No. 646,147. Patented Mar. 27, 1900.

H. F. JOEL.

ELECTRIC MOTOR.

(Application filed Feb. 4, 1899.)

(No Modal.) 2 Sheets—Sheet 1.

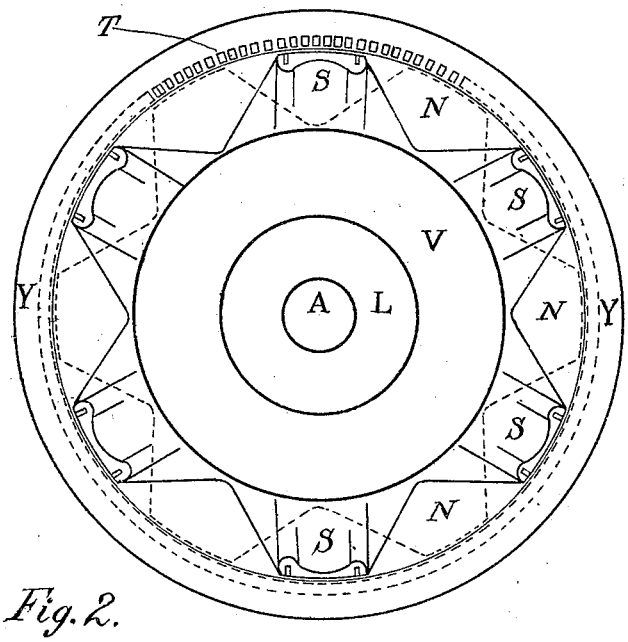
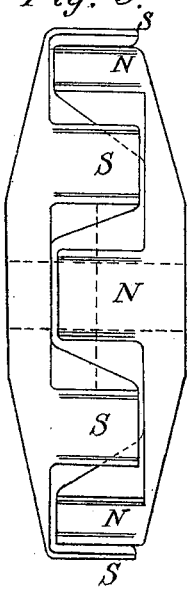


Fig. 2.

Fig. 3.



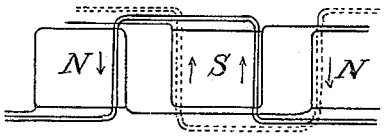


Fig. 5.

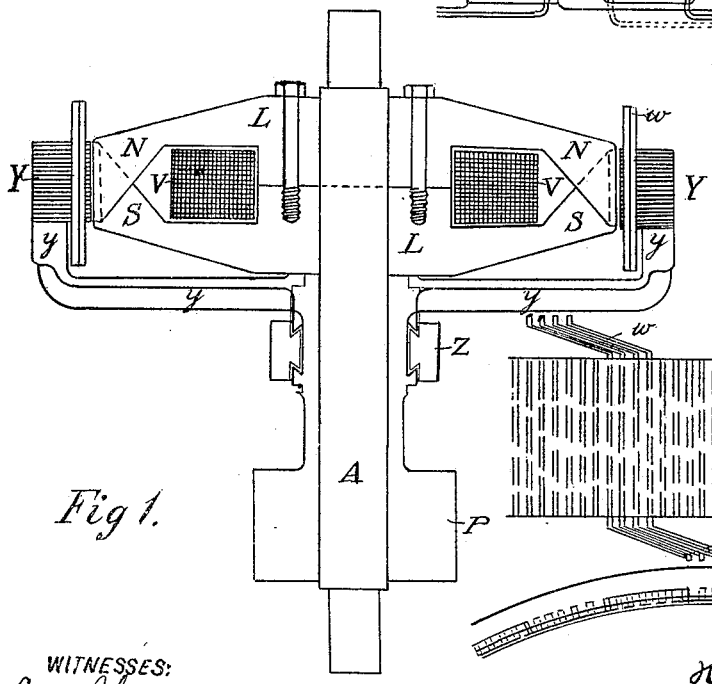
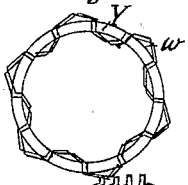


Fig 1.

Fig 6.



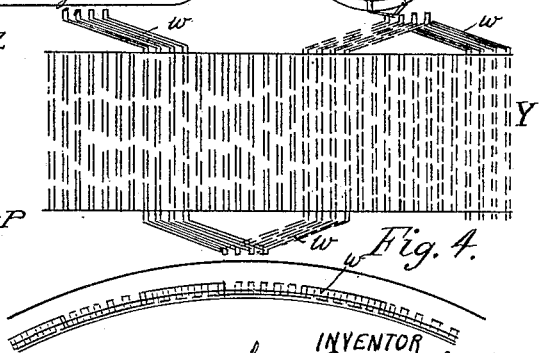


Fig. 4.

