# United States Patent

Mabuchi

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[54] **ELECTRIC-POWERED MODEL AIRPLANE**


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Oct. 26, 1971 Japan .....46/84305

[52] **U.S. Cl.**.....**46/243 AV**, 46/244 B, 46/76
[51] **Int. Cl.**.....**A63h 27/00**, A63h 33/26
[58] **Field of Search**.....46/76, 243 AV, 244 B



[56] **References Cited**

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*Attorney*—Edward S. Irons et al.



[57] **ABSTRACT**

A novel electric-powered model airplane is for the first time disclosed which has an electric motor for driving a propeller and a specific dry cell mounted thereon, said dry cell being of a high capacity, small size and light weight and, if desired, encased in a case with a plurality of openings or fins for heat radiation. The model airplane may be provided with a remote control device, if desired. Thus, the present model airplane can be simply operated and affords enjoyment to adults as well as children.


**6 Claims, 4 Drawing Figures**

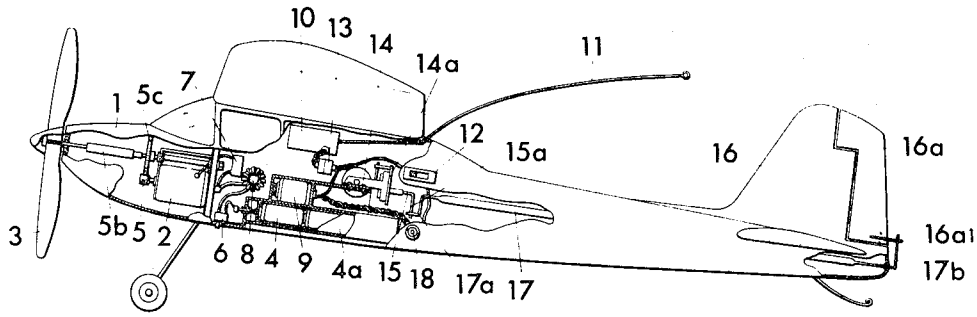


FIG. 1

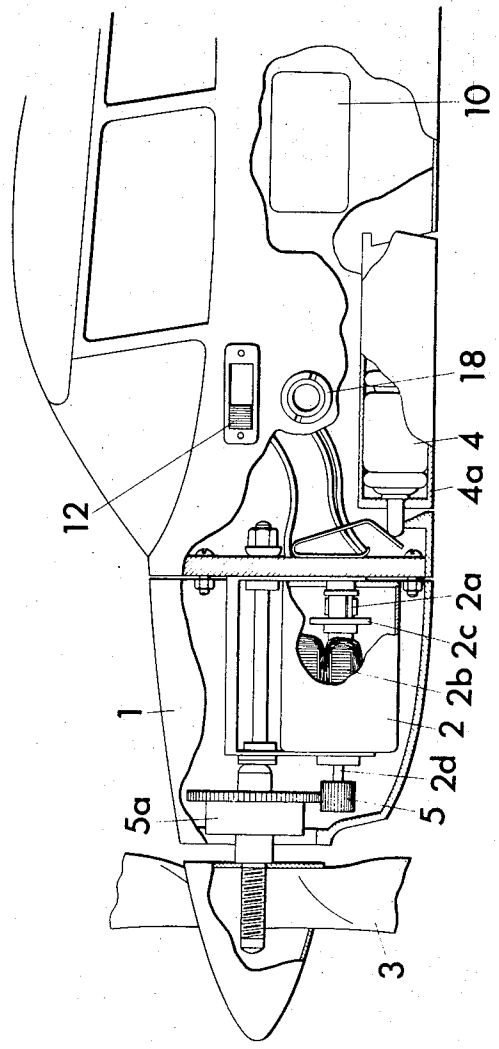
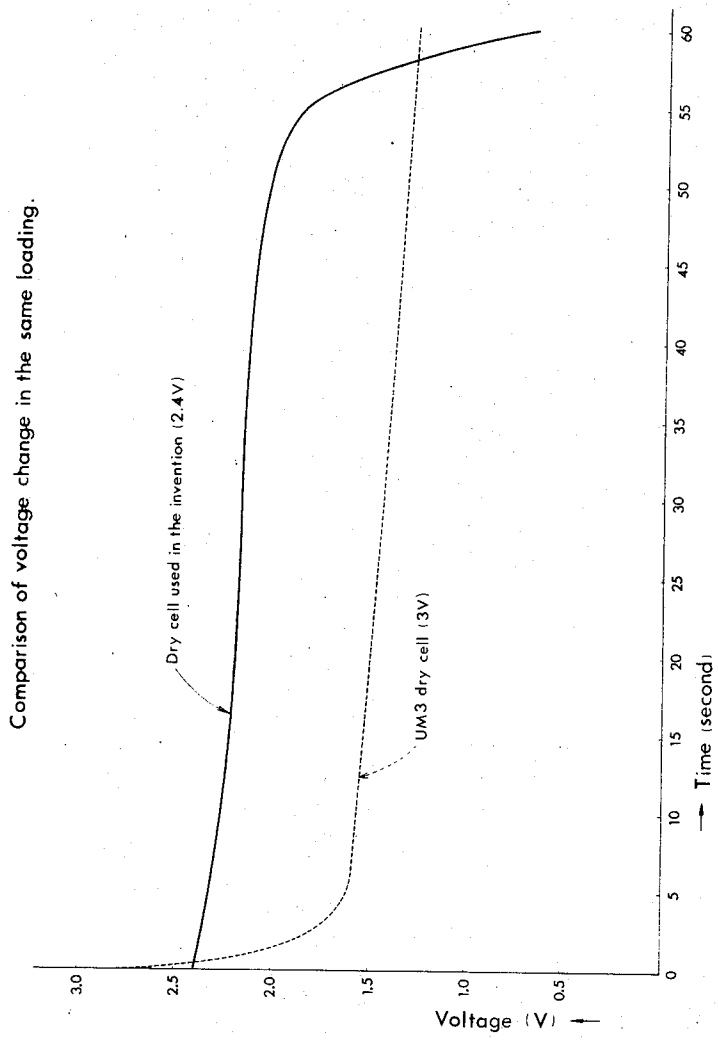
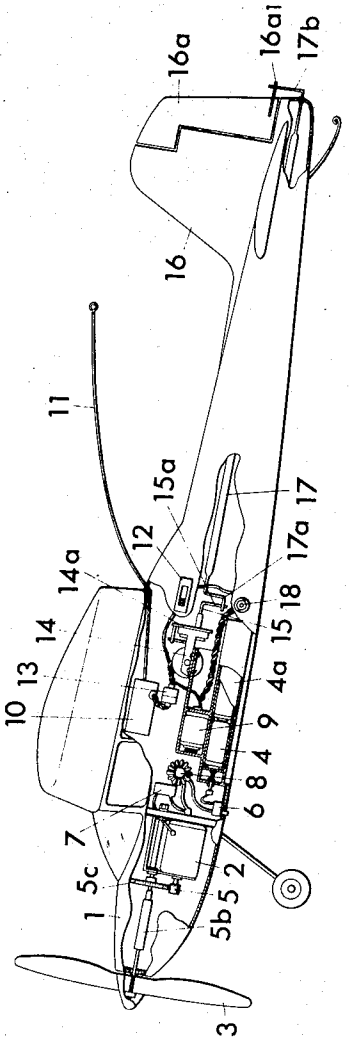


FIG. 2


Comparison of voltage change in the same loading.
Dry cell used in the invention (2.4V)
UM3 dry cell (3V)
Voltage (V)
3.0
2.5
2.0
1.5
1.0
0.5
0
5
10
15
20
25
30
35
40
45
50
55
60
Time (second)


16a
16a1
17b
16
11
15a
17
12
17a
14a
18
15
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4a
13
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4
8
6
7
2
5c
5
1
5b
3

FIG.3

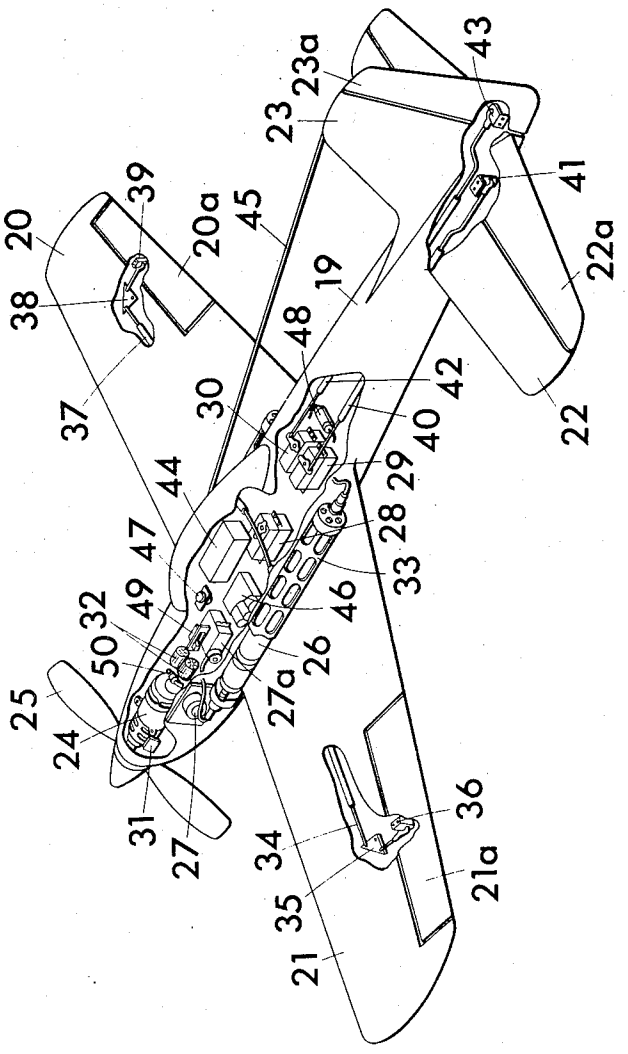
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FIG.4

BY

# ELECTRIC-POWERED MODEL AIRPLANE

This invention relates to a model airplane, and more particularly to a model airplane having an electric motor and a dry cell as an electric power source mounted thereon and adapted to fly by itself.

There have been known model airplanes which are driven either by a rubber band or an internal combustion engine. The combustion engine type model airplane is complicated in structure so that the operation and maintenance are difficult especially for children, and, moreover, is of high costs. It is also noted that the gas and oil mess when handling the internal combustion motor; there is a difficulty in starting the internal combustion motor; and when used in an alpine region, such known model airplane is often suffered from output reduction due to a change of atomospheric pressure.

In order to overcome the above-mentioned disadvantages of the known model airplanes, various investigations on electric-powered model airplane had been made by those in the art, but no electric-powered model airplane having an electric motor and an electric power source mounted thereon and adapted to fly by itself was not realized. In spite of many remarkable advantages which will possibly been obtained in comparison with an internal combustion-powered airplane, an electric-powered airplane has not been realized for such a reason that the conventionally available electric power source which has a capacity sufficient to power the electric motor for a model airplane is too large and heavy in weight to be carried by the model.

Recently there has been developed a dry cell to satisfy the requirements for use in a model airplane. Even with such new dry cell, an electric-powered model airplane could not be realized without a high quality miniature electric motor which can be driven by lower voltage and is free from a spark incurring jamming.

In addition, it is noted that the dry cell being subjected to high drain and the electric motor connected to the cell are extremely heated to place the model in a undesirable condition. Such undesirable condition can be avoided by providing a plurality of openings in a housing for the electric motor and/or case for dry cells and disposing the case or case at a position where it is exposed to air flow so that the housing and/or case may be effectively cooled.

Accordingly, one and principal object of this invention is to provide an electric-powered model airplane having an electric motor and a dry cell mounted thereon and adapted by itself.

Another object of this invention is to provide an electric-powered model airplane of the kind described, wherein the flight time can be varied by employing a rechargeable dry cell and by adjusting recharging of the dry cell.

A further object of this invention is to provide a model airplane having a rechargeable dry cell mounted thereon and adapted to simulate such a refueling operation of airplane.

A still further object of this invention is to provide a model airplane which is remotely controllable in flight time and direction.

A still further object of this invention is to provid an electric-powered model airplane without a danger of superheating and damage of the electric motor and the dry cell employed. Essentially, according to this invention, there is provided an electric-powered model airplane capable of flying by itself comprising a body; a propeller rotatably mounted on a forward portion of the body; an electric motor substantially free from a spark and having a shaft engaged with propeller shaft through gearings; a case encasing a dry cell having an electrical connection to the motor through a switch means.



The foregoing and other objects, features and advantages of this invention will be apparent to those skilled in the art from the following detailed description with reference to the accompanying drawings and appended claims.

In the accompanying drawings:

FIG. 1 is a partly cut-away side view of the forward part of a model airplane according to this invention, showing the internal structure;

FIG. 2 is a diagram showing the relation between the voltage drop of a dry cell used in this invention and the time, shown in comparison with that with respect to a conventional dry cell;

FIG. 3 is a partly cut-away side view of another embodiment of this invention, showing the internal structure; and

FIG. 4 is a partly cut-away perspective view of still further embodiment of this invention, showing the internal structure.

Referring to the drawings, there are shown model airplanes ordinarily having a body 1 composed of a frame work made of balsa and a paper or cloth attached thereto. The model body may also be made of a suitable plastic foam. An electric motor 2 is fixed to the body at an appropriate position such as a partition.

Referring now to FIG. 1 the electric motor is of such a kind that it is driven at a relatively low voltage and it has a rotor 2b with, for example, a disk-shaped condenser 2c disposed around a commutator 2a for preventing spark. Such kind of an electric motor has been disclosed in British Patent application No. 30202/69 filed on June 13, 1969. The electric motor has a shaft 2d connected to a propeller 3 directly or through gearings such as a toothed wheel 5 and the like, and a self-clutching and declutching means 5*a*. The self-clutching and declutching means serves the propeller to be connected with the electric motor when the motor is driven, and to be disconnected from the motor when the motor is stopped.

The airplane body carries at its predetermined position a case 4*a* for encasing therein a rechargeable dry cell 4 of miniature type and light weight. The dry cell 4 may be previously loaded into the case 4*a*, whereupon the case encasing therein the dry cell is fixed to a predetermined position in the body. The dry cell used according to this invention is a light and miniature type one having large short-circuit current, and is preferably rechargeable.

In order to drive, for example, a so-called single channel type model airplane of a certain size in which a rudder is controlled by a remote control system, electric power of 36 watts is required. Twenty-one conventional dry cells 3V, of VM3 size [Japanese Industrial Standards (JIS)] the total weight being about 300g, should be used to satisfy the above requirement. In multi-channel type model airplane in which a rudder, elevators and ailerons are controllable by a remote

control system, fifty conventional type dry cells of UM2 (JIS), the total weight being about 2,000g, should be used to supply the power of 150 watts which is required for operation.

In order to demonstrate the light weight of dry cells (Ni-Cd dry cell manufactured and sold by General Electric Corp. in U.S.A. which is hereinafter referred to "GE Ni-Cd dry cell") used in this invention, the investigations were conducted and the results are summarized in the following table, shown in comparison with those of conventional dry cells.

| Type of model airplane | Type of dry cell | Number of cells | Total weight of model (g.) | Weight of remote control system (g.) | Weight of cells (g.) | Weight percent of cells to the total weight (percent) |
|---|---|---|---|---|---|---|
| Single channel type | GE Ni-Cd dry cell ["⅔AA" size (ASTM)] | 6 | 500 | 150 | 78 | 16 |
| | Reclanché dry cell ("UM3" size) paper jacketed type | 21 | 735 | 150 | 315 | 43 |
| Multi-channel type | GE Ni-Cd dry cell ["Sub C" size (ASTM)] | 13 | 2,000 | 500 | 550 | 28 |
| | Reclanché dry cell ("UM2" size) paper jacketed type | 50 | 3,450 | 500 | 2,000 | 58 |
| Free flight type | GE Ni-Cd dry cell ["½AA" size (ASTM)] | 2 | 110 | 0 | 14 | 13 |
| | Reclanché dry cell ("UM3" size) paper jacketed type | 4 | 156 | 0 | 60 | 38 |

The dry cell **4** is electrically connected with the electric motor **2** through the medium of a control system such as a switch **12** or a wireless control means **10**. The dry cell is also electrically connected to a recharging terminal **18** provided in the body wall. In this connection, the dry cell is recharged to a degree sufficient to effect flying of the model airplane and then a switch **12** is turned on or a signal to close the electrical circuit is given by the wireless control system **10**. The electric motor begins to rotate and then said self-clutching means is operated to effect revolution of the propeller. As a result, the model airplane starts to fly. When the capacity in the dry cell becomes low, flight velocity drops to stop rotation of propeller and then airplane glides in the air. In the meantime a propeller is disengaged from the motor by said self-declutching means, whereby the model airplane will be smoothly landed. In case the wireless control means is employed, it is apparent that a propeller can be stopped or restarted to rotate at any desired time without a continuous flight until the dry cell will be exhausted.

Referring to FIG. **2**, the diagram shows the relation between the voltage drop of the dry cell used in this invention and the time, shown in comparison with that of the conventional dry cell, the former and the latter being designated in solid curve and dotted curve, respectively. It is clearly seen from FIG. **2** that in the dry cell used in the present invention the voltage is Kept at a substantially constant level for a relatively long time and thereupon drops, as opposed to that of the conventional dry cell of which the voltage drops rapidly at the beginning.

Modified model airplanes of this invention which are controllable by a wireless control system are illustrated in FIGS. **3** and **4**.

FIG. **3** shows a model airplane of a type in which a single channel system for remote control is employed. A switch **6** for starting an electric motor **2**, a condensor **7** for preventing the motor from sparking, a toroidal coil **8** also for prevention of sparking are connected between the electric motor **2** and a dry cell **4**. The dry cell **4** is encased in a case **4a** having a plurality of openings for heat radiation. The case is positioned at a predetermined place suitable for cooling the dry cells by air flow during the flight.

Another dry cell **9** is provided for actuating a wireless control system, which is electrically connected with radio wave receiver **10**, to which an antenna **11** is also connected for receiving control wave. The dry cell is also of a light weight and small size and is rechargeable. The receiver of a miniature and light weight type is used. The radio wave receiver **10** is also electrically connected to a switch **12** for a wireless control and an automatic control system **14** through a connector composed of a multi-terminal plug and a socket.

The automatic control system **14** has a rotary disk **14***a* adapted to be gradually rotated in both directions by the signal of the received wave. The rotary disk **14***a* is fixedly mounted on a rotary shaft **15** having a bent **15***a*. As the disk **14***a* is rotated, the bent **15***a* is caused to rotate. The bent **15a** is brought into engagement with a bent rod **17***a* provided at one end of a torque transmission rod **17** which is provided at the other end thereof with another bent rod **17***b*. A tail fin **16** of the model airplane has a rudder **16***a* hinged to the tail. The bent rod **17***b* is engaged with a projection $16a_1$ fixed to the rudder **16***a*. When the bent rod **15***a* rotates, the rudder gradually rotates about a vertical axis. A terminal **18** for recharging dry cell **4** is provided in the outer wall of the airplane body **1** and electrically connected to the dry cell.

FIG. **4** shows a model airplane of a type in which a multi-channel system for remote control is employed. The model body **19** has a right and left wings **20**, **21**, stabilizers **22** and a tail fin **23**. Both the wings **20**, **21** each have aileron **20***a* **21***a*. The stabilizers **22** each have an elevator **22***a* hinged thereto and the tail fin **23** has a rudder **23** pivotally connected thereto.

An electric motor **24** having a shaft connected to a propeller **25** is, in turn, connected to a dry cell **26** for driving the motor. The electric motor and the dry cell may be the same as is used for the single channel system of the model airplane.

A control device **27** for the revolution speed of the motor is electrically connected with the electric motor **24** and two dry cell units **26**. Numeral **27***a* designates a servo-motor. The electric motor **24** has a condenser **31** and a troidal coil **32** both for preventing jamming. Numeral **50** designates a switch for the motor. Each dry cell unit **26** is mounted on the outside of the body at a base portion of the wing. A servo-motor **28** is connected with a right-side aileron **21a** through a push rod **34**, a bell crank **35** and a horn **36**, and with a left-side aileron **20***a* through a push rod **37**, a bell crank **38** and a horn **39**. A servo-motor **29** is connected with elevators **22a** through a push rod **40** and a horn **41**. A servo-motor **30** is connected with a rudder **23***a* through a push rod **42** and a horn **43**.

The model airplane as shown in FIG. **4** is provided with a wireless control device **44**, an antenna **45**, a dry cell **46** for actuating the wireless control device **44**. The

dry cell is of the same type as shown in FIG. 3. A recharging terminal 47 and a fuse 48 are also provided.

As described, according to the present invention, a model airplane is for the first time provided which has an electric motor for driving a propeller and a specific dry cell mounted thereon, said dry cell being of a high capacity, small size and light weight and encased in a case with a plurality of openings or fins for heat radiation. The model air plane may be provided with a remote control device, if desired. Thus, the present model air plane can be simply operated and affords enjoyment to adults as well as children.

What is claimed is:

1. An electric-powered model airplane capable of flying which comprises a body; wings; a tail fin; stabilizers; a propeller rotatably mounted on the body at its forward portion, a miniature electric motor having a shaft connected to a shaft of the propeller, a case encasing a small-sized dry cell having an electrical connection to the electric motor through a switch means.

2. An electric-powered model airplane as claimed in claim 1, wherein said case is disposed in a position in which the case is exposed to air flow to cool the dry cell.

3. An electric-powered model airplane as claimed is claim 1, wherein said case is provided with a plurality of openings and/or fins, thereby enabling heat generated from the dry cell to be radiated.

4. An electric-powered model airplane as claimed in claim 1, wherein the dry cell is rechargeable.

5. An electric-powered model airplane as claimed in claim 4, further comprising recharging terminals in the wall of the body.

6. An electric-powered model airplane as claimed in claim 1, further comprising a wireless control device for controlling the switch means, a rudder of the tail fin, an aileron of the wings and/or an elevator of the stabilizers.

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