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ELECTRICAL RELAY WITH CONTACT MULTIPLYING MOVEMENT

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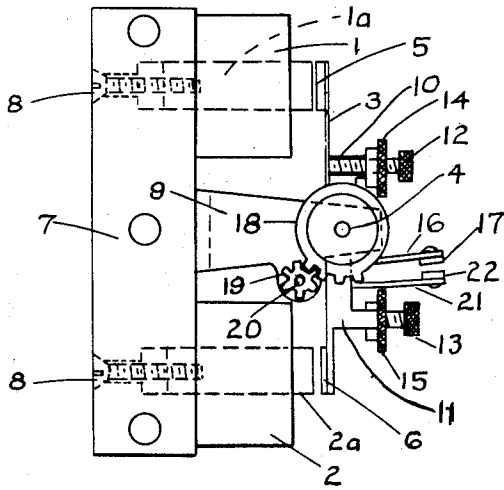


Fig. 1.

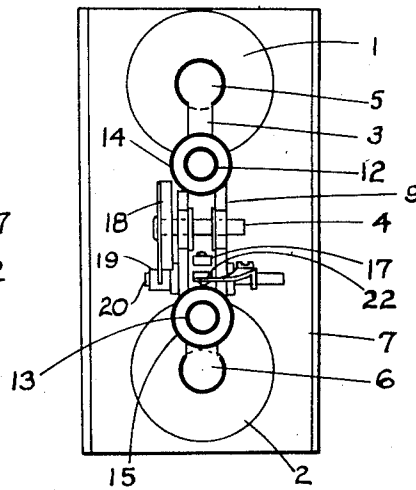


Fig. 2.

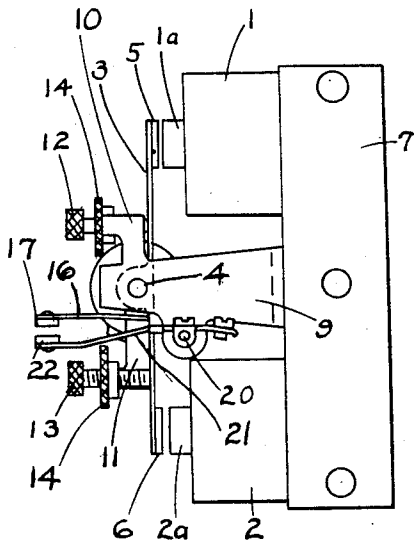


Fig. 3.

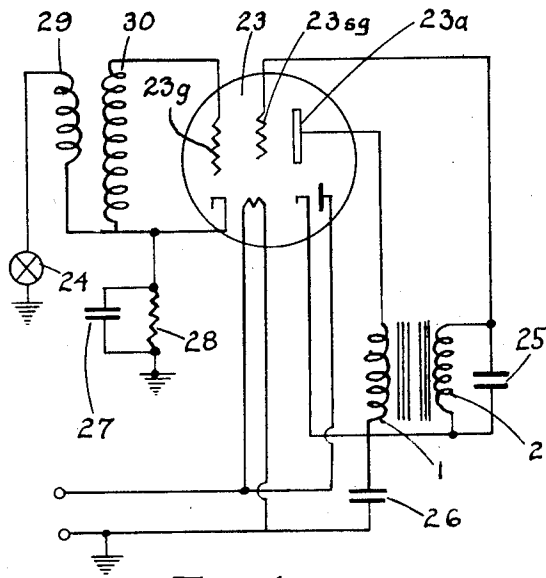


Fig. 4.

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2,491,265

ELECTRICAL RELAY WITH CONTACT
MULTIPLYING MOVEMENT

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563,281. Divided and this application February
7, 1946, Serial No. 646,045

4 Claims. (Cl. 200—87)

1

The present invention relates to electrical circuit controlling devices of the type commonly known as relays, and is a division of my original application Serial No. 563,281, filed November 13, 1944, for an Electronic relay control circuit.

The device of the present application has for its object to provide a relay of novel form and particularly adapted for use in connection with a thermionic vacuum tube circuit, to the extent that the actuating coils of the relay are included in and form part of the tube circuit. Other and further objects of the invention are to provide a relay of extreme sensitivity, requiring no springs or mechanical bias, and free from mechanical resonance effects and chatter.

The relay of the present application is characterized by a fast make and break, with relatively wide separation between the current carrying parts, and in which the actuating armature is extremely stable and relatively insensitive to jarring in either open or closed position, of the relay contacts. The improved relay is further characterized by a wide range of adjustment to meet various operating conditions.

The above and other advantageous features of the invention will hereinafter more fully appear from the following description with reference to the accompanying drawings, in which:

Fig. 1 is a side view of a relay embodying the invention.

