

[54] **REMOTE-CONTROLLED TWO-POSITION ACTUATOR**

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[51] Int. Cl. **G08b 3/10**

[58] Field of Search **340/148; 318/460; 343/225; 307/117, 133, 142; 335/68, 73**

[56] **References Cited**

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Primary Examiner—Donald J. Yusko

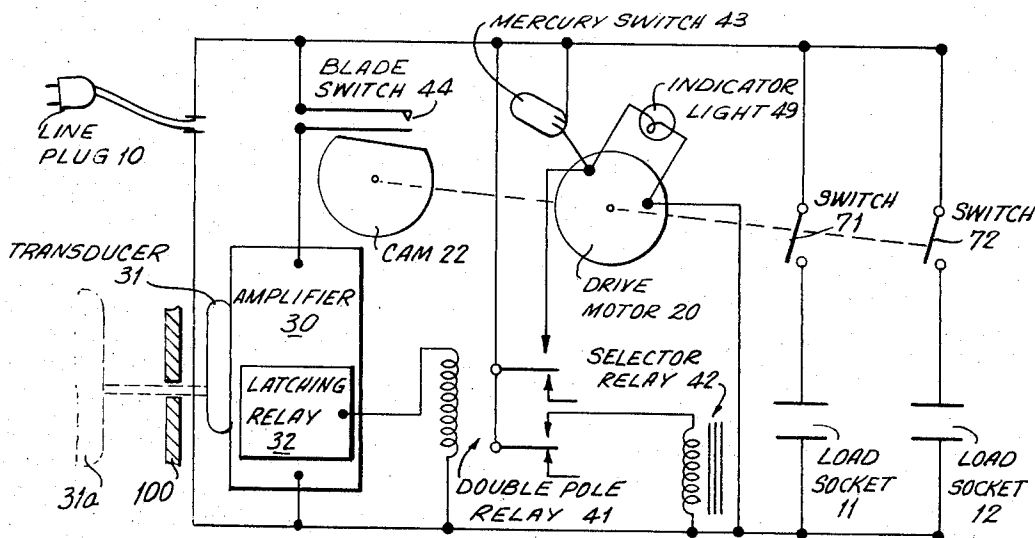
Attorney, Agent, or Firm—Lilling & Siegel

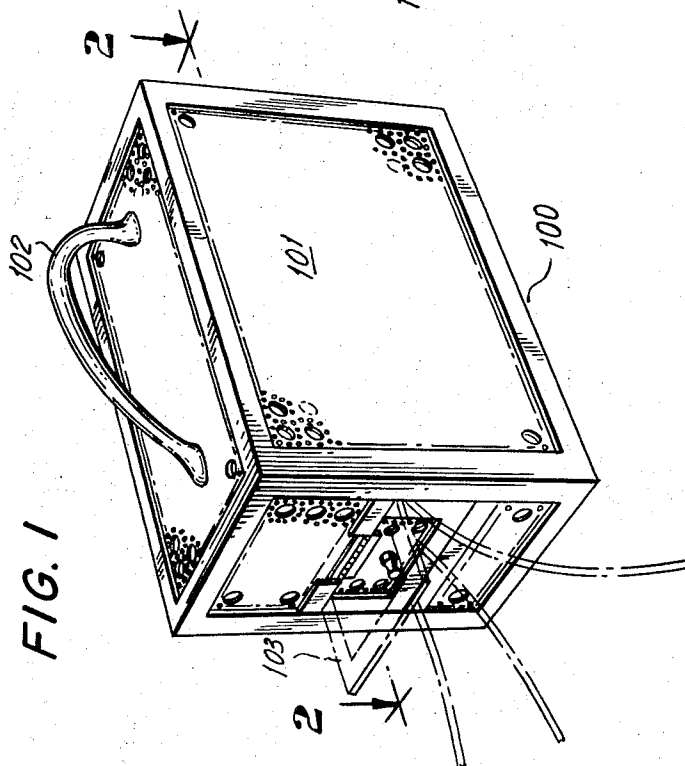
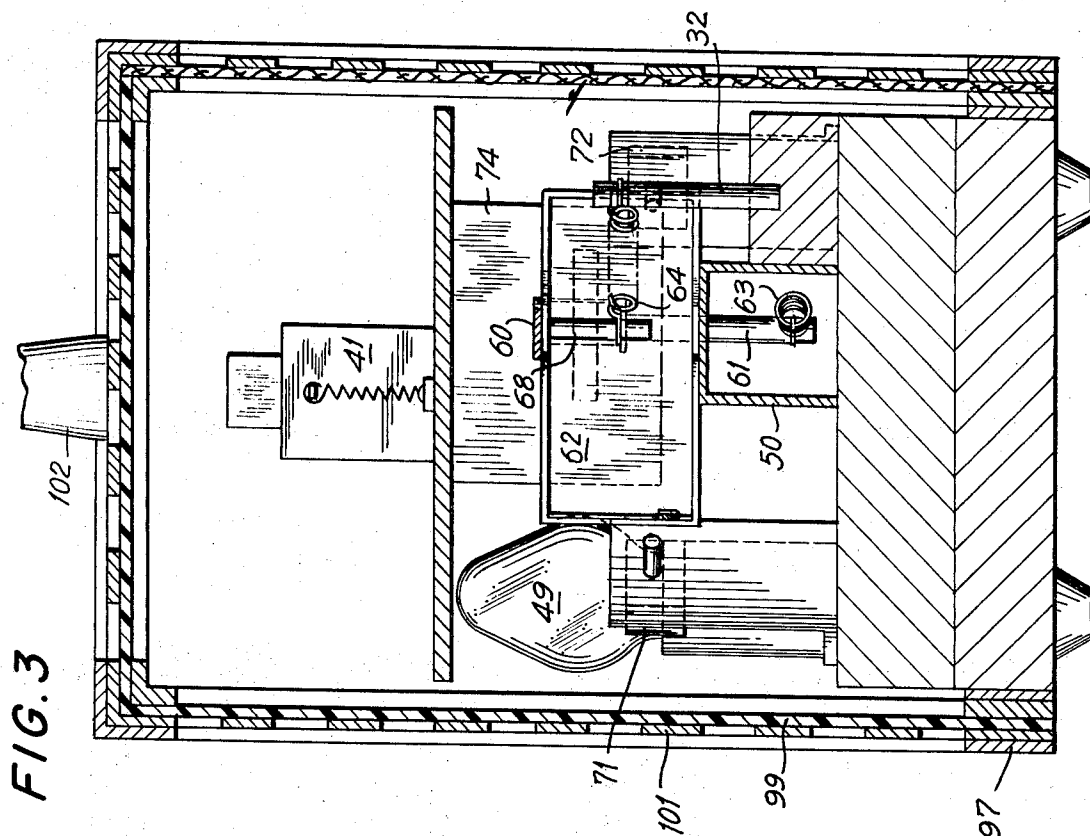
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ABSTRACT

An actuator capable of selectively breaking or making either, or both, of a pair of electrical circuits, in response to audio signals generated by a hand-held whistle, is provided with a transducer sensitive to the emitting frequency of the whistle, an amplifier for the signal generated in the transducer and a motor-driven ram, whose cycle is initiated by the transducer signal, adapted to actuate one of two maintained position switches in the aforementioned pair of electrical circuits. The ram operates the first of said switches whenever the number of audio pulses received by the transducer during its receptive period is odd, for example one; it operates the second of said switches whenever the number of such pulses is even, for example two.

10 Claims, 12 Drawing Figures





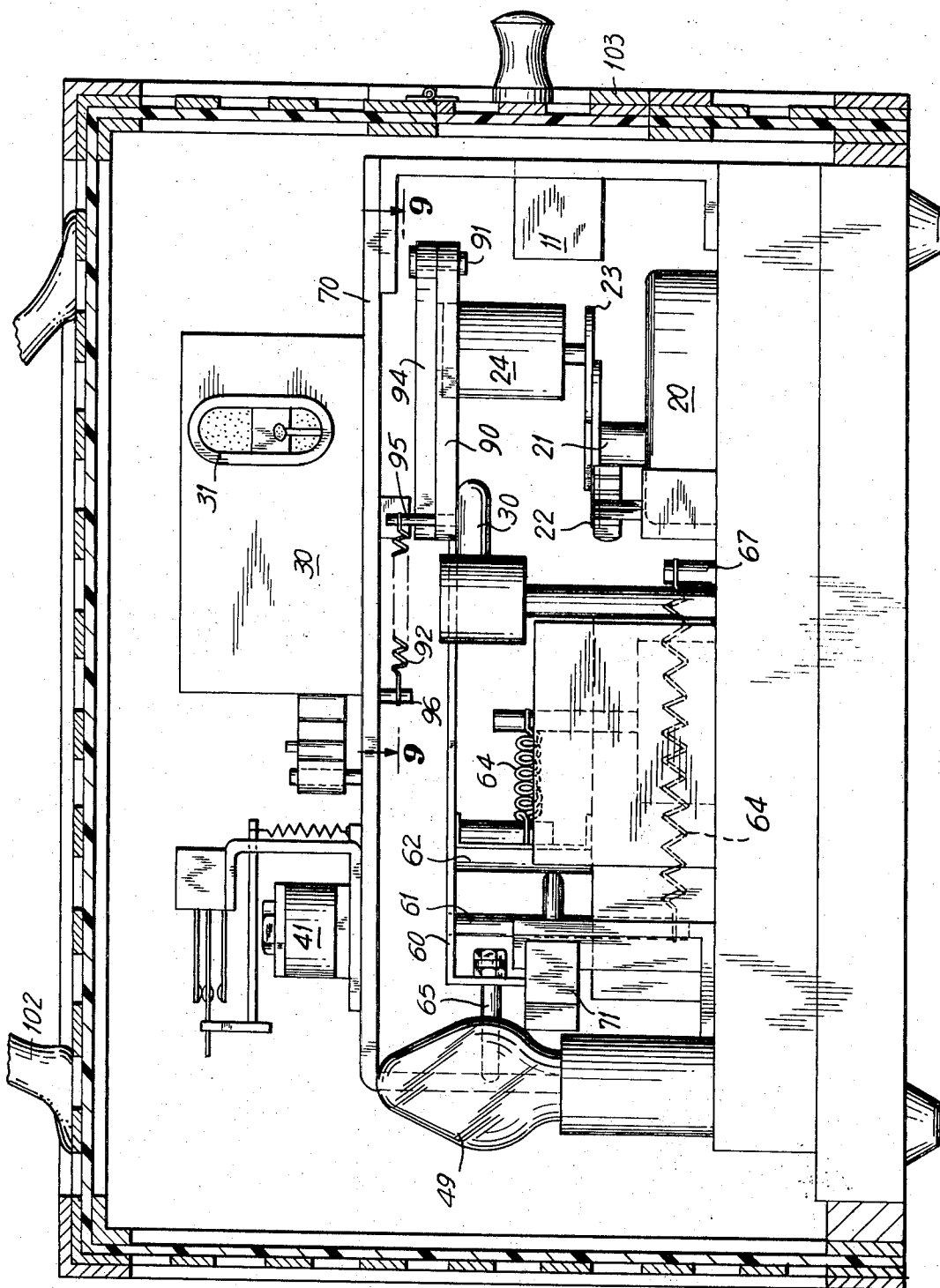


FIG. 4

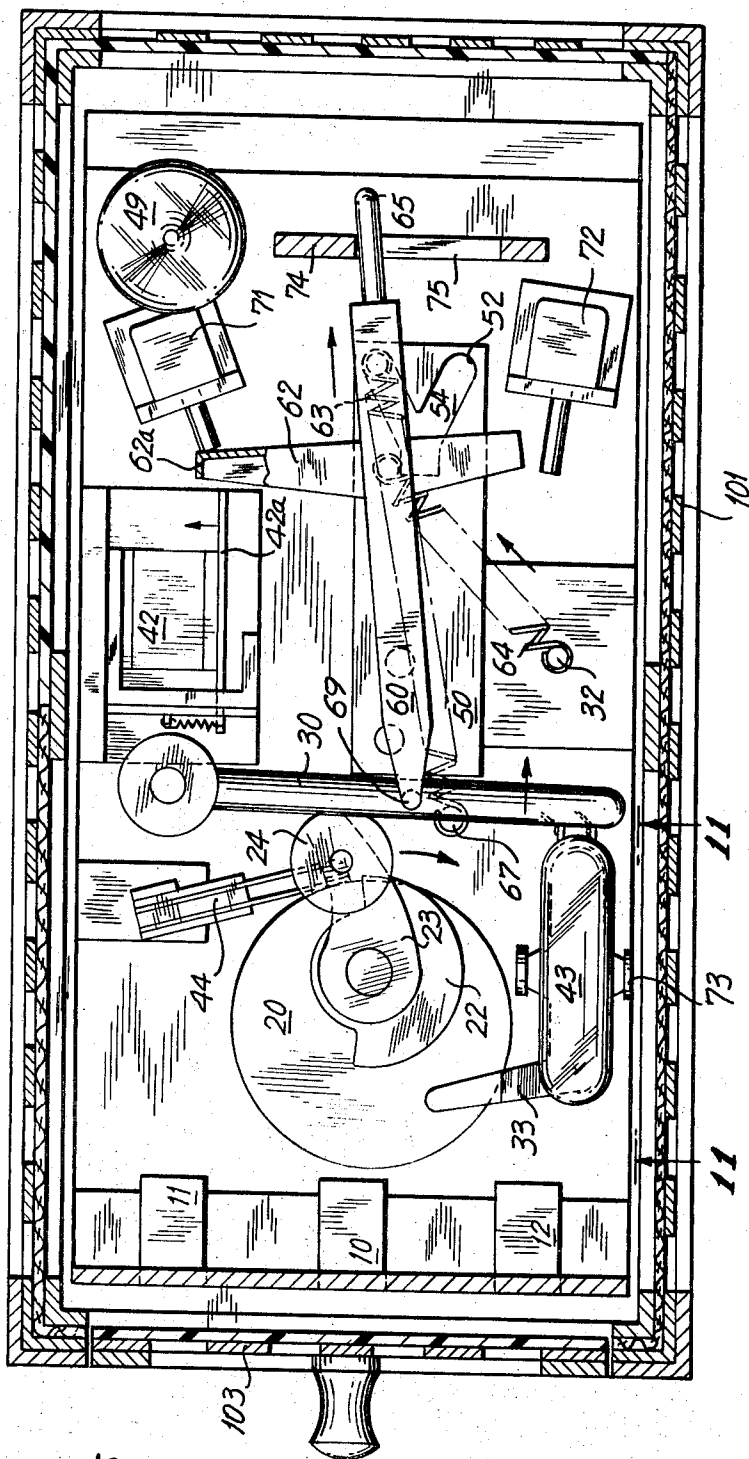


FIG. 5

FIG. 6

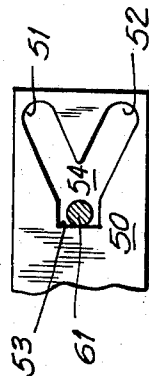


FIG. 7

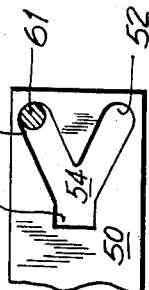


FIG. 8

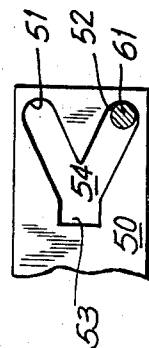


FIG. 9

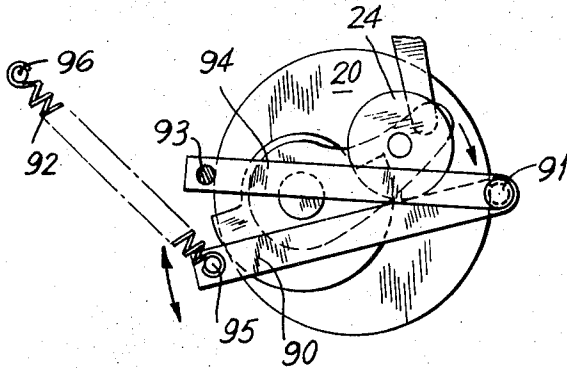


FIG. 10

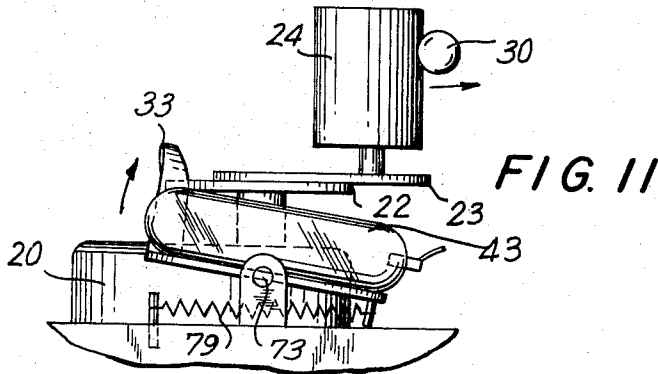
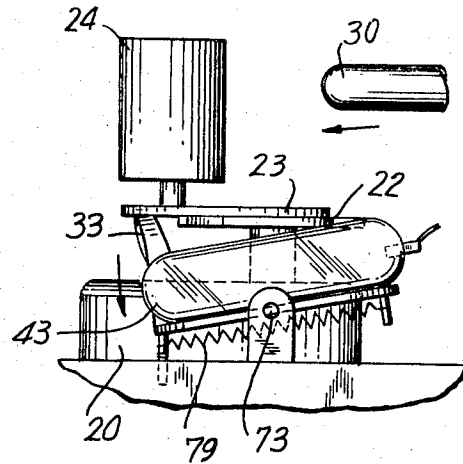
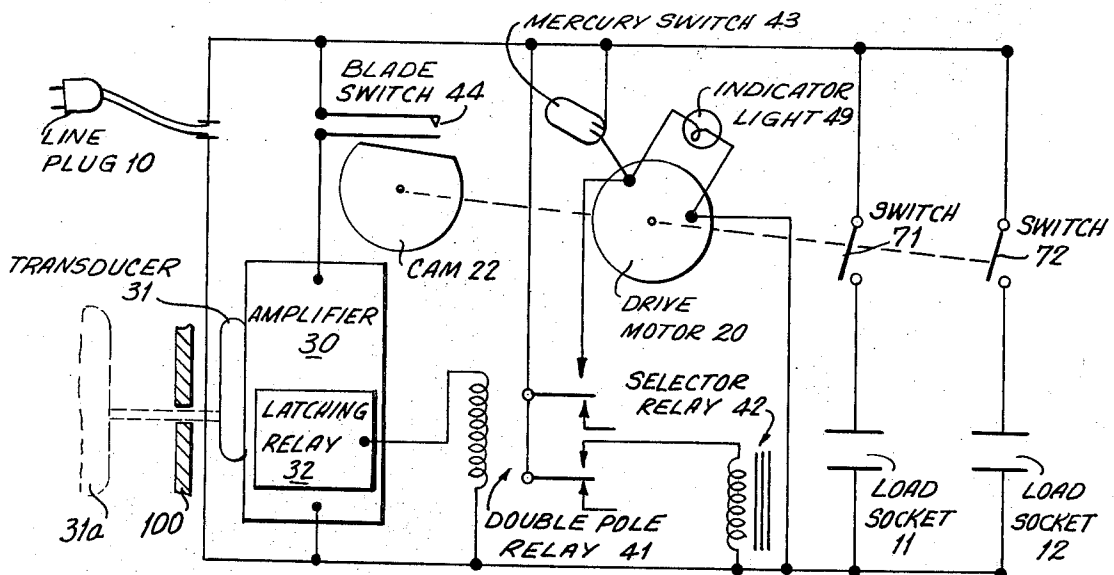


FIG. 12



REMOTE-CONTROLLED TWO-POSITION ACTUATOR

The instant invention relates to devices adapted to control equipment from a distance; more particularly, to such devices operable by means of an audio link.

The invention also relates to the class of bi-stable actuators; and more particularly to such devices in which one function is performed normally and an alternate function may be performed in the presence of a suitable control signal.

The combination of the advantages of these two classes of controllers provides the invention with considerable utility in many applications.

