Feb. 28, 1939. R. E. DE LAND 2,148,732

ELECTRIC SWITCH

Filed March 18, 1937

Fig. 1

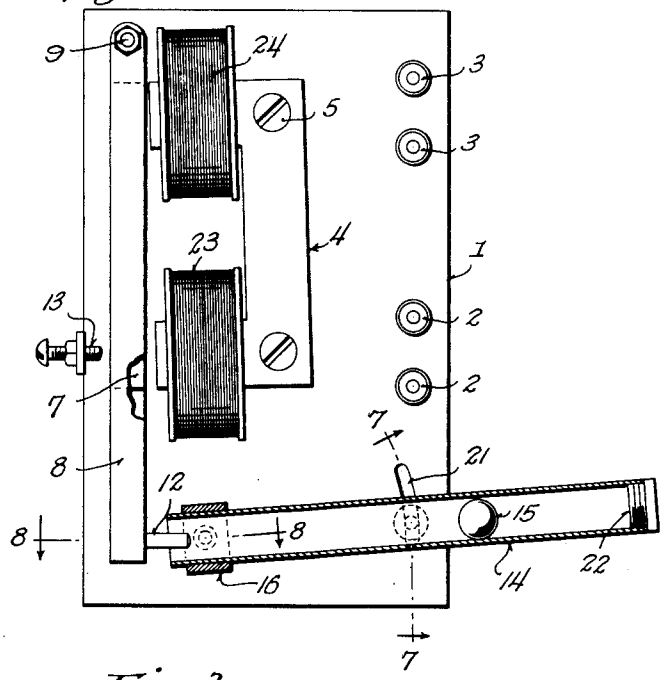


Fig. 2

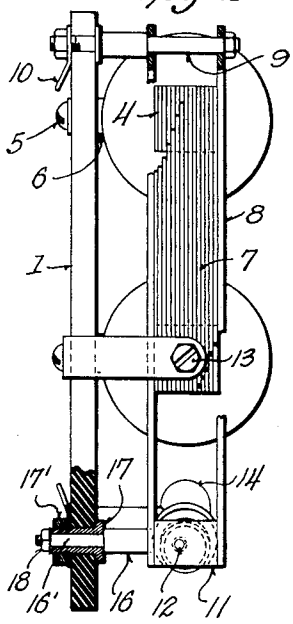


Fig. 3

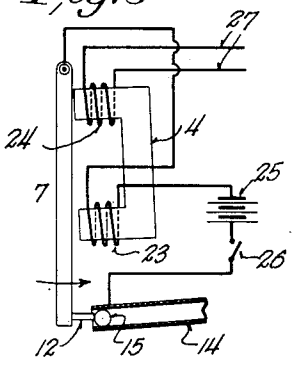


Fig. 4

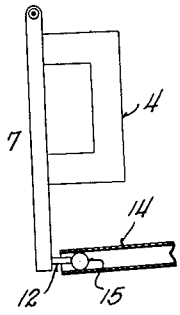


Fig. 5

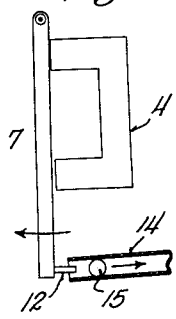


Fig. 6

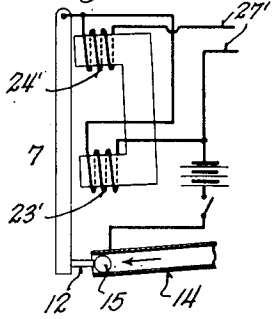


Fig. 7

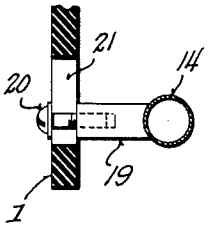
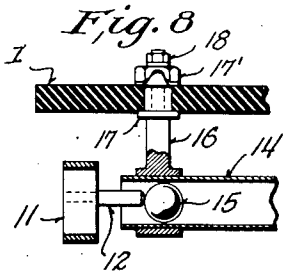


Fig. 8



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ELECTRIC SWITCH

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Application March 18, 1937, Serial No. 131,595

8 Claims. (Cl. 175—365)

This invention relates to electric switches.