Fig. 2 is a view in front elevation of the relay shown in Fig. 1.

Fig. 3 is a side view similar to Fig. 1, as viewed from the opposite side.

Fig. 4 is a circuit diagram illustrating one use of the relay.

Referring first to Figs. 1 and 2, the relay consists of separate coils 1 and 2 which constitute the energizing windings for relay armature 3, which may be in the form of a rockable bar pivoted at its center as at 4, and carrying at its opposite ends pole pieces of magnetic material 5 and 6 adapted to be attracted by coils 1 and 2, respectively. The relay itself is mounted upon a suitable base 7, upon which are directly mounted coils 1 and 2, and each of these coils is provided with a core of magnetic material.

Preferably, suitable means are provided for adjusting either or both of cores 1a and 2a longitudinally of coils 1 and 2, and one form which such adjustment may take is indicated in Fig. 1, in which there is shown a screw 8 freely received within a hole in base 7, and threaded within core 1a or 2a in such a manner that as the screw 8

2

is rotated the corresponding core moves longitudinally within the coil 1 or 2.

The armature 3 is carried by a bifurcated fulcrum bracket 9, which may have outwardly extending arms 10 and 11, these arms carrying set screws 12 and 13, and lock nuts 14 and 15, by means of which the rotational movement of armature 3 on its shaft or pivot 4 may be very closely adjusted between limits. Fixed to armature 3 is an arm 16 extending outwardly therefrom, this arm carrying at its outer extremity a contact 17. It will be seen that as armature 3 rocks on its pivot 4, arm 16 will be carried thereby, and contact 17 will describe an arc about point pivot 4.

Likewise, secured to pivot 4 and thereby to armature 3 there is provided a relatively large gear 18, this gear engaging a small pinion 19 secured to a shaft 20, mounted for rotation in the bifurcated bracket 9. This shaft 20 carries an outwardly extending arm 21 provided at its end with a contact 22 adapted to engage with contact 17. It will be understood that with this construction both contacts 17 and 22 are movable, and if Fig. 1 is considered as showing the position of the relay with armature 3 at the full extent of its counter-clockwise movement, then as the armature moves clockwise, contact 17 will swing in an arc clockwise about pivot 4 and contact 22 will swing in an arc counter-clockwise about pivot 20, and the motion of contact 22 will be in excess of the motion of contact 17 in the ratio of the number of teeth on gear 18 to the number of teeth on pinion 19.

Thus, a relatively large movement occurs between contacts 17 and 22, with a relatively small movement of the armature 3, and this may be in the ratio of the order of 5 to 1; that is to say, it is a relatively simple matter to provide a motion of $\frac{1}{10}$ " between contacts 17 and 22 with a motion of only $\frac{2}{100}$ " between pole piece 5 and core 1a.

When using the relay with the tube 23 shown in Fig. 4, the tube 23 is operated rather differently than in conventional practice. The constants are so chosen that under normal conditions; i. e., with no sounds falling upon the microphone 24, a considerable plate current is drawn, which flows through coil 1, and this current under usual conditions may be as much as 20 milliamperes.

The voltage applied to screen 23g is made approximately the same as that upon plate 23a, but the screen current under such conditions is relatively low, and may be of the order of not more than 2 milliamperes. This may be achieved by adjustment of condenser 25, which may be of the order of 20 microfarads, and condensers 26

and 27, which may be of the same order, and by selection of the value of resistor 28, which may be of the order of 100 ohms. Condensers 25, 26 and 27 may be made variable if desired, although for economy fixed condensers may be used.

Inductances, as represented by relay coils 1 and 2, are not critical but should be of high impedance and of the order of the internal impedance of the tube in the circuits in which they are connected. Very satisfactory results have been obtained with coils having an inductance of 12 henries, D. C. resistance of 5,110 ohms, wound with 21,000 turns of #42 wire. Under such conditions the relay will remain in the condition shown in Fig. 1; i. e., with the contacts 17 and 22 open to the full extent of their swing.

If, now, noise or sounds impinge on the microphone 24, as will be understood, they produce an alternating or fluctuating voltage, and this is impressed through the transformer windings 29 and 30 upon the input electrodes of tube 23. When this occurs, the direct plate current drawn by anode 23a sharply decreases and may under certain conditions decrease almost or to zero, while simultaneously the direct current drawn by screen grid 23sg increases many times; for instance, to 10 or more milliamperes.

The result of this is that the pull of coil 1 on pole piece 5 decreases to little or nothing, whereas the pull of coil 2 upon pole piece 6 sharply increases, and the relay closes with an extremely rapid action. Since there is no spring associated with the armature as in conventional relays, no substantial mechanical resonance effects are encountered as in ordinary relays, and there is little or no tendency to bounce, chatter, and arc.