A convalescent or handicapped person may use such a device to control appliances — a radio and a tea-kettle, for example — without stirring from bed or wheelchair.

A workman in a factory may selectively start and stop any two pieces of equipment, while tending to a third, without the need to carry entangling umbilical connections.

It is, therefore, a primary object of the invention to teach the construction of a bi-stable remote-controlled actuator.

It is a further object of the invention to describe such constructional features in a controller with the recited characteristics as will provide for ease of manufacture and reliability in operation.

To achieve the above objectives the invention provides a sliding ram guided in a Y-shaped track in such a manner that the quiescent position of the actuator corresponds to the common leg of the Y. A motor-driven cam is also provided which, upon the activation of the actuator, causes the ram to advance into the branch of the Y. A bias spring ensures that, unless otherwise commanded, the ram shall always enter a particular branch of the guide, corresponding to the second of the controlled circuits. An electromagnetic relay, capable of overcoming the force of the bias spring, is also provided and may direct the ram into the other branch of the guide, corresponding to the first of the controlled circuits. The relay is always activated by the first control signal, emanating from a whistle for example, along with the motor. It is also arranged that a second signal from the same source, received within a short time of the first, shall turn off the aforementioned relay but not interrupt the functioning of the motor.

The controlled elements, electrical switches in the preferred embodiment, are so arranged at the ends of the alternate branches of the Y as to be tripped by the advancing ram.

By these means it is achieved that a first actuation of the signal generator shall cause the tripping of the switch in circuit 1, while two successive signals shall result in the ram advancing into the Y-branch leading to the switch of circuit 2.

The functioning of the remote-controlled, two-position actuator is described in detail with reference to the drawings illustrating the preferred embodiment.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS:

In which:

FIG. 1 is a perspective view of the remote-controlled actuator in its housing;

FIG. 2 is a section, taken along line 2—2 of FIG. 1,

of the actuator, showing its components in plan view;

FIG. 3 is a transverse section of the embodiment of FIG. 1, taken along line 3—3 of FIG. 2, showing the relative locations of the ram and the controlled switches;

FIG. 4 is a section of the preferred embodiment in elevation, taken along line 4—4 of FIG. 2;

FIG. 5 is another section plan, corresponding to FIG. 2, and showing the components of the actuator at the end of the travel of the ram;

FIGS. 6, 7 and 8 are partial views of the guide by means of which the ram is led to activate one of the two controlled switches;

FIG. 9 is a detail view, in plan, of the mechanical amplifier which stores energy during the inactive portions of the working for release as required;

FIGS. 10 and 11 are side views of the mercury switch controlling the drive motor in the on and off positions, respectively; and

FIG. 12 is a schematic of the interconnection of the several electrical control elements in the actuator.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

The preferred embodiment of the invention is shown in the perspective view of FIG. 1, with the housing 100, perforated side-plates 101 and carrying handle 102 clearly visible. Also shown is a hinged door 103 through which access is had to a power supply jack 10 and load sockets 11 and 12.

FIG. 2 is a section, in plan, through the actuator housing 100, exposing the working components of the device. The actuator receives its motive power from an electrical gear-motor 20, whose output shaft 21 carries cams 22 and 23 and a rotary cam-follower 24 pivoted on the latter. When the motor is set into motion, in a manner fully discussed below, the rotation of shaft 21 brings cam-follower 24 into contact with a swing-arm 30, pivoted on a shaft 31 fixed to the machine base, and causes a ram 60, pivoted on swing-arm 30 by means of pin 69, to move into selective engagement with the operating plunger of one of two switches 71 or 72. The switches 71 and 72 are of the push-push, maintained-position type and are directly connected to the electrical loads to be alternately activated or turned off by the remote-controlled actuator.

The ram 60 carries a pusher 62, a box-like structure mounted at right angles to the ram's direction of motion, through which the depression of the selected switch plunger is accomplished. A track-box 50, in the shape of an inverted channel is fixed to the actuator base below the ram 60 and has a Y-shaped guide 54 milled into its top surface in which a guide-pin 61, extending at a right angle from the ram 60, rides.

A return 63 and a bias spring 64 complete the mechanism by means of which the ram 60 is constrained to move in one of two alternative paths. One of these paths is represented in FIG. 8 where the ram 60 and its integral guide-pin 61 have advanced into branch 52 of the guide 54 — bringing pusher 62 into contact with the plunger of switch 72 in the process. The ultimate position of the ram is also shown, for this alternative, in the dotted outline of FIG. 2.

The other possible path, represented by the position of the guide-pin 61 in branch 51 of the guide 54, is shown in FIG. 7; FIG. 6 illustrates the position intermediate between the extremes of ram travel, when moving

either into or out of engagement, with guide-pin 61 in the common branch 53 of the Y.

Selective actuation of the switches 71 and 72 is achieved with the aid of relay 42 and its associated armature 42a, which, in its rest position, lies inside the narrow leg 62a of the box structure of the pusher 62. When the relay 42 is energized the armature 42a is pulled toward the coil pole of the relay and pulls the pusher 62 into such alignment that the guide-pin 61 is constrained to enter branch 51 of the guide 54 as the ram moves forward. It is, of course, necessary that the force exerted by the relay coil on the armature 42a exceed the bias force of the spring 64 on the ram assembly.

A further constructional element visible in FIG. 2 is the lateral guide-pin 65, attached to the forward end of the ram 60, and a slot 75 in alignment plate 74 in which the pin 65 moves. The slot 75 is horizontal and its width defines the extent of lateral travel permitted the forward end of the ram by the guide 54.

FIG. 3 is a transverse section through the actuator, taken along section-line 3—3 of FIG. 2. The track-box 50 is shown sectioned, with the guide-pin 61 extending through its surface into engagement with the return spring 43. The bias spring 64 is shown attached to an anchor 68 affixed to the ram, at one end, and to a stationary spring-pin 32 fixed in the actuator base, at the other. The switches 71 and 72 are also visible in this view, the latter partly obscured by the pusher 62.

FIG. 4 is a section in elevation, taken along line 4—4 of FIG. 2. A bracket 70 is shown, its top surface forms a mount for amplifier 30 and switching relay 41. Also shown are the motor 20, with its integral speed-reducing gear train, the cam-plates 22 and 23 on motor output shaft 21, and the follower 24 whose shaft is integral with cam 23.

FIG. 5 is a plan view, corresponding to FIG. 2. It shows the mechanism at the end of an advance stroke commanded to actuate switch 71. The motor shaft 21 has completed one half of a complete rotation and the cam-follower 24 is bearing against swing-arm 30; the selector relay 42 is energized and has pulled armature 42a into contact with the relay pole, thereby ensuring that the ram 60, in its forward motion, followed the path of branch 51 in the track-box 50.

FIG. 12 shows, schematically, the electrical control logic of the remote-controlled actuator. A line connection to jack 10 provided means for connecting the actuator to a household circuit, or other source of power and provides the electrical supply to the actuator itself and to the two load sockets 11 and 12 which power the controlled circuits. An amplifier 30, with integral sound-sensitive transducer 31 and latching relay 32 is connected to a blade-switch 44. The switch 44 is opened and closed by the cam 22 and is so arranged that power is provided to the amplifier 30 in the rest, or off, position of the actuator and during the first 160°, approximately, of the motor shaft rotation.

The internal wiring of the amplifier 30 is so arranged that upon sensing a sound signal of the appropriate frequency, as provided by a whistle for example, the signal output of the transducer 31 causes the latching relay 32 to connect, or disconnect, power from the coil of switching relay 41, and to hold that condition until another sound signal is received or the amplifier is turned off. In the latter event the latching relay moves automatically to the off position, thereby causing the

switches attached to relay 41 to switch power to the 'normally off' output terminals.

Assuming the actuator to be in the rest position, corresponding to a motor output shaft rotational angle of 0°, the amplifier 30 is powered through switch 44 and is sensitive to an external control signal; the relay 41 is not energized and none of the other components in the control circuit receive electrical power.

Upon the emission of a suitable sound signal, the internal latching relay 32 of the amplifier energizes relay 41 and causes its switching elements to move to the 'on' position and to supply power to the drive motor 20 and to the coil of selector relay 42, which, in the manner discussed above, causes the ram 60 to be biased toward operating switch 71.

As the motor shaft rotates from the 0° position, its cam 23 frees a mercury switch 43, biased toward the 'on' position by spring 79, to swing over and to connect the motor directly across the line. This ensures that regardless of the subsequent status of the relay 41 the motor will complete one revolution, corresponding to one working cycle of the actuator.

When it is desired that switch 72, rather than switch 71, be actuated in the control cycle under progress, the user will provide a second sound signal upon seeing an indicator light 49, connected across the motor windings, go on. Should the user not be in a position to see the light 49 he may instead wait a few seconds and then provide the second signal.

Upon the receipt of the second signal the latching relay 32 will cause the relay 41 to return to its 'off' condition, thereby removing power from the coil of selector relay 42 and releasing its armature 42a; the ram 60 will, thereupon, return into its normal bias toward switch 72, under the influence of spring 64.

During the initial rotation of the motor shaft from 0° to 160° no forward motion of the ram 60 is caused, the cam-follower 24 being out of contact with the swing-arm 30. This period is, therefore, available to the user to change from activating switch 71 to activating of switch 72. Should the transducer 31 receive a number of consecutive switching commands the logic will cause control to be aimed at switch 71 for all odd number of input signals and at switch 72 for all even number of signals.

At the completion of the initial 160° of shaft rotation, the cam 22 releases switch 44, thereby inactivating the amplifier 30, and cam-follower 24 engages the swing-arm 30 and advances the ram 60 into contact with the plunger of the selected control switch.

As the cam-follower 24 passes its limit of travel at a rotation of 180°, the ram follows its retreating motion under the influence of return spring 63; the cycle is completed when the cam 23 trips the mercury switch 43 into the 'off' position, at about 358°, and the motor coasts to a stop at 0°, at which point cam 22 re-engages the switch 44 and enables the unit to begin another control cycle.

To permit the use of a low powered gear-motor 20, of the type commonly provided in electric clocks and similar devices, whose available torque is insufficient to accomplish the mechanical work required in actuating the control switches 71 and 72, a mechanism has been provided which accomplishes the storage of energy in a spring 92 during the non-loades part of the cycle and the recovery of the stored energy during the phase of maximum output demand.

