M. E. A. BAULE.
ELECTRIC IMPULSION MOTOR.
APPLICATION FILED MAY 1, 1919.

1,347,002. Patented July 20, 1920.
2 SHEETS—SHEET 1.

FIG. 1

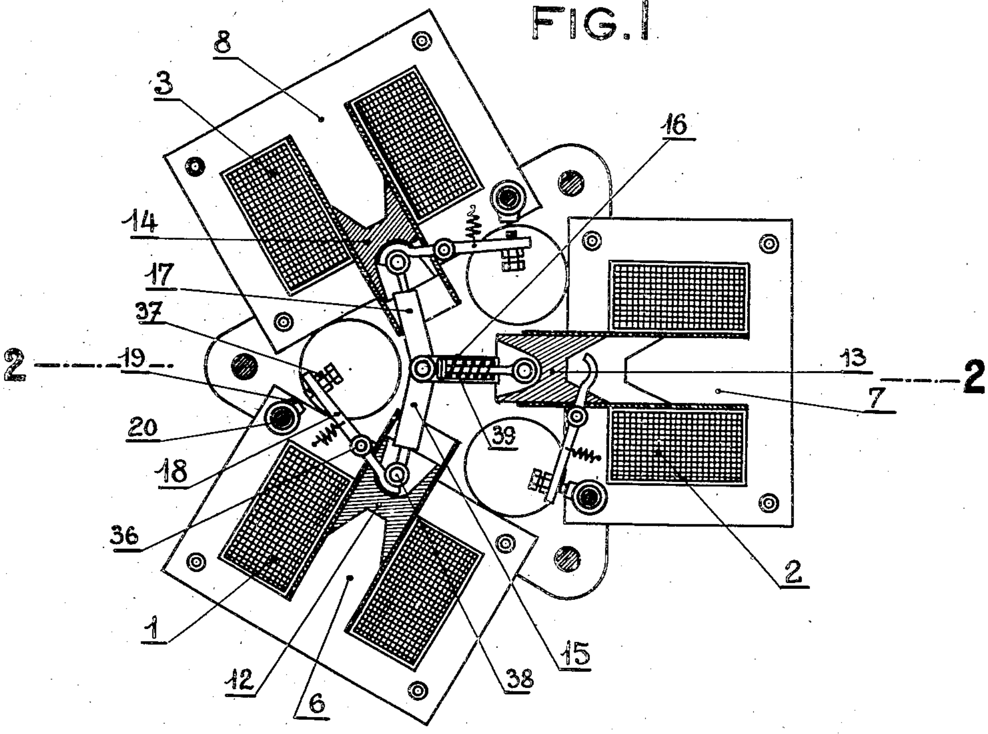
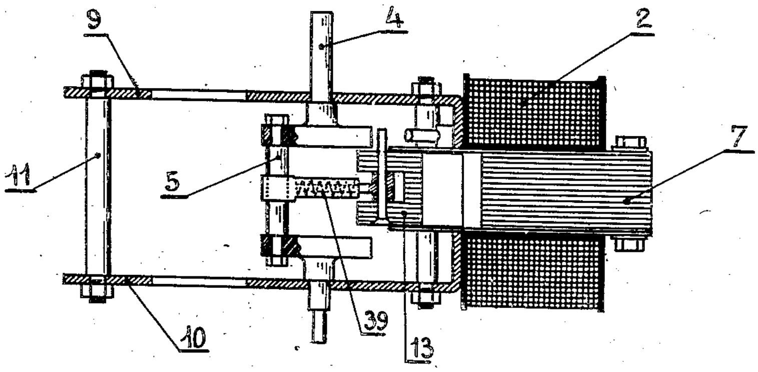


FIG. 2



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2 SHEETS—SHEET 2.