As long as the microphone continues to pick up sustained sounds, the relay will remain with its contacts in closed position since the plate current through coil 1 remains very small and the screen grid current through coil 2 remains relatively large. When the microphone ceases to pick up sounds, the circuit reverts to former conditions; that is, the control electrode 23g returns to its normal potential, the screen current through coil 2 drops to a very small value, the plate current through coil 1 returns to its normal value, and this action likewise takes place very rapidly, the relay then returning very quickly to open position.

Since in either open or closed position the relay contacts 17 and 22 are held at one extremity or the other of their movement by flow of current in either coil 1 or coil 2, and no spring action is involved, the relay is extremely insensitive to mechanical jars and vibration and thus is relatively free from spurious openings or closings to which conventional relays are quite sensitive.

A particular advantage of the arrangement of Fig. 4 is that the relay is substantially independent of fluctuations in the supply voltage, since both the screen and plate circuits are affected to the same degree by any change in supply voltage. The value of current in coils 1 and 2 may vary widely with different tubes or even the same tube under different operating conditions, provided coils 1 and 2 are properly designed to carry the maximum current without damage. Likewise, various sizes of contact points may be employed and the speed of make and break may be so regulated as to provide the desired action for any particular type and kind of contact employed.

While for purposes of illustration the above described differential operation of the relay coils

1 and 2 has been with reference to the making and breaking of a circuit through contacts 17 and 22, it is clear that the movement of the armature 3 about its pivot 4 may as readily be employed to perform a purely mechanical function, as by actuating a lever or link forming part of an associated mechanism not necessarily concerned with the flow of electrical current. For instance, the movements of the armature 3 in response to impulses received from the microphone might be readily employed to control the operation or non-operation of a clockwork mechanism of an alarm device.

Also, I have applied my invention in the operation of toys and novelties. An example of this is a flag-raising toy wherein the relay contacts are in series with the circuit of a ratchet motor operating the halyards of a small flag attached to a flagpole at the top of a miniature fort. By properly adjusting the constants and voltages of the tube, singing or whistling reveille or other desired music may be made to cause the raising of the flag.

Another application which I have made is the control of a dancing figure in time with music. In this instance there may be provided an articulated mannequin having a solenoid having its core arranged and attached to the jointed arms and legs so as to deliver a pull to them when the relay is closed. With such an arrangement, pick-up by the microphone of music being played or sung will cause the mannequin to dance in time with the music.

While my invention is of particular utility in providing for operation of a relay in response to rapidly fluctuating or pulsating impulses, it will also be of considerable utility where steady biasing voltages are used for relay operation, because of its sensitivity, freedom from chatter and arcing, and insensitivity to jars.

I claim:

1. In a relay, in combination, a pivoted armature, an arm extending therefrom carrying a contact, a gear secured to said armature, a second arm mounted for rotation toward and away from the first mentioned arm and carrying a contact adapted to engage the first mentioned contact, and a pinion secured to said second arm meshing with said gear.

2. In a relay, in combination, a pivoted armature, magnetic means for moving said armature, a first contact-carrying arm mounted upon and movable with said armature, a second contact-carrying arm mounted adjacent said armature for movement toward and away from said first arm thereby to close and open said contacts, and motion-multiplying means connected to said second arm and actuated by said armature.

3. In a relay, in combination, a pair of electromagnets, an armature pivotally mounted between and disposed in magnetic relation with said electromagnets, a first contact-carrying arm mounted upon and movable with said armature, a second contact-carrying arm mounted adjacent said armature for movement toward and away from said first arm thereby to close and open said contacts, and motion-multiplying means connected to said second arm and actuated by said armature.

4. In a relay, in combination, a pair of electromagnets, an armature pivotally mounted between and disposed in magnetic relation with said electromagnets, a first contact-carrying arm mounted upon and movable with said armature, a second contact-carrying arm mounted adjacent said armature for movement toward and away from

5

said first arm thereby to close and open said contacts, a first gear secured to said second arm, and a second gear secured to said armature and meshing with said first gear thereby to actuate said second arm in response to movements of said armature.

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REFERENCES CITED

The following references are of record in the file of this patent:

6

UNITED STATES PATENTS

Number	Name	Date
273,728	Hamilton	Mar. 13, 1883
329,808	Bruns	Nov. 3, 1885
384,323	Mallett	June 12, 1888
626,606	Gallegos	June 6, 1899
754,689	Pearne et al.	Mar. 15, 1904
1,302,284	Beall	Apr. 29, 1919
1,748,917	Leake	Feb. 25, 1930
1,954,365	Reich	Apr. 10, 1934
2,092,560	Runaldue	Sept. 7, 1937