WITNESSES:

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No. 646,147. Patented Mar. 27, 1900.

H. F. JOEL.

ELECTRIC MOTOR.

(Application filed Feb. 4, 1899.)

(No Model.) 2 Sheets—Sheet 2.

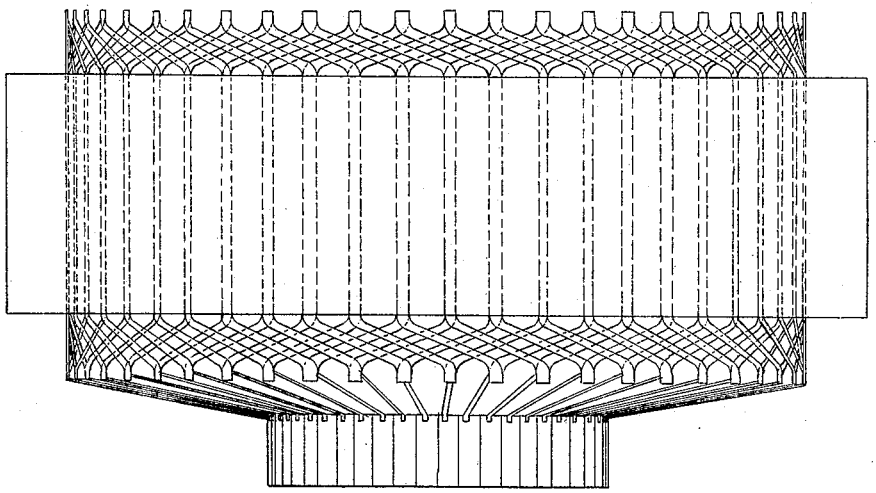

FIG. 8.

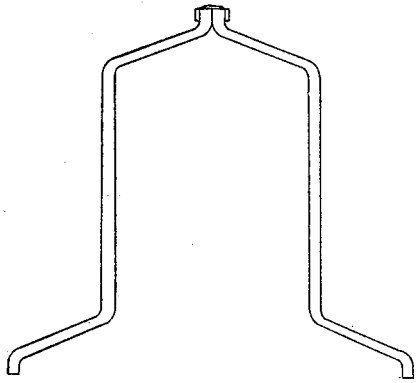

FIG. 9.

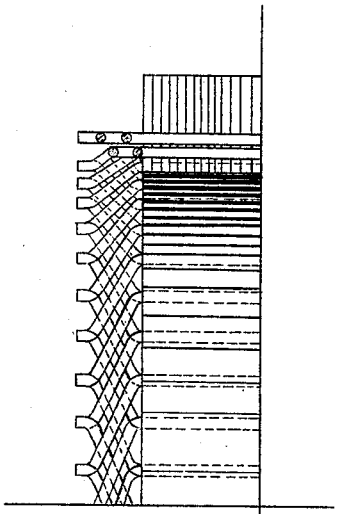

FIG. 7.

WITNESSES:
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UNITED STATES PATENT OFFICE.

HENRY FRANCIS JOEL, OF LONDON, ENGLAND.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 646,147, dated March 27, 1900.

Application filed February 4, 1899. Serial No. 704,560. (No model.)

To all whom it may concern:

Be it known that I, HENRY FRANCIS JOEL, a subject of the Queen of Great Britain and Ireland, residing at London, England, have invented a new and useful Improved Electric Motor, (for which I have made application for Letters Patent in Great Britain under No. 17,813, dated August 18, 1898; in France under No. 268,630, dated August 23, 1898; in Belgium under No. 107,665, dated August 29, 1898, and in Italy under No. 40/156, dated September 1, 1898,) of which the following is a specification.

This invention relates to electric motors; and it consists of an improved winding of the armature, by which a maximum proportion of the winding is effective in induction and a minimum absorbed in ineffective connections, in combination with a system of internal multiple and contiguous poles of the magnetic field.

Figure 1 is a longitudinal sectional elevation of my improved motor. Fig. 2 is a side elevation of the armature with winding removed and one set of field-poles. Fig. 3 is a plan of the duplicate field-poles in juxtaposition. Fig. 4 is an enlarged plan and elevation of a section of the armature, showing the winding; and Fig. 5 is a diagrammatic view of the winding, showing two rings of winding throughout the armature. Fig. 6 shows a supplementary field-magnet winding about the poles. Fig. 7 is a quarter-section of the completed armature connections. Fig. 8 is a plan of the same; and Fig. 9 is a detail of two of the wires detached, showing mode of bending and attachment at ends.

The advantages I claim for this motor are comparatively-light weight for the power given and high efficiency, owing to the small waste in connections between the operative parts of the winding of the armature, any increase in the width of the armature giving increased proportion of effective winding to that required for connections which remain constant.

The motor is made with internal electromagnetic fields L L, which are duplicate castings, and any number of poles N S are arranged to interspace one with another of the two castings, and thus to lie in the same plane of rotation, and are bolted to one another and conveniently to a fixed axle A. A central wire magnet-coil V is inclosed within the iron or steel arms of the field-magnets on three sides, and thus utilizes the utmost effect of the current in this coil. The pole-pieces N S from the frame on either end of the central coil V, having opposite polarity to one another, interspace and are turned true outside to run as closely as possible to the armature-core Y. Z is the commutator, with the usual brushes, and P is the driving-pulley, connected to the armature-core Y by the arms *y*.

A supplementary field-magnet wire may be wound around the top edges of the poles N S, as in Fig. 6, through grooves in the top faces, which serve to fix the poles to more evenly distribute the magnetic fields and to prevent any possible sparking at the commutator.

The armature-core Y is made of laminated iron rings, and a number of oblong holes T are punched around the inside edges of the rings. The armature-wires *w w* are passed through these slots—two wires in each. Assuming there to be twelve consecutive poles in the field there will be one hundred and forty-five slots. Two wires being passed through each slot are then connected upon the edges of the armature-core to form one hundred and forty-four successive overlapping complete windings about the whole armature. The top one of every twelve pair of cross effective wires is connected on each edge of the armature-core alternately on one side and on the other to the adjoining twelve bottom cross-wires, as shown in Fig. 5, thus making a continuous winding throughout the armature, with twelve passes through the core corresponding to the number of field-magnet poles. Upon completion of the one complete winding the connection of this is now made to the cross-wires one hole behind the last connected cross-wires, and a further complete circumferential winding with twelve crossings across the armature is thus completed, and so on until twelve complete windings in series have been completed about the armature-core. These may be duplicated by connecting up in the same way the duplicate wires not yet connected, thus connecting up the cross-wires in all the one hundred and forty-four holes in two parallel and zigzag cross-windings about the armature-core, leav-

ing the last hole for the final ends to be connected. The connections at the sides of the armature-core lie flat to the sides, each adjoining connection lying alongside and parallel to the neighboring connection, and thus pack compactly to the core. This form of winding with the multipolar field gives effective work at slow speeds, and there is obviously a very small waste of ineffective connections between the cross effective wires as compared with either a usual drum-winding or a ring-winding, where connections pass around the core.

The double ends of the connecting-wires, either between each cross-wire or between every five or six of such cross-wires, are connected to the commutator Z, having as many commutating-strips as there are connectors to it.

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

1. In an electromotor, adapted to operate with continuous current and having interspaced multiple poles of alternate diverse polarity, an armature-core pierced with apertures parallel to axis of revolution, there being one more aperture than a multiple of the number of poles, cut sectional wires lying in such apertures, connected at side of armature to form a zigzag winding, crossing the armature as many times in one complete coil as there are poles, the spacing of the apertures between transverse wires being absolutely uniform, and causing each transverse part of such winding to approach poles step by step with perfect uniformity of succession, thus diminishing usual sparking from short-circuit at the commutator under the brushes.

2. In an electric motor for continuous currents an armature-winding connection, consisting of cut sections of wire, all of uniform length; iron-surrounded apertures in said armature parallel to the axis of rotation, receiving two or more of such cut lengths of wire; shortest and uniform connections between selected transverse wires, formed by the ends of such selected wires being bent wholly in the plane of revolution of such wires; and contiguous ends turned out perpendicularly to the armature, and connected by solder to form laterally-projecting annular flanges on either side of the armature, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

HENRY FRANCIS JOEL.

Witnesses:

REGINALD WILLIAM JAMES,

RICHARD A. HOFFMANN.