FIG. 3

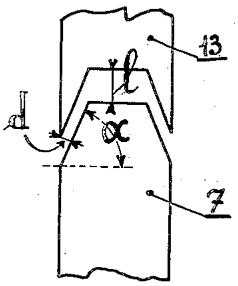


FIG. 4

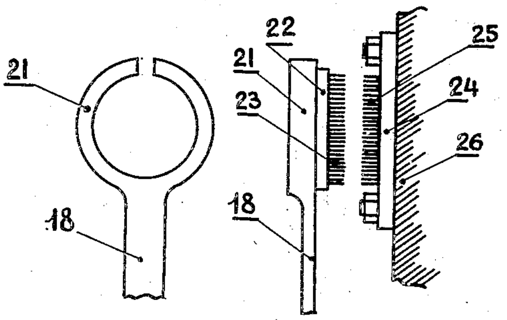
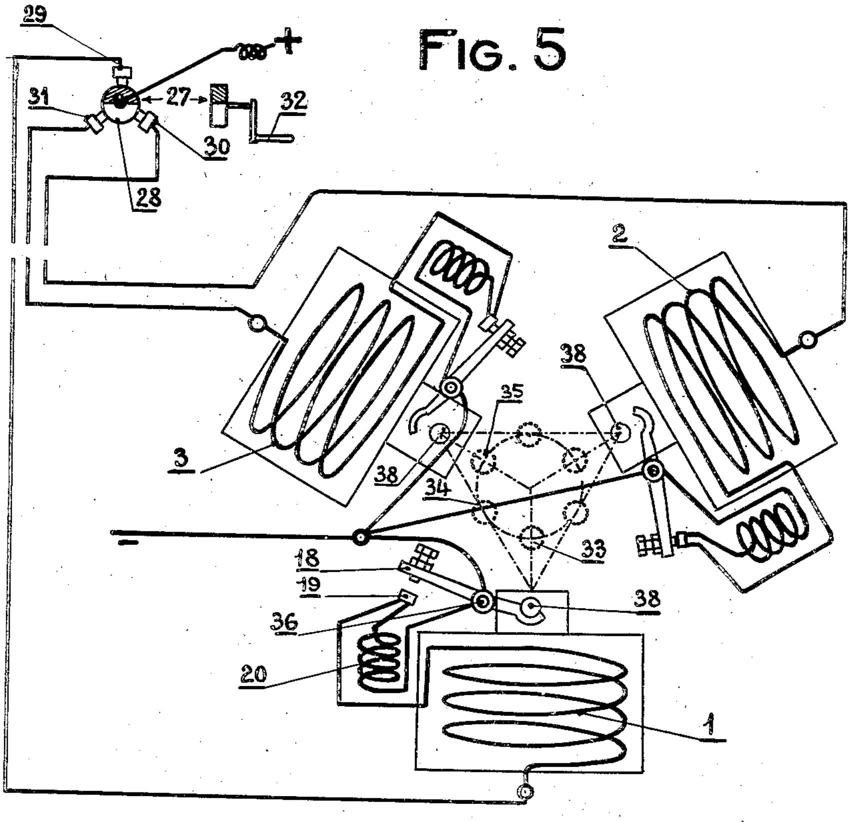


FIG. 5



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UNITED STATES PATENT OFFICE.

MARIE EMILE ALFRED BAULE, OF LYON, FRANCE.

ELECTRIC IMPULSION-MOTOR.

1,347,002. Specification of Letters Patent. Patented July 20, 1920.

Application filed May 1, 1919. Serial No. 294.060.

To all whom it may concern:

Be it known that I, MARIE EMILE ALFRED BAULE, a citizen of the French Republic, residing at No. 87 Cours Gambetta, Lyon, France, have invented certain new and useful Improvements in Electric Impulsion-Motors, of which the following is a specification.

This invention relates to electric impulsion motors. These motors are of the type comprising a plurality of electro-magnets located in a circle and excited successively by a current distributer. This generates a magnetic field which varies at regular intervals and acts in such a manner as to bring the shaft of the motor into a determined position at each variation of the field, said shaft being located in the center of the electro-magnets. This shaft is thus rotated by impulses, and passes successively through a given number of predetermined positions.

It has already been proposed to employ motors of this type wherein the shaft carries a magnetic armature having either two or four polars extensions said armature taking up at each impulse a determined position in the magnetic field generated by the excited electro-magnets.

The motor forming the subject matter of the present invention comprises electro-magnets that attract their movable cores, these cores carrying connecting rods that are attached to the crank pin of the driving shaft.

An embodiment of the improved motor is illustrated by way of example in the accompanying drawings in which—

Figure 1 is a plan of the motor with one of the side plates removed.

Fig. 2 is a section on a line 2—2 of Fig. 1.

Fig. 3 is an explanatory diagram.

Fig. 4 illustrates a metal brush contact.

Fig. 5 is a diagram showing the diagram of the circuits and the current distributer.

Three core-attracting electro-magnets consisting of coils 1, 2, 3, are arranged 120° apart around a shaft 4 having a crank pin 5. Their pole pieces are constituted by bundles of soft iron plates 6, 7, 8, insulated from one another and connected together. All these parts are fixed on a frame consisting of two recessed plates 9 and 10 connected by stay bolts 11.

These electro-magnets 1, 2, 3 are fitted with movable cores of soft iron 12, 13, 14 which are similarly constituted by plates that are insulated from one another and connected together. These cores are adapted to slide in guide tubes and are connected to the crank pin 5 by elastic connecting rods 15, 16, 17 each containing a spring such as 39. To the base of the motor there are attached axes 36 about which levers 18 pivot. Levers 18 terminate at one end in a screw 37 which may establish contact with a fixed member 19 connected to one of the ends of a coil 20 the other end of which is connected to the axis 36. Each of these members 19 is connected to one of the ends of one of the windings 1, 2, 3 and other end terminating in one of the three fixed brushes 29, 30, 31 of a distributer 27 (Fig. 5). The rotating part of this distributer is formed by a cylinder 28 conductor over a semi-circumference, insulated on the other half. A crank 32 permits rotation of the cylinder which is permanently connected to one of the poles of the source.

The movable cores 12, 13 14 are each provided with a lug 38 which may contact with the oscillating lever 18 and cause the latter to rock.

The operation is as follows: The current which passes through the coil passes through lever 18 and contact 19 which shunts the resistance coil 20. When the core 12 is attracted lug 38 strikes the small arm of lever 18 and opens the contact 19; the current then passes into resistance 20 which assures of the reduction of the current in the coil 1.

The pole pieces 6, 7, 8 of the electromagnets are provided with short stationary cores extending inside the coils 1, 2, 3 the ends of said extensions being beveled, and the movable cores 12, 13, 14 are made of complementary shape at their inner ends. When the core 13 (Fig. 3) is only at a distance l from the pole piece 7, the distance between the oblique faces measured in a line at right angles to these is $d=l \cos \alpha$, where α is the angle between the beveled surfaces and a plane normal to the axis of the coil, that is to say, d is smaller than l. The lines of magnetic force pass along this line at right angles, and it is known that the attraction is greater the shorter the distance through which the lines of force must pass between the two surfaces. It will thus be perceived that this arrangement yields at the end of the stroke of the core a greater attraction than would be the case if the contact surfaces of the pole pieces and the cores were at right angles to their axes.

The contacts 19 are preferably constructed as shown in Fig. 4. The lever 18 terminates in an elastic split ring 21 into which there is mounted with a driving fit a mount 22 carrying a metal brush 23. Facing this is a mount 24 which is provided with a similar brush 25 and is fixed to the fixed part 26. When the brushes 23 and 25 are in contact, their filaments will engage one with the other so that vibration and shock are unable to break the contact. This contact can be broken only by moving the two contacting parts intentionally and through a considerable distance.

In the position shown in Fig. 5 the electromagnet 1 only is excited and electromagnets 2 and 3 are not excited. Core 12 is attracted and causes the raising of the lever 18; coil 20 is put in series with electromagnet 1. The considerably reduced current which then passes through suffices to hold the movable core adherent. The crank of the shaft carried along by the rod 15 comes opposite the excited electromagnet at 33; in this position the resilient rod 15 retains almost its original length; its spring 39 is very slightly compressed. This is the first position of equilibrium of the shaft.

If the distributer rotates 60° in a counter clockwise direction the electromagnet 3 is in turn excited at the same time as electromagnet 1, the core of which remains attracted. The core 14 tending likewise to pass to the lower-end of the stroke, the two resilient rods 15 and 17 elongate by compressing their springs; when the core 14 is at the lower end of its stroke the crank has taken the position 34 centrally between the two excited electromagnets; this is the second position of equilibrium of the shaft.

If the distributer rotates 60° farther in a counter clockwise direction the electromagnet 1 has its circuit opened and only electromagnet 3 remains excited; the resilient rod withdraws the core 12 from its electromagnet and the crank of the shaft comes opposite the electromagnet 3 at 35. There are thus obtained six positions of equilibrium of the shaft for the six different electric connections made by the distributer at each revolution.

It is seen that the contact device 18 which shunts the resistance 20 and which is opened by the movement of the movable core so as to introduce the resistance into the circuit of the electrogmagnet as soon as the shaft has assumed its position of equilibrium, permits of attaining considerable economy of current by automatically reducing the current of the corresponding electromagnet.

The current flowing in the coils of the electro-magnets is liable to large and rapid variations which cause a similar variation of the flux in the pole pieces and in the cores. This variation would generate in the said pole pieces if they were made of a continuous block of metal self induction currents and Foucault currents which would cause an appreciable loss of energy and would interfere with the proper working of the apparatus. This risk is obviated by making the pole pieces of the electromagnets and their cores of metal sheets insulated from one another.

The improvements which consist in diminishing the working power of the electro-magnets and in constituting the pole pieces by metal sheets insulated from one another, are equally applicable to impulsion motors of the known type.

What I claim is:—

1. In an electric motor, comprising a crank shaft, a plurality of electromagnets arranged circumferentially about the crank shaft, the combination with each of the electromagnets of a core placed in each electromagnet, a resilient rod connecting each core to the crankshaft and normally holding said core in retracting position, a resistance in series with the coil of each electromagnet for reducing the current through said electromagnet, a switch arranged so as to normally short circuit each resistance and a device to automatically open each switch when the corresponding core moves out of its retracted position.

2. In an electric motor comprising a crank shaft, a plurality of electromagnets arranged circumferentially about the crankshaft, the combination with each of the electromagnets of a core placed in each electromagnet, a resilient rod connecting each core to the crank shaft and normally holding said core in retracted position, a resistance in series with the coil of each electromagnet for reducing the current through the latter, a switch for short circuiting each resistance formed of two metallic brushes the blades of which penetrate into each other, and a device for automatically opening each switch when the corresponding core moves out of its retracted position.

3. An electric motor comprising in combination a crank shaft and a plurality of electromagnets arranged circumferentially around the crankshaft, a core placed in each electromagnet, a resilient rod connecting each core to the crankshaft and normally holding it in retracted position, a resistance in series with the coil of each one of the electromagnets for reducing the current through said electromagnet, switches arranged in such manner as to normally short circuit each of said resistances, devices to automatically open each of these switches when the core of the corresponding electromagnet moves out of its retracted posi-

tion, a current distributer permanently connected to one of the poles of the source, and brushes acting frictionally on said distributer and each connected to one of the electromagnets.

4. In an electric motor, the combination of an electro-magnet, an armature therefor, a crankshaft, a resilient connecting-rod connecting said armature with the crank of said shaft, a resistance in series with the coil of said electromagnet, a switch arranged to short circuit said resistance, and means to automatically close said switch when the armature is in retracted position.

In testimony whereof I have signed my name to this specification.

BAULE MARIE EMILE ALFRED.

Witnesses:

MARIN VACHON,

LOUIS ESCHER.