This mechanism is shown in FIG. 9 and consists of a scissor-link pair 90 and 94 pivoted to the frame of the actuator at 93, to each other at 91, and re-connected to the frame through spring 92, attached to link 90 at its end remote from the pivot 91. The spring is anchored to the frame at 96 and engages a pin 95 set into link 90. As the cam-follower 24 advances from its rest position it tends to push the arm 90 against the partially stretched spring 92, upon passing the maximum extension of that spring, about 100° into the working cycle, the link 90 begins to exert a positive torque upon the motor shaft 21 which reaches its maximum value as the pusher 62 moves into engagement with the appropriate switch plunger.

FIGS. 10 and 11 illustrate the 'off' and 'on' positions of the mercury switch 43, respectively. The switch 43 rocks on pivots 73 and is tilted into the 'on' position by spring 79, unless cam 23 pushes arm 33 directly connected to the switch bubble, into the 'off' position.

While the preferred embodiment of the remote-controlled actuator has been described in some detail, there are many variations in the detail design of the device which may be introduced without exceeding the scope of the invention. In the illustrated construction, for example, the housing 100 is provided with a metal frame 97 in which perforated metal panels 101 and sound insulating layers 99 of fabric-like material provide both physical protection for the internal components of the actuator and a path for the sound signals which must have access to the transducer 31, mounted internally to the housing 100. It is possible to provide an alternative arrangement in which the transducer 31 is mounted externally to a solid-sided housing, as shown in dotted outline in FIG. 12.

Many other changes in the arrangement or shape of the component parts may become apparent to one skilled in the art, once he is exposed to the teachings of the above disclosure.

I claim:

1. A bi-stable electro-mechanical actuator, comprising:
 - a bifurcated guide;
 - a sliding member engaged in said guide;
 - a pair of control elements placed at the ends of said bifurcated guide;
 - elastic bias means, urging said sliding member into preferential engagement with one branch of said guide;
 - electro-magnetic selector means, opposing said bias means, urging said sliding member into engagement with the other branch of said guide upon energization;
 - drive means for reciprocating said sliding member along said guide; and
 - governing means for setting said drive means into motion and for selectively energizing said selector means, thereby achieving actuation of one of said control elements, upon contact with said sliding member moving along one or the other of said branches as determined by energization state of said selector means.

2. The actuator defined in claim 1, wherein said drive means include an electric motor.

3. The actuator defined in claim 2, wherein said drive means further comprise at least one eccentric cam, driven by said motor and bearing upon said sliding member, and elastic return means for maintaining positive contact between said cam and the sliding member.

4. The actuator defined in claim 1, wherein said governing means include a controller whose first actuation procures starting said drive means and energization of said selector means, and whose second actuation de-energizes said selector, thereby permitting selective actuation of the control element in said other branch of the guide by a single control signal, or actuation of the control element in said one branch of the guide by a successive pair of control signals applied to said controller.

5. The actuator defined in claim 4, wherein said signals are generated by a whistle and said controller includes a transducer sensitive to sound frequency of said whistle, amplifying means for electrical signal generated in said transducer and switching means, controlled by output of said amplifying means for starting said drive means and energizing said selector means.

6. The actuator defined in claim 5, wherein said drive means include an electric motor.

7. A remote-controlled, two-position, electro-mechanical actuator, governed by electronic transducer means sensitive to audio signals at a pre-selected frequency, comprising:

- a bifurcated guide;
- a sliding member engaged in said guide;
- a pair of control elements placed at the ends of said bifurcated guide;
- elastic bias means, urging said sliding member into preferential engagement with one branch of said guide;
- an electro-magnetic relay acting on said sliding member and urging it into engagement with the other branch of said guide upon energization, in opposition to said bias means;
- drive means, powered by an electric motor, for reciprocating said sliding member along said guide; and
- switching means, governed by said transducer means, for setting said electric motor into motion and selectively energizing said electro-magnetic relay, thereby achieving actuation of one of said control elements by the sliding member moving along one or the other of said branches as determined by the energization state of the relay.

8. The actuator defined in claim 7, wherein said control elements are electrical switches.

9. The actuator defined in claim 8, wherein said switches are of the maintained position type.

10. The actuator defined in claim 7, wherein said switching means include a latching relay, which, upon receipt of a first audio signal by said transducer means starts said electric motor and energizes said relay, and upon receipt of a second audio signal by said transducer means de-energizes said relay.

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