Objects of this invention are to provide a novel form of automatic electric switch which is so made that it gives an intermittent impulse which may be of any desired voltage, such as a relatively high voltage for flashing a neon light, for charging a cattle restraining wire or fence, for operating an intermittent highway signal, or for any other purpose where an intermittent electrical impulse is desired.

Further objects of this invention are to provide an automatic intermittent electric switch which is adapted for actuation from any source of power with a minimum consumption of energy, the construction being such that if desired the switch may be operated from a battery or other source of energy and will make a very small demand for energy from the source so that if a battery is used, a very long life thereof is obtained.

Further objects are to provide a construction which avoids the use of expensive contacts but instead in which the moving member itself may constitute one of the contacting elements, the member presenting different portions for contact and thus preventing pitting.

Further objects are to provide a construction in which the time between successive impulses may be varied so that a very slowly repeated impulse may be provided or one that repeats in a very short interval, or any intermediate rate that may be desired.

Further objects are to provide a construction in which the device is provided with a primary winding and a secondary winding either in the form of a distinct secondary or as an autotransformer in which the primary aids the secondary, and in which provision is made for securing a quick break in the electrical circuit and also simultaneously increasing the reluctance of the magnetic circuit, thereby getting an extremely rapid rate of decay of the magnetic flux and thus generating a secondary impulse of very high value, the construction also providing for the decreasing of the magnetic reluctance of the magnetic circuit at the same time that the current is building up in the primary.

Further objects are to provide a construction which has a very long life and in which the parts are not subject to any material wear but are very lightly mechanically loaded, on the one hand, and are caused to operate with the minimum friction or loss of mechanical power, and in which a construction of extreme simplicity is obtained that may be cheaply manufactured and may be readily adjusted even by an unskilled person.

An embodiment of the invention is shown in the accompanying drawing, in which:

Figure 1 is a front view of the device, with parts broken away and parts in section.

Figure 2 is a side elevation thereof, with parts broken away and parts in section.

Figure 3 is a view showing the device as the armature is moving towards the core.

Figure 4 shows the position of the parts at the instant the armature contacts with the core.

Figure 5 is a view of the parts at an instant after they have arrived at the position shown in Figure 4, and after the electric circuit has been broken and while the reluctance of the magnetic circuit is being rapidly increased.

Figure 6 is a view showing the position of the parts when the traveling member has struck and moved the armature portion of the apparatus rearwardly a slight amount.

Figure 7 is a sectional view on the line 7—7 of Figure 1.

Figure 8 is a sectional view on the line 8—8 of Figure 1.

Referring to the drawing, it will be seen that the device may be carried upon an insulating body portion or back plate 1 provided with primary terminals 2 and secondary terminals 3. A magnet core, preferably U-shaped, is indicated at 4 and is formed of laminated magnetic material. This core is rigidly secured to the back plate 1 in any suitable manner, as by means of screws 5 passing through spacers 6.

An armature 7 formed of laminated magnetic material is provided. Preferably the armature includes the relatively heavier side plates 8 which may be of magnetic or non-magnetic material, the latter for example, such as brass for instance, or any other suitable material.

These side plates are continued upwardly and are pivoted in any suitable manner, as for example by means of the pivot pin 9 rigidly secured to the base and provided with a terminal lug 10, or any other suitable means whereby an electrical connection may be made. The side plates 8 continue downwardly and are provided with a lower block 11 to which a forwardly projecting metal pin 12 is rigidly secured. An adjustable stop 13, see Figure 1, may be provided to limit the rearward swinging motion of the armature, normally the armature hanging vertically as shown in Figure 1.

A metal tube 14 is pivotally mounted in any suitable manner and houses a metal ball 15, pref-

erably a hardened steel ball. The tube may be pivoted in any suitable manner. For example, it may be carried in a holder 16 provided with a shouldered portion, a reduced extension 16' terminating in a threaded portion, see Figures 2 and 8. The reduced extension passes through a metal bushing 17 which is locked in place by the nut 17', as shown particularly in Figure 2. A nut 18 may be screwed upon the threaded extension of the holder 16 as shown. Any other suitable means may be employed for pivotally holding the tube.

It is intended that the back plate 1 be mounted in a vertical position and that the tube slant downwardly towards the pivot point thereof. The exact angle at which the tube is set may be adjusted to have either a rapid periodic impulse provided, by having a relatively steep slant of the tube, or having a very slow impulse provided by the apparatus by having a relatively slow or gradual slant of the tube downwardly towards the pivot point.

