Dec. 1, 1925.

1,563,380

G. R. KUNKLE

ELECTRIC MOTOR MECHANISM

Filed May 14, 1923

2 Sheets-Sheet 1.

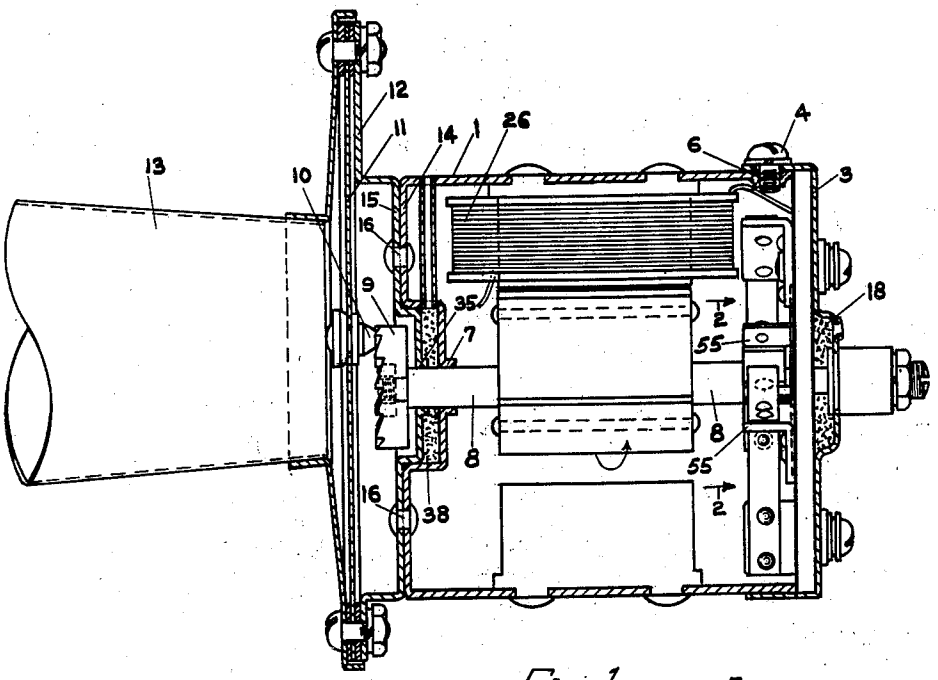


Fig-1

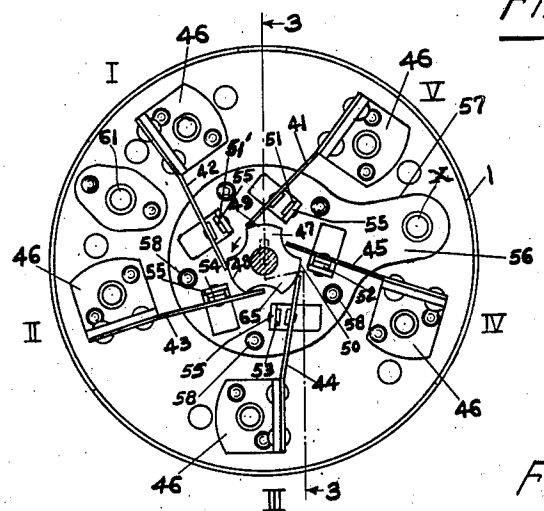


Fig-2

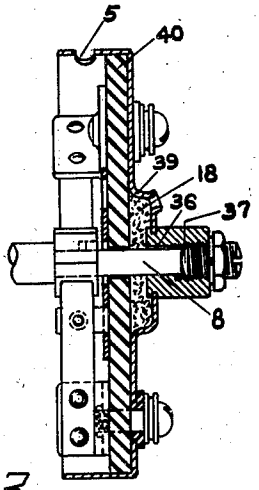


Fig-3

George R. Kunkle
INVENTOR.

BY Richey, Slough + Watts

HIS ATTORNEYS

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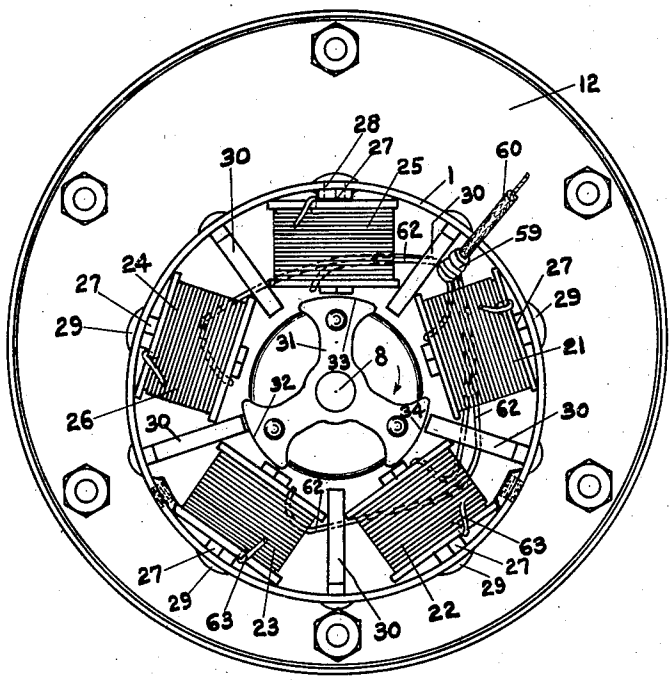


Fig-4

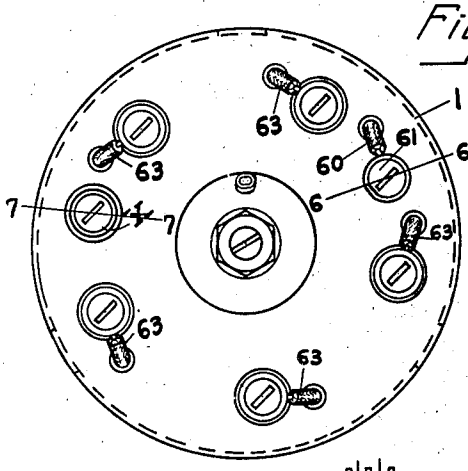


Fig-5

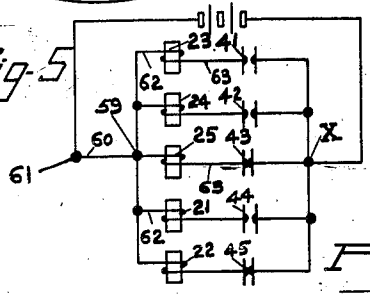


Fig. 8

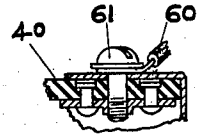


Fig-6

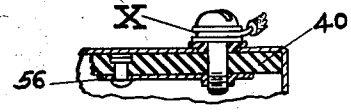


Fig-7

George R. Kunkle.
INVENTOR.

BY Richey, Slough & Watts

HIS ATTORNEYS

Patented Dec. 1, 1925. 1,563,380

UNITED STATES PATENT OFFICE.

GEORGE R. KUNKLE, OF ELYRIA, OHIO.

ELECTRIC-MOTOR MECHANISM.

Application filed May 14, 1923. Serial No. 638,811.

To all whom it may concern:

Be it known that I, GEORGE R. KUNKLE, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Electric-Motor Mechanisms, of which the following is a full, clear, concise, and exact description, such as would enable others skilled in the art to which my invention appertains to make and use the same.

My invention relates to electric motor mechanisms, and is particularly applicable, in the case of small electric motors, for such purposes as operating signal horns, and the like, although my invention is not limited to such uses.

Among the objects of my invention are, to provide an electric motor which may be inexpensively manufactured but which will be efficient in operation, and of sturdy construction so that it will be durable in use and reliable in operation.

Other objects of my invention, and the invention itself, will be apparent from the disclosure thereof contained in the following description, and in which description reference is had to the accompanying drawings illustrating an embodiment of my invention.

Referring to the drawings:

Fig. 1 shows a longitudinal, medial sectional view of an embodiment of my invention shown in connection with the means for operating an electrical signalling horn, certain parts being shown in elevation.

Fig. 2 is a view in elevation of the cam and contact sets operated by the cam for the purpose of controlling the magnet circuits, this view being taken looking in the direction of the arrows 2—2 shown in Fig. 1.

Fig. 3 shows a sectional view of the cam, cam shaft, and circuit controlling springs, together with associated parts, taken on the line 3—3 of Fig. 2.

Fig. 4 shows an end elevational view of the armature and field magnets, looking forwardly toward the sound amplifier horn from a position to the rear of the said armature and magnets and in the front of the cam and spring assembly at the rear of the casing.

Fig. 5 shows a rear end elevational view of the casing cover which carries the contact spring sets and armature and cam shafts bearing together with terminal connections for the circuit conductors.

Fig. 6 shows a section on line 6—6 of Fig. 5.

Fig. 7 is a section on line 7—7 of Fig. 5.

Fig. 8 is a circuit diagram of the electrical connections.

Referring now to the drawings in all of which like parts are designated by like reference characters, at 1, I show a cylindrical casing whose open end is closed by a cap or cover 3, which is secured thereto by screws, as 4, which pass through openings 5, in the cover, and which are threaded into the casing as at 6. The other end of the casing is closed, the closed end being perforated at 7, to admit a motor armature shaft 8, through the perforation.

In the embodiment of my invention illustrated, I have illustrated it as being embodied in an automobile signal horn mechanism, wherein a toothed wheel 9, carried on the armature shaft 8, is rotated, the teeth making rapid intermittent contact with a contact wear element 10, carried on a vibratile diaphragm 11, said diaphragm being carried in a casing 12, which supports a sonorous horn 13, communicating to the interior of the casing 12.

I have illustrated the motor embodiment of my invention in connection with a signal device of this character to show one of the uses to which my invention may be put; it is apparent that it may be put to many other uses.

The casings, 1 and 12, have their end walls 14 and 15, respectively, riveted together as at 16, so as preferably to make of the signal horn and motor casings a unitary structure. Carried by the casing 1, which is preferably made of soft steel, are a plurality of electromagnets 21, 22, 23, 24 and 25. These electromagnets comprise electromagnetic windings such as shown at 26, and magnet cores such as shown at 27, said windings being mounted on said cores, and said cores being rigidly secured as by riveting to the casing 1, the riveting being effectually accomplished by providing the cores with reduced ends, passing the reduced core ends through openings as at 28, in the casing, and then by riveting the ends of the cores over to create a flanged head to engage with the outer wall of the casing as shown at 29. Intermediate of the electromagnets, and carried in like manner by the casing 1, and in like manner extending radially within the casing, are a plurality of return pole

pieces 30, one of said pole pieces being disposed between each adjacent pair of electro-magnets, the cores return pole pieces projecting inward radially to substantially the same distance, and within the magnetic pole, faces comprising the inner ends of said cores and pole pieces, an armature 31, is provided, being carried on the shaft 8, and adapted to rotate with the said shaft, said armature being tripolar and presenting its pole faces 32, 33 and 34 to the core and pole piece faces above mentioned. The pole faces 32, 33, and 34, are preferably of about the same width as the width of the core and pole pieces, and the length of the armature pole faces is substantially the same as the distance between opposite edges of adjacent magnet core and pole piece faces. The armature 31, is carried on an armature shaft 8, said armature shaft having bearings at 7, 35, and 36, and a variable, adjustable thrust bearing at 37, the thrust at the other end of the shaft 8, being by the toothed wheel 9, exerted against the contact wear element 10, carried on the diaphragm 11, as before described. To insure proper lubrication of the bearing aforesaid, I have provided between the wall 14, of the casing 1, and the wall 15, of the casing 12, and adjacent the shaft 8, a lubricant containing compartment 38, and between the cover end wall 39, and an insulating plate 40, through which shaft 8, passes, and adjacent the bearing 37, a lubricant containing chamber 18. In the lubricant containing chambers 38, and 18, I place a lubricant absorbing pad such as a felt pad which is capable of absorbing, retaining, and, as needed, communicating oil to the engaging surfaces of the shaft 8, and the bearings 35, 7 and 36, respectively, as well as to the thrust bearing. The plate of insulating material, shown at 40, may be of fiber, or like material, for the purpose and which is perforated to admit a shaft such as 8, and on this insulating plate are mounted a plurality of contact springs 41, 42, 43, 44 and 45.

Mounted rigidly on the shaft 8, is a cam 47, having three cam faces 48, 49 and 50, separated by intervening recessed portions: the springs 41, 42, 43, 44 and 45, except for the lifting action of the cam 47, normally making contact with contact elements 51, 51′, 54, 53 and 52 which are mounted on upright metallic supports 55, integral with a metallic base 56, having an arm 57, said base being secured to the insulating plate 40, by a plurality of rivets, as 58. A terminal screw x is adapted to pass through the opening in the arm 57, for the purpose of making an electrical connection to the plate 56, from the outside of the casing by virtue of the contact element supports 55, all being mounted on the same metallic base 56, thereby electrically connected together. The contact springs 41 to 45, inclusive, however, are insulated one from the other, and a circuit conductor leads from each spring carrying plate 46 to a particular electro-magnetic winding, which windings are supported on the casing 1 by magnet cores 27. The other ends of all of the windings not connected to contact spring supporting plates as 46, are all joined together as at 59, and joined to a circuit conductor 60, which leads to a terminal 61, on the outside of the casing, thus the electric circuit of the motor will comprise the terminal 61, circuit conductor 60, then one or more of the circuit conductors 62, which lead therefrom to the different windings as 25, then from these circuit conductors as 63, which leads through a contact supporting member as 46, a contact spring, such as 43, and 45, which at the time are making contact with their respective associated contacts 54, or 52, respectively, through the conducting plate 56, to the terminal x. The terminals 61, and x are placed on the outside of the casing and to these terminals the source of current adapted to properly energize the motor windings to operate the motor, is connected when it is desired to operate the motor, as for instance when operating the signal horn to which the electric motor of my invention may be applied.

In order to rotate the armature 31, carried on the shaft 8, by the electro-magnetic action of the electro-magnets the proper number of contact springs together with a three toothed cam 65, are actuated, so that only those coils which will accelerate or continue the rotation of the armature 31, by electro-magnetic attraction thereupon are energized, and at the proper times.

The timing of the contact mechanism may be varied considerably, but I find that I get very satisfactory results when the different contacts are closed and opened as follows, during one revolution of the armature:—

In this description I have numbered the contact sets in order counterclockwise from No. 1 to No. 5 inclusive:—

In one revolution of the armature and therefore of the fiber cam 47, each pair of contacts comprising a contact set open and close between the following portions of a complete circle; No. 1 contact set closes at 0° and opens at 55°, again closing at 120°, subsequently opening at 175°, then closing at 240°, opening at 295° and finally closing at the end of the complete revolution at 360° which corresponds to the starting point. Contact set No. 4 as shown by the drawing, Fig. 2, is so disposed with reference to the three cam faces, as 48, that this set of contacts are opened and closed for the same number of periods and length of periods during the revolution except that this set of contacts operates preferably about 24 degrees later than the first contact set; simi-

larly, the No. 2 contact set operates in the same manner except that the different periods of operation occur approximately 24° later than with the No. 4 contact set. No. 5 contact set operative periods following the No. 2 contact set by 24° and the No. 3 contact set following the No. 5 contact set by 24°.

It will be obvious, therefore, that for brief periods there will be three contact sets simultaneously closed, the operative periods being sufficiently overlapped as to preferably produce this result, although fair results may be secured with only two contact sets simultaneously operative, but to secure the very best result, it is preferable that at the moment of breaking contact of a given contact set, that two other contact sets are closed. This produces a smoothness of operation of the armature, and decreases the sparking tendency at the contacts and insures ready starting at all times.

I am aware that the different periods may be altered and the number of coils may be altered and still the same mode of operation would result.

Having thus described my invention, I am aware that numerous and extensive departures may be made from the embodiment hereir illustrated and described but without departing from the spirit of my invention.

I claim:

1. In an electric motor, the combination with an odd number of field electro-magnets comprising at least five magnets, an equal number of contact elements each controlling the flow of current to a particular different one of said magnets, a rotatable armature comprising more than two equally spaced magnet pole pieces adapted when rotated to successively present said pole pieces to each field electro-magnet pole, and a controlling means carried by said armature comprising a plurality of contact element operating means equal in number to the said armature magnet pole pieces, a source of current and circuit connections interconnecting said source, said contact elements and said magnets.

2. In an electric motor, a three-pole rotatable armature therefor, a five-pole field, a magnet winding for each field pole piece, an electric circuit for each said magnet winding, means adapted during rotation of the said armature to close the circuit of each said winding three times during one armature revolution, the periods of closure of the different magnet circuits being so timed that at all times two of said circuits will be closed, and that for shorter periods three of said magnet circuits will be closed.

3 In an electric motor, the combination with five electro-magnets, a circuit for each said magnet, a three-pole armature, means to maintain closed each magnet circuit throughout three equally spaced circuit closing periods during a single revolution of the armature, the periods of closure of the different electromagnet circuits being so related and overlapping that at all times two of said electromagnet circuits will be maintained closed and that at the moment of breaking the circuit of one of said electro-magnets a third electromagnet circuit will be closed, all of said circuits being disposed in multiple circuit, a source of current adapted to be connected to said multiple connected circuits.

4. In an electric motor, the combination with a three pole armature, a five pole field, windings for each of the field poles, circuit closing contacts equal in number to the said field magnets, controlling means equal in number to the armature poles controlling said contacts to cause each of said contacts to close the circuit of a particular different one of said magnets three times during a single revolution of the said armature, the periods of circuit closures of the different electro-magnets being so timed relative to each other that overlapping periods of circuit closing of the different magnets will occur to cause two of said magnet circuits at all times to be closed and at the moment of breaking of the circuit of any of said electromagnets a third electromagnet circuit will have previously been closed.

5. In combination, an electric motor armature, an electromagnetic energizing field therefor, said armature and field being relatively rotatable, said field comprising a plurality of field pole energizing windings, a pole piece energized by each of said windings, said armature presenting to the pole pieces energized by said windings a plurality of armature pole pieces successively, a circuit for each said winding, circuit controlling means comprising operating elements equal in number to the said armature pole pieces for controlling the circuits through the said windings and adapted to cause each of the said circuits to be closed a number of times equal to the said number of armature pole pieces during each revolution of the said armature, the different winding circuits being closed in overlapping periods whereby at all times at least two electromagnet circuits will be simultaneously closed, and a third electromagnet circuit will be closed prior to the breaking of one of the other said magnet circuits previously closed.

6. In an electric motor, the combination with a five pole field, a three pole armature, a winding for each field pole piece, a circuit for each winding, a contact element in each said circuit, an energizing circuit comprising a source of current, and circuit controlling means adapted to operate the said contact elements in sequence in overlapping

periods, the number of periods of circuit closures of each said circuit during a single revolution of the armature being equal to the number of poles in said armature.

7. In an electric motor, a plurality of electro-magnet windings, an electric circuit comprising a source of current, an independent circuit closer for each said winding adapted when operated to connect its associated winding in the said circuit, a cam shaft actuated by the motor, camming means carried by said shaft adapted to operate said circuit closers in predetermined sequence, and timing means comprising a plurality of equally spaced camming faces whereby each said closer will be operated during one revolution of the cam shaft a number of times equal to the number of cam faces, each of said circuit closers comprising a rigidly supported contact and a contact spring adapted to contact therewith by spring pressure, said cam faces adapted during rotation of the shaft to lift the springs from their contacting positions.

8. In an electric motor, a plurality of field windings at least five in number, an electric circuit comprising a source of current, a circuit closer for each winding adapted to include it in the said electric circuit, a motor shaft, circuit closer operating means carried by the said shaft adapted to operate said closers to include the different windings in the said circuit in sequence, the timing of the said closer operations being such that a first winding in the direction of rotation will be first included, a fourth winding taken in the direction of rotation being next included, and a second winding in the direction of rotation being then included in the said circuit, said first winding being immediately thereafter excluded from the said circuit and a fifth winding subsequently included.

9. In an electric motor, a plurality of field windings at least five in number, an electric circuit comprising a source of current, a circuit closer for each winding adapted to include it in the said electric circuit, a motor shaft, circuit closer operating means carried by the said shaft adapted to operate said closers to include the different windings in the said circuit in sequence, the timing of the said closer operations being such that a first winding in the direction of rotation will be first included, a fourth winding taken in the direction of rotation being next included, and a second winding in the direction of rotation being then included in the said circuit, said first winding being immediately thereafter excluded from the said circuit and a fifth winding subsequently included, said fourth winding being subsequently excluded from the circuit and a third winding thereafter included therein.

10. In an electric motor, a plurality of field windings at least five in number, an electric circuit comprising a source of current, a circuit closer for each winding adapted to include it in the said electric circuit, a motor shaft, circuit closer operating means carried by the said shaft adapted to operate said closers to include the different windings in the said circuit in sequence, the timing of the said closer operations being such that a first winding in the direction of rotation will be first included, a fourth winding taken in the direction of rotation being next included, and a second winding in the direction of rotation being then included in the said circuit, said first winding being immediately thereafter excluded from the said circuit and a fifth winding subsequently included, an armature carried by the said shaft and having a plurality of magnet pole pieces at least three in number adapted to successively be presented to said field magnet pole pieces.

11. In an electric motor, a plurality of field windings at least five in number, an electric circuit comprising a source of current, a circuit closer for each winding adapted to include it in the said electric circuit, a motor shaft, circuit closer operating means carried by the said shaft adapted to operate said closers to include the different windings in the said circuit in sequence, the timing of the said closer operations being such that a first winding in the direction of rotation will be first included, a fourth winding taken in the direction of rotation being next included, and a second winding in the direction of rotation being then included in the said circuit, said first winding being immediately thereafter excluded from the said circuit and a fifth winding subsequently included, said fourth winding being subsequently excluded from the circuit and a third winding thereafter included therein, and an armature carried by the said shaft and having a plurality of magnet pole pieces at least three in number adapted to successively be presented to said field magnet pole pieces.

12. In an electric motor, the combination with a field frame, field magnet cores projecting inwardly radially from said frame, an armature, an armature shaft, said armature comprising a plurality of cores extending outwardly radially from the said shaft, windings on alternate field cores only, and commutating means controlling the flow of current through the said windings operated responsive to the rotation of the shaft to energize each said winding a plurality of times during each shaft revolution, the periods of energization of the successively energized windings being overlapping.

In witness whereof, I have hereunto subscribed my name this 12th day of May, 1923.

GEO. R. KUNKLE.