July 29, 1930. C. BERGER 1,771,609

ELECTRIC TOY MOTOR

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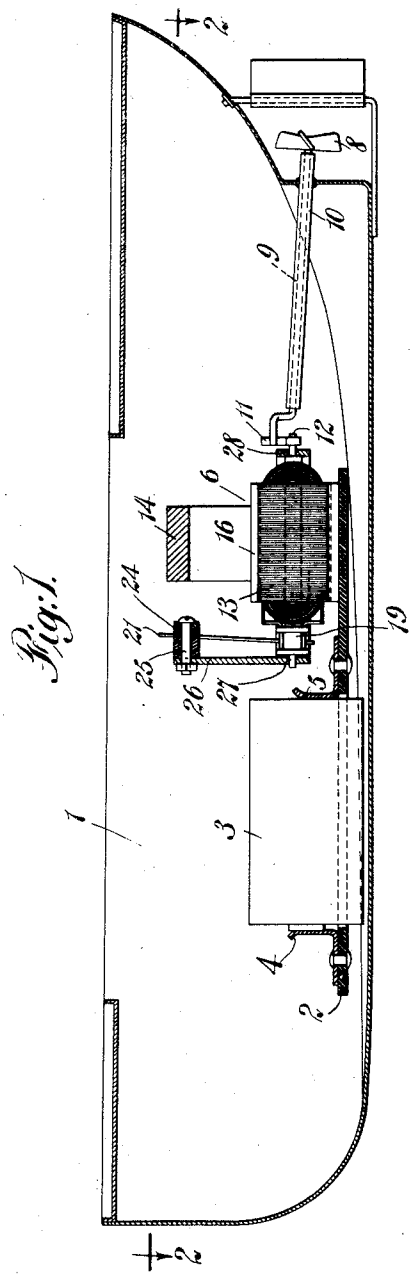


Fig. 1.

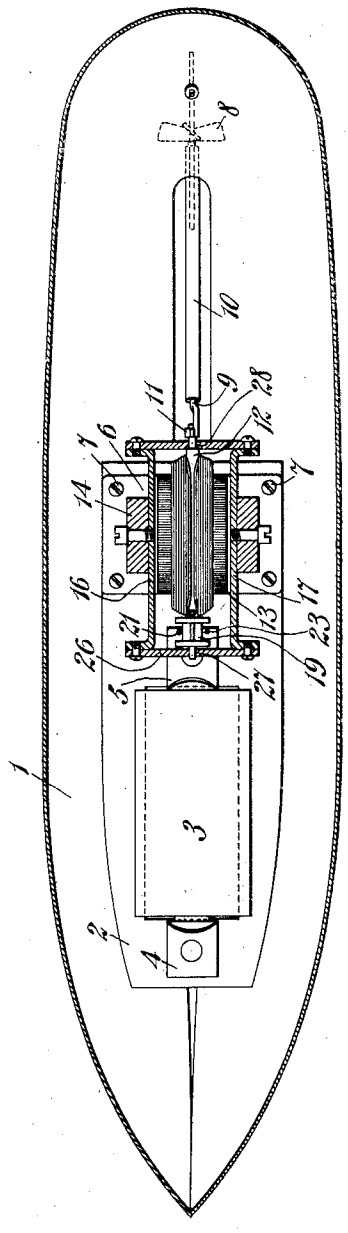


Fig. 2.

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Fig:3.

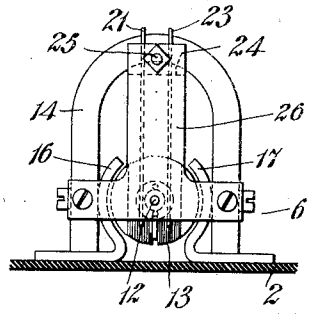


Fig:4.

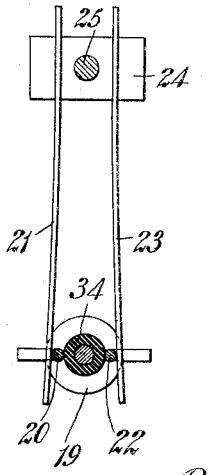


Fig:5.

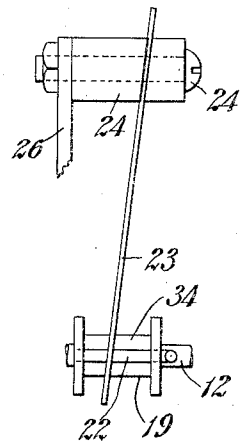


Fig:7.

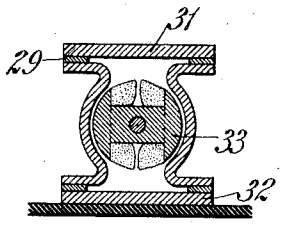


Fig:8.

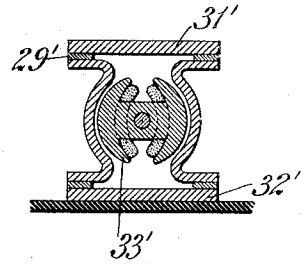


Fig:6

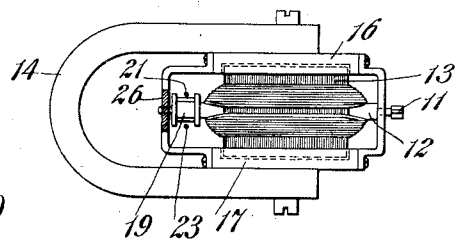
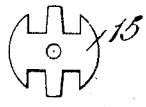


Fig:9.



Christian Berger Inventor

By his Attorney C. Campbell Brinckle

Patented July 29, 1930 1,771,609

UNITED STATES PATENT OFFICE

CHRISTIAN BERGER, OF BROOKLYN, NEW YORK, ASSIGNOR TO FREDERICK T. SAWYER, TRUSTEE

ELECTRIC TOY MOTOR

Application filed November 23, 1925. Serial No. 70,762.

This invention relates to an electrically propelled toy.

Electrically operated toys are much in demand. The desirable source of power is the dry cell due to the greater mobility of the toy as it is not dependent upon a connection with the lighting circuit and the freedom from possible injury to the child. Such toys in order to be salable must comply with certain specifications. If a boat, it must have a speed of at least one half a boat length per second. In order to make a popular priced toy it must be within certain limitations of size and low first cost which in turn limits the size of the dry battery to a unit cell of the small cartridge flashlight type. Such a cell at 1.5 starting and 1.3 cut off volts will yield at an average discharge rate of .2 ampere service for 4 to 5 hours. The motor must be of light weight in order not to increase the displacement of the boat and must have sufficient power to drive the hull and contents at the prescribed speed. The ratings of the motor are then: impressed voltage 1.4 volts, current 0.2 ampere, number of revolutions to conform to the most effective propeller used, about 300 R. P. M. and such commercial efficiency that the useful output will be sufficient for the power required by the boat under the specified cell discharge conditions at the specified rate of propulsion. In addition, the motor must be capable of manufacture by the toy trade. Limitations were so many that a motor complying with the above specifications could not be found and was not known to the art. Miniature or toy motors have an exceedingly low efficiency, due partly to causes inherent to small-scale electromagnetic devices and partly to design which must aim at low cost of manufacture at the expense of efficiency, the latter being in hitherto known cases of little consequence, since it has not been known that a motor of such small input should propel itself and its current supply, to say nothing of propelling a vehicle body.

One of the objects of this invention is to provide an electrically propelled toy of the so-called popular priced variety.

Another object is that the toy must be operable using as a source of current supply a small dry battery known as a unit cell which has a low first cost and a large geographic distribution.

Still other objects are to provide a motor that will be operable from and by such a source of supply with a current consumption of .2 ampere or less with 1.4 voltage and deliver sufficient power to drive the toy boat at a high speed amounting at least to one half of a boat length per second.

Referring to the drawings:

Figure 1, is a view in vertical section, parts in elevation, of a hull, cell, motor and drive mechanism.

Figure 2, is a plan view partly in horizontal section of Figure 1 along the line 2, 2, looking in the direction of the arrows.

Figure 3, is an end view in elevation of the motor.

Figure 4, is an end view of the commutator and brushes.

Figure 5, is a side view of the commutator and brushes.

Figure 6, is a modified form of motor wherein the permanent field magnet is placed in a horizontal position.

Figure 7, is a modified form of motor wherein the permanent field magnets are bar magnets.

Figure 8, is a modified form of Figure 7, wherein the armature core is the semi-enclosed type.

Figure 9, is a modified form of armature core.

In carrying out my invention, I provide a hull 1, and a base 2. Base 2 is cut out to permit cell 3 to set therein for the purpose of holding cell 3 and to lower the position of the center of gravity. Spring clip contacts 4 and 5 are secured to base 2. Motor 6 is secured by screws 7 to base 2. Propeller 8 is driven by shaft 9 in sleeve 10 through arm 11 secured to motor shaft 12.

A basic condition of the invention for the satisfaction of the requirements is the use of a permanent magnet for establishing the field for the armature that is a substantial residual flux in the magnetic circuit of the motor. The invention further consists of so

proportioning and arranging the electromagnetic and ferro-magnetic system that at the stated low voltage of 1.4 volts and small input of substantially 0.3 watt the output of the motor is raised to the required amount by increasing the total output i. e., and by diminishing stray power losses by means compatible with the physical and economic requirements of the invention.

In large motors a high counter E. M. F. is produced by permitting the motor to run at high speed, but in the present motor only low speed is possible on account of the disproportionately large losses which would use up all the output long before the counter E. M. F. would approach the impressed voltage in anything like the same proportion as in the case in larger machines. To get an increased total output i. e., with the limited amperage and therefore ampere-turns at disposal, a larger counter E. M. F. is induced. To increase the flux through the armature 13 without increasing the weight of the field magnet 14, I improve the permanence of the air gaps mainly by making the air gaps of large cross section and as narrow as is consistent with cheap manufacture. In other words, the magnet 14 terminates in pole pieces 16, 17, of relatively large surface adjacent the armature 13. The gap between the armature 13 and the pole pieces 16, 17, should be as small as possible but is limited by the tolerance necessary in toy manufacture and the high cost of permanent magnets answering close dimension specifications in particular. In the wholesale manufacture of permanent magnets for small apparatus the distortion is very marked. But no difficulty obtains in making the pole faces wide i. e. air gap cross section large even though greater tolerances are required in the air gap between armature 13 and pole pieces 16, 17, than is desirable.

In addition the efficiency of the motor is further increased by reducing the losses, not by mechanical refinements but by means that lend themselves to ready and cheap quantity production. After all is done consistent with cheap manufacture to lessen losses by eddy currents, such as the sub-division of the armature core 15, see Figure 9, core 15, a very great loss arises in brush friction. In most toy motors the power required to overcome brush friction is equal to or exceeds the output of a motor of the present rating. It must be borne in mind that the current consumed by my motor is less than that consumed by a pocket flashlight lamp. The principle underlying the commutator 19 is that a very small contacting surface only is necessary to carry the small current without undue volt-drop, if at the same time the pressure of the contacting members 20, 21, 22, 23, is equal to or above the so-called critical contact pressure per square inch, that is, that pressure above which no further gain in conductivity of the contact is produced. The simplest mechanical embodiment of this principle is seen and applied in crossing two cylindrical wires 20, 21 and 22, 23, when owing to the very small contact area thus produced a small pressure is sufficient to insure perfect contact for that area. At the same time such contact satisfies also the requirement of minimum friction in that the parts have a small contacting area and the pressure is small. In order to increase the wearing and self cleaning quality of the commutator wires 20 and 22, I prefer to have the brush wires cross not at right angles, see Figure 5. Commutator wires 20 and 22, are positioned as close to the axis of revolution as possible to reduce the moment of friction. The commutator bushing 34 is therefore as thin as practicable. Variations might be made such as the substitution of a narrow reed or brushes 21, 23, that is brushes of non-circular but small cross section, but the friction losses due to this type of contact increase with the square of the contacting area at critical pressure of the contact.

Brushes 21 and 23, are supported by insulating block 24 bolted by bolt 25 to frame 26, which also supports motor shaft 12 in bearings 27, 28.

To minimize eddy losses in the permanent magnet a semi-closed type armature wherein the pole pieces 33′ of the armature core are peripherally extended is shown in Figure 8, which lessens the changes of flux and eddy losses in the magnet. A similar effect is had with the armature core shown in Figure 9. The armature 13 is of the shuttle wound type and the core is made up of soft steel laminations.

In certain models of toy boats, in order to have proper stability and balance, it is necessary to keep the center of gravity low by adding ballast to the keel. To accomplish this result without ballast it may be desirable to place the permanent magnet 15 in a horizontal position as shown in Figure 8. The same reason is one of the causes for cutting out a portion of base 2 to permit unit cell 3 to set therein to lower its center of gravity in the hull.

While I have shown the operation of the device in connection with a single unit cell the motor is designed to operate satisfactorily in connection therewith but will drive at a greater speed if a multiplicity of cells are used and I therefore do not desire to be limited to the use of a single unit cell.

Although the invention is the solution of the problem of electrical toy boat propulsion of a popular price toy, yet any electrical toy vehicle wherein the requirements are the same would involve the principles of my invention and hence I do not desire to be restricted to a toy boat.

What I claim is:

A toy motor having a current consumption of about .2 ampere with a voltage of about 1.4, said motor having a permanent magnet forming the field for the armature, said field having large cross section and a narrow gap, an armature having a shaft, laminated core, a commutator, said commutator consisting of two wires close to the said shaft to reduce the brush moment of friction, said wires of said commutator carried by a thin bushing of non-conducting material on said axis of revolution, brushes having a point contact with said commutator.

Signed at New York in the county of New York and State of New York, this 21st day of November, A. D. 1925.

CHRISTIAN BERGER.