Any suitable means for securing the adjustment may be provided. For example, the tube 14 may be provided with a laterally projecting standard 19, see Figure 7, which receives the screw 20 threaded thereinto and passing through the arcuate slot 21 formed in the insulating body portion 1 so that the screw may be loosened and the tube 14 adjusted to the exact angle desired to secure the desired interval between successive impulses. The tube is provided with a closure 22 at its outer end, as shown in Figure 1.

The electrical circuit comprises a primary winding 23 preferably wound on the lower leg of the core 4 as shown diagrammatically in Figure 3, and a secondary 24 wound on the upper leg of the core 4. If desired, the secondary may be entirely distinct from the primary and may comprise a large number of turns of fine wire. This separate and distinct secondary is shown in Figure 3.

The primary may be energized from a battery 25 and if desired a switch 26 may be provided for interrupting the battery circuit when it is desired to stop the operation of the apparatus. One side of the primary is connected directly to the battery; the other side of the primary is connected directly through the armature to the combined contact and striking pin 12. The other side of the battery is connected to the metal tube 14. Thus it is apparent that when the ball 15 is in the position shown in Figures 3, 4, 6 and 8 the circuit through the primary is closed. When the ball moves outwardly under the impulse of the blow struck by the armature through the medium of the pin 12, for example when the ball occupies the position shown in Figures 1 and 5, the primary circuit is open.

The secondary is connected by means of high voltage or impulse distributing lines 27 to the apparatus which is actuated by these impulses. For example if a neon light or other light of this order is to be lighted intermittently, the secondary will be a large number of turns of fine wire. The same general construction would be employed if a cattle restraining wire or fence was to be intermittently energized. Obviously the device is not confined to the generation of high tension impulses for if low voltage impulses were desired, obviously they could be readily supplied by providing a smaller number of turns on the secondary. In this case the secondary obviously would be wound with larger wire to reduce the resistance.

An autotransformer action may be employed if desired to add the voltage generated in the primary at the instant of opening the circuit to that generated in the secondary. For example as shown in Figure 6, the primary 23' is so connected to the secondary 24' that an adding of the voltages is obtained. Otherwise the construction in Figure 6 is the same as that shown in Figure 3. The high tension leads or impulse conducting leads are indicated by the reference character 27'.

In Figures 4 and 5 the winding has been omitted to simplify the figures as these were shown merely to show the relative position of the parts at different instants in the operation of the device.

The operation of the apparatus is as follows:

When the ball rolls downwardly in the tube and strikes the member 12, the electric circuit through the primary is closed. The momentum of the ball will carry the armature rearwardly a slight distance to the position shown in Figure 6 for instance, the stop—not shown in Figure 6, limiting the rearward stroke of the armature. Thereafter the armature moves inwardly, as indicated in Figure 3, driving the ball forwardly until the armature actually strikes the pole faces of the core 4 as shown in Figure 4. At this instant the ball has its maximum forward speed but has not left the member 12. It immediately leaves the member, however, and the armature starts away from the pole faces, the rearward motion of the armature being also assisted by the rebound action. A very brief instant later the parts occupy the position shown diagrammatically in Figure 5, the armature moving away from the core and the ball continuing its travel up the slanting tube 14.

It is apparent, therefore, that when the electrical circuit is broken and the magnetic flux quickly decays, that this decay is hastened due to the mechanical motion of the armature away from the pole faces, thus introducing an air gap in the magnetic circuit and rapidly increasing the reluctance of the magnetic circuit. This causes an abrupt drop in the magnetic flux and consequently generates a high voltage in the secondary considerably higher than would be obtained merely from the breaking of the electrical circuit without altering the reluctance of the magnetic circuit.

In order to prevent pitting of the ball after a long period of use, it is to be noted, particularly with reference to Figure 2, that the pin 12 has been set off center so that the ball will be slightly turned at each power stroke and will thus present a different face for its contact area. Additionally there is a slight scraping action between the ball and the pin 12 in their successive relative positions while the ball is in contact with the pin.

It will be seen that a novel form of automatic switch has been provided which produces an extremely rapid decay in the magnetