitable material interposed between them. Some or all of the plates *h h*—say every fourth plate—are connected with the collectors, as will be well understood, for which purpose the plates to be so connected have projecting pieces *o*, as seen in Fig. 7 and in dotted lines in Fig. 5.

In dynamo-machines for large currents, where the section of the plates *h h* must be considerable, I connect several plates together in quantity, and I couple each group to the adjacent group by means of a copper piece, instead of by bending part of the plate, as before described.

The object of connecting several plates together in lieu of using a single bar or plate of the requisite thickness is to obviate the formation of local currents, which are set up when thick bars are used. The division or opening *l* at the end of the plates is in this case, as seen in Fig. 10, as wide as the hole *i*.

r r, Fig. 11, represent copper pieces which connect the plates together in quantity, in groups of three, for (example) these pieces *r r* likewise serving to connect the upper portion of each group—that is, the portion above the opening *l* to the lower portion of the adjacent group.

In order to prevent "Foucault" currents in the core *m*, I construct it of rings of soft steel or other suitable magnetic material of trough section, as clearly seen in Fig. 9, these rings being separated from each other by insulating material *p p*, and fastened together with screws *q q* passing through insulating-bushes. The troughs are filled with iron-wire-gauze ribbon *r'* wound edgewise, the meshes of the gauze being filled up with iron filings, and insulating material is applied between the successive turns of the ribbon. The core thus built up allows no currents in the core perpendicular to the direction of rotation, and the iron being finely subdivided gives great facility to the molecules to rotate quickly upon their axes so as to change the polar directions, which is necessary in each revolution of the armature. When insulated iron wire is used for this purpose, each separate layer produces a prejudicial magnetic induction upon the layer beneath. With wire-gauze, however, used as above described, the strands running from the periphery toward the axis prevent this and make the magnetic conduction continuous between the outer and inner edges of the core.

I am aware that it is not new, broadly, in dynamo-machines of a different construction from mine to make the armature-bearings separate and bolt them to the bed; but I do not know of any machine wherein the armature may be moved laterally to free it from the pole-pieces, and then lifted out by simply removing one plumber-block in order to make room for the commutator, as herein described.

I am also aware that it is not new, broadly, to construct the armature-coil of copper plates secured together so as to form a helical circuit; but, so far as I am aware, these have not been shaped as I have herein described and claimed them. By making them wedge-shaped or tapered they fit more snugly the periphery of the armature and pack more closely.

What I claim, and desire to secure by Letters Patent, is—

1. The combination, in a dynamo-electric machine, of the exciting-magnets formed of a number of bars secured together, and the cast-iron end pieces forming the neutral portion of the magnetic system, cast upon the ends of the said exciting-magnets, substantially as and for the purposes set forth.

2. The combination, in a dynamo-electric machine, of the exciting-magnets, constructed substantially as described, the pole-pieces fixed on the said magnets, and the cast-iron end pieces forming neutral parts of the magnetic system, cast upon the ends of the exciting-magnets, substantially as and for the purposes set forth.

3. The combination of the armature and its shaft and commutator, the pole-pieces *b*, set, as shown, to leave an opening for the passage of the armature-shaft between them, and the frame which supports the shaft, provided with a removable plumber-block at one end next the commutator, whereby space may be provided by the removal of said plumber-block for the lateral displacement of the armature, substantially as set forth.

4. An armature for dynamo-electric machines having its coil composed of copper plates the form of which in section is wedge-shaped or tapered, the said plates having a hole in the middle to fit over the soft-iron core, and having a division or opening extending from said hole to one end of the plate, and the said plates being connected together so as to form a continuous helical-like circuit on the circumference of the core, substantially as and for the purpose set forth.

5. An armature for dynamo-electric machines having its soft-iron core in the form of a drum made of rings of trough section insulated from each other and fastened together, and with iron-wire-gauze ribbon wound edgewise in the troughs, the meshes of the gauze being filled with iron filings, substantially as and for the purpose set forth.

6. The combination, in an armature for dynamo-electric machines, of a coil composed of copper plates having the form hereinbefore described, and fitted upon the core, and connected together as shown, and of a core in the form of a drum composed of rings of trough section insulated from each other and fastened together, and having iron-wire-gauze ribbon with its meshes filled up with iron filings wound edgewise in the troughs, substantially as set forth and shown.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CHARLES HORACE BENTON.

Witnesses:

JOHN C. MEWBURN,

GEORGE C. BACON.