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SERVO MOTOR SYSTEM AND MECHANISM

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2 Sheets-Sheet 2

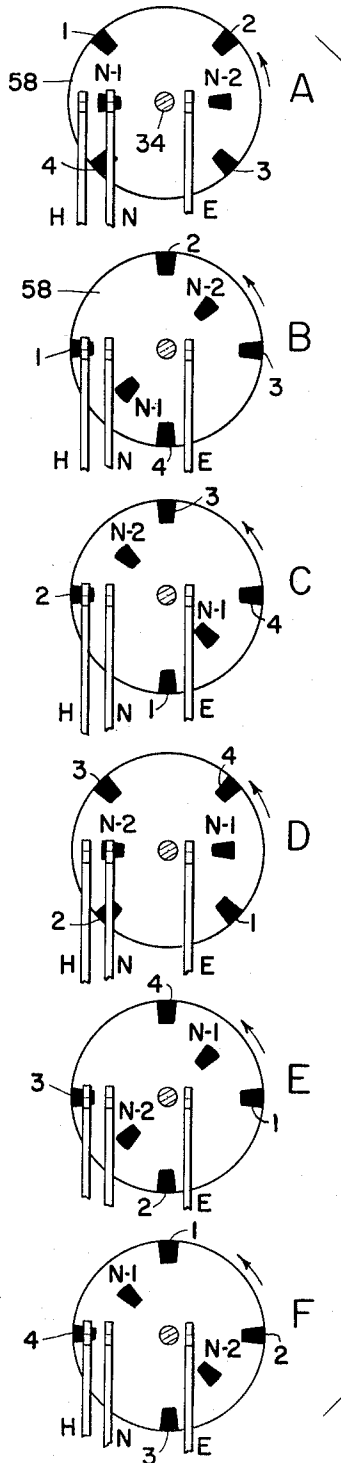


FIG. 5

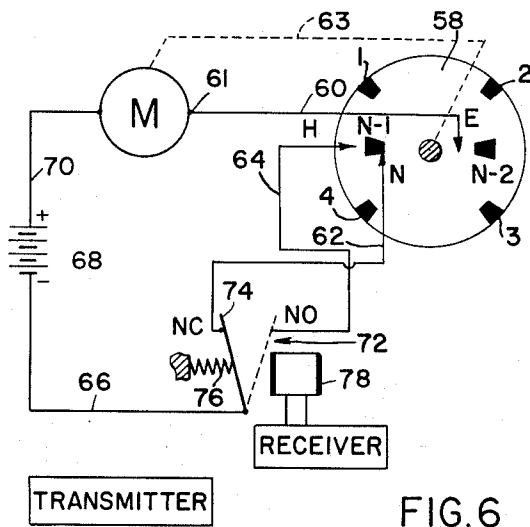


FIG. 6

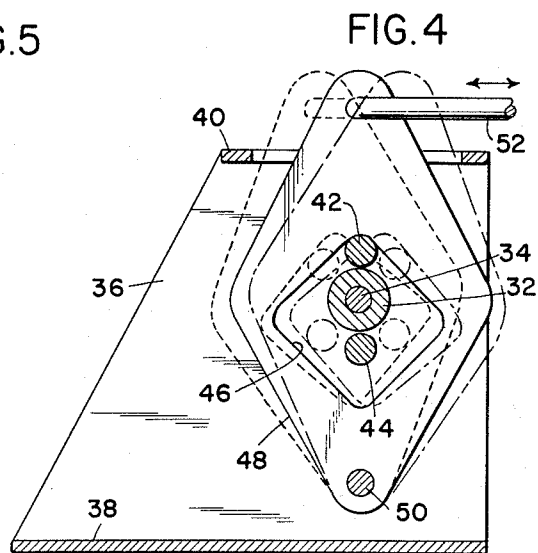


FIG. 4

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SERVO MOTOR SYSTEM AND MECHANISM
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This invention relates to servo motor mechanism for actuating a remotely controlled device, such as the rudder or other steering means or other part of a model airplane, boat or other vehicle. Known mechanisms for such purposes have been subject to various defects because too complicated and expensive, too heavy, too slow and unreliable in operation, or for other reasons.

One object of the present invention, therefore, is to provide an improved mechanism of the above character avoiding such defects.

Another object, more specifically stated, is the provision of a mechanism of this nature of a more simple, practical and inexpensive construction.

A further object is to supply such a mechanism having a minimum number of parts of simple construction and minimum weight as especially advantageous for model airplane use.

A still further object is to provide a mechanism for this purpose adapted for operation in a rapid and simple manner and with reliable performance.

To these and other ends the invention resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

FIG. 1 is a top plan view of a servo motor and associated parts embodying the present invention;

FIG. 2 is an elevation of the same as viewed from the left in FIG. 1;

FIG. 3 is a sectional elevation of parts thereof as viewed from the line 3-3 in FIG. 1;

FIG. 4 is a sectional elevation of parts thereof as viewed from the line 4-4 in FIG. 2;

FIG. 5 includes schematic elevations of switch parts shown in FIG. 3 in the several successive positions thereof, and

FIG. 6 is a diagrammatic view of the mechanism to more particularly illustrate the circuit connections of the several parts.

This invention comprises a receiver responsive to radio impulses, with a relay having switch means controlling the circuit through the battery, motor and cooperating switch contacts variably positioned by the motor. The motor includes a power take-off for actuating the device to be controlled, such as the rudder of an airplane or a boat. The relay switch serves to selectively connect in circuit the switch contacts positioned by the intermittent rotations of the motor, to actuate the control device between a neutral position and opposing positions such as left or right rudder positions. On excitation of the receiver, the control device is moved to one position, as "left rudder," as long as the excitation is continued. When the receiver is energized, and then deenergized and reenergized in rapid succession, the control device is moved to an opposite position, as to "right rudder." When the receiver is allowed to remain deenergized, the control device is returned automatically to neutral, these operations being reliably accomplished with a rapidity effected by minimum movements of the parts.

The embodiment of the invention, herein disclosed by way of illustration, preferably comprises a base plate 10, preferably of electrically insulating material, on which is fixedly mounted a small and light electric motor 12 adapted for operation by a battery in a single direction.

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The motor shaft 14 has fixed thereon a pinion 16 meshing with a gear 18 having a hub 20 fixed on a shaft 22 for rotating in bearings 24 and 26 carried by the housing of the motor. Shaft 22 has fixed thereon a pinion 28 meshing with an element or gear 30 having a hub 32 rotating on a stub spindle 34 fixed in the vertically extending portion of a bracket 36. Bracket 36 has a horizontal portion 38 mounted on base plate 10 and the vertical portion 36 has an inwardly turned top flange 40.

Gear 30 carries a pair of follower pins 42 and 44, cooperating with a substantially rectangular profile opening 46 (FIG. 4) cut in a lever plate 48 pivotally mounted at its lower end on a spindle 50 carried by the vertical bracket portion 36. The rotation of gear 30 with its follower pins serves to oscillate lever plate 48, as indicated in broken lines in FIG. 4, and the upper end of the lever plate has pivotally connected therewith a rod 52 for reciprocating movement to actuate, in any known and suitable manner, the rudder or other device to be controlled. The lever plate 48 is shown in full lines in its neutral position in FIG. 4, from which it is movable to the opposite rudder positions shown in broken lines, by rotations of the pins 42 and 44 through angles of 45° or 135°. A spring leaf 54 fixed at its lower end on a plate 56 of insulating material on base 38, has its upper end rounded and yieldably engaged with the teeth of gear 18 to serve as a detent for arresting or braking its motion.

Element or gear 30 carries a disk 58, preferably of insulating material, having its outer planar face provided with a plurality of contacts of printed circuit type. The surface of the disk may be printed with conducting and non-conducting areas, in known ways, or the disk may be surfaced with a thin sheet of copper or other conducting metal having openings formed therein to expose the insulating material to serve as insulating areas, or may be constructed in other known ways so as to provide conducting and non-conducting areas lying substantially in a planar surface as the disk is rotated by the reduction gearing from the motor. The disk is provided in a manner such as described with a plurality, preferably four, non-conducting areas, as 1, 2, 3 and 4 (FIG. 5-A), these areas being concentrically positioned in equally spaced relation with one another at the circular periphery of the disk, as shown. A pair of non-conducting areas, N-1 and N-2, are positioned concentrically on the disk and at equal radial distances from its center less than the radial distance of the areas 1, 2, 3 and 4, as shown. As the disk is intermittently rotated by the motor, these conducting and non-conducting areas are brought into cooperation with a plurality of stationary contacts which will now be described.

Each of the stationary contacts, of conducting and somewhat resilient metal, has a base portion fixed on the insulating plate 56 (FIGS. 2 and 3) its upper end being rounded to yieldably engage the respective areas of rotary disk 58. One contact, E, bears against the inner, continuously conducting area of the plate. Another contact, N, is positioned to engage the conducting area and also the non-conducting areas, N-1 and N-2, of the disk, while contact H is positioned to engage the conducting area and the non-conducting areas 1, 2, 3 and 4 of the rotary disk.

Contact E is connected by wire 60 with one terminal 61 of motor M, this contact being schematically represented in FIG. 6 as the single pole of a double throw switch engaging contacts H and N. A broken line 63 is shown to diagrammatically indicate a driving connection between motor M and the disk 58 which is rotated by the motor to control the connections between the contacts E, H and N. Contact N is connected by a wire 62 (FIG. 6) with one contact NC, of the relay switch hereafter described. Contact H is connected by wire 64 with the other contact NO of the relay switch. The single pole of the

relay switch is connected by a wire 66 (FIG. 6) with one side of an electric battery 68 having its other side connected by a wire 70 with the other terminal 71 of the motor M.

The receiver and its relay, shown conventionally in FIG. 6, preferably include a single pole, double throw switch indicated generally at 72, having its pivoted pole 74 yieldably actuated by a spring 76 for engagement with the contact NC and actuated by the relay solenoid 78 into engagement with the opposite contact NO. It is apparent from this description that in the normally closed or de-energized position of the relay switch 72, stationary contact N is connected in or disconnected from the circuit (as by switch pole E, FIG. 6) depending upon the positions of the areas of disk 58, while in the normally open or energized position of the relay switch with its pole engaging contact NO, stationary contact H is connected with or disconnected from the circuit, depending likewise upon the positions of the areas on the disk 58.

In operation, disk 58 being in the neutral position of FIG. 5-A, on receipt from the transmitter of a radio impulse, the pole 74 of the relay switch is moved by the relay solenoid into engagement with the contact NO, closing the circuit through wire 64, contact H, the conducting area of disk 58 and contact E to the motor and the battery, through wire 66, and back to the pole of the relay switch. The radio impulse being continued, the motor rotates the disk from the neutral position (FIG. 5-A) through 45° until non-conducting area 1 of the disk engages contact H, thereby opening the circuit and bringing the motor to rest, since the circuit through contact N is broken at the relay switch while it is energized. This serves to actuate the rudder to be controlled from neutral to one active position, say that of "left rudder," the position of the contacts being then as shown at FIG. 5-B.

If the impulse is then discontinued, pole 74 of the relay switch is spring actuated into engagement with contact NC, completing a circuit through contact N and disk 58 through the motor and battery as described above, starting the rotation of the motor and disk 58 which continues until the disk is moved through an angle of 135° to the second neutral position (FIG. 5-D). This restores the rudder to neutral position.

With the contacts in the left rudder position (FIG. 5-B) the receiver being rapidly deenergized and reenergized, the circuit is first established through contacts NC and N to start and rotate the motor and then changed to complete a circuit through the contacts NO and H, with the result that disk 58 rotates through 90° until non-conducting area 2 disconnects contact H, the circuit through N having been broken by disengagement at NC. This produces an actuation to "right rudder" with the contacts in the position shown at FIG. 5-C. If the receiver is then deenergized, engagement is established through contacts NC and N and disk 58 is rotated through 45° to the second neutral position as shown in FIG. 5-D.

For an actuation to right rudder position from the first neutral position (FIG. 5-A), the receiver is energized to start rotation of disk 58 and then rapidly deenergized and reenergized, with the result that the disk is rotated through 135° to the position of the contacts shown in FIG. 5-C, so long as the energization of the receiver continues. When the receiver is thereafter deenergized, the disk is rotated through 45° to neutral position.

With disk 58 in the second neutral position (FIG. 5-D) the above operations may be repeated while the disk is rotated intermittently through 180° back to the first neutral position (FIG. 5-A) actuating the rudder in the several ways described above. Such actuations of the rudder require the rotation of the disk 58 through angles of only 45°, 90°, or 135° and are all accomplished within a rotation of the disk 58 through a movement of 180° between the two neutral positions of FIG. 5-A and FIG. 5-D. To effect these movements, disk 58

is rotated as rapidly as consistent with convenient transmission of the radio impulses, so that the control device is actuated rapidly and reliably from position to position, returning automatically to a neutral position when the receiver relay is deenergized through some inadvertence.

The construction is simple and practical in construction, of a nature requiring minimum weight and operating in a precise and reliable manner.

It will thus be seen that the invention accomplishes its objects and while it has been herein disclosed by reference to the details of a preferred embodiment, it is to be understood that such disclosure is intended in an illustrative, rather than a limiting sense, as it is contemplated that various modifications in the construction and arrangement of the parts will readily occur to those skilled in the art, within the spirit of the invention and the scope of the appended claims.

I claim:

1. In a servo motor mechanism for actuating a remotely controlled device, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, an element having an electrically conducting surface provided with a plurality of spaced non-conducting areas, a plurality of contacts arranged for engagement with said surface and areas, means actuated by said motor for effecting relative intermittent movement in the same direction between said contacts and said surface, switch means operated by said relay means to selectively and alternately connect said contacts in said circuit to control said motor, and power take-off means for said motor provided with means for actuating said device in opposite directions.

2. In a servo motor mechanism for actuating a remotely controlled device, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, an electrically conducting element having a surface provided with a plurality of non-conducting areas spaced from one another at different radial distances from a common center in said surface, a plurality of contacts arranged for engagement with said areas, means actuated by said motor for effecting relative intermittent rotation in the same direction between said contacts and said surface, switch means operated by said relay means to selectively and alternately connect said contacts in said circuit to control said motor, and power take-off means for said motor provided with means for actuating said device in opposite directions.

3. In a servo motor mechanism for actuating a remotely controlled device, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, a rotary element having an electrically conducting surface provided with a plurality of non-conducting areas spaced from one another at different radial distances from the rotary axis of said element, a plurality of contacts arranged for engagement with said areas, a contact continuously engaging said surface means actuated by said motor for intermittently rotating said element in the same direction, single pole double throw switch means operated by said relay means to selectively and alternately connect said contacts in said circuit to control said motor, and power take-off means for said motor for connection with said device.

4. In a servo motor mechanism for actuating a remotely controlled device, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, a rotatable electrically conducting element in said circuit and provided with a plurality of non-conducting areas spaced from one another concentrically with said rotary element and at different radial distances from the rotary center thereof, a pair of contacts arranged for engagement with said areas, a contact continuously engaging

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said element, means having a positive driving connection with said motor for rotating said element, single pole double throw switch means operated by said relay means to selectively and alternately connect said contacts in said circuit to drive said motor intermittently in the same direction, and power take-off means for said motor for connection with said device.

5. In a servo motor mechanism for actuating a remotely controlled device, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, an element in said circuit provided with electrically conducting areas and a plurality of non-conducting areas, said non-conducting areas being spaced from one another at predetermined distances on said element, a plurality of contacts arranged for engagement in circuit with said areas, means actuated by said motor for effecting relative intermittent movement through different distances in the same direction between said contacts and said element, switch means operated by said relay means to connect said contacts in said circuit to control said motor and reduction gearing actuated by said motor for actuating said device.

6. In a servo motor mechanism for actuating a remotely controlled device, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, a rotatable element having an electrically conducting planar surface provided with a plurality of non-conducting areas lying substantially in said surface and spaced from one another concentrically with said rotary element, a pair of contacts arranged for engagement in circuit with said surface and areas, means having a positive driving connection with said motor for rotating said element through different angular distances, switch means operated by said relay means to connect said contacts in circuit with said motor to drive the same intermittently in the same direction, and power take-off means for said motor for actuating said device.

7. In a servo motor mechanism for actuating a remotely controlled device between neutral and a plurality of operating positions, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, a rotatable electrically conducting element provided with a plurality of non-conducting areas spaced from one another concentrically with said rotary element, a plurality of contacts arranged for engagement with said element and areas, means actuated by said motor for rotating said element, switch means operated by said relay means and cooperating with said element and contacts to drive said motor intermittently in the same direction, said element and contacts being arranged and relatively movable to actuate said device from neutral to one of said operating positions through a rotary angle not exceeding 45° and to another of said operating positions through a rotary angle not exceeding 135°, and power take-off means for said motor for actuating said device.

8. A servo motor mechanism as specified in claim 7 in which said element and contacts are arranged and relatively movable through a rotary angle not exceeding 90°

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to actuate said device from one of said operating positions to another thereof.

9. A servo motor mechanism as specified in claim 7 in which said element and contacts are arranged and relatively movable to actuate said device from one of said operating positions to another thereof by deenergizing and rapidly reenergizing said receiver.

10. A servo motor mechanism as specified in claim 7 in which said element and contacts are arranged and relatively movable through an angle not exceeding 135° to actuate said device from one of said operating positions to another thereof by deenergizing and rapidly reenergizing said receiver.

11. In a servo motor mechanism for actuating a remotely controlled device between neutral and two operating positions, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, a rotatable electrically conducting element provided with a plurality of non-conducting areas spaced from one another concentrically with said rotary element, with a pair of said areas spaced from one another through a rotary angle of 180° and each corresponding with the neutral position of said device and with a pair of said areas positioned on each side of each neutral area to correspond with said operating positions of said device, a pair of contacts positioned for engagement with said element, means actuated by said motor for rotating said element, switch means operated by said relay means to connect said contacts in circuit with said motor to drive the same intermittently in the same direction, and power take-off means for said motor for actuating said device.

12. In a servo motor mechanism for actuating a remotely controlled device, the combination in an electrical circuit of a receiver responsive to radio impulses and provided with relay means, a source of power, a motor, a rotatable element provided with conducting and non-conducting areas, contacts arranged for engagement with said areas, gearing actuated by said motor for rotating said element, switch means actuated by said relay means to connect said contacts in circuit with said motor, a pivoted lever provided with means for actuating said device, and cam and follower means connecting said element and lever for oscillating said lever.

13. A servo motor mechanism as specified in claim 12 in which said lever is formed internally with a cam profile and said element carries pin means coacting with said cam profile to rock said lever.

14. A servo motor mechanism as specified in claim 12 in which said areas and contacts are arranged and relatively movable for driving said motor intermittently in the same direction through predetermined rotary angles, said lever is formed internally with a cam profile, and said follower means is carried by said element for cooperation with said cam profile to rock said lever in opposite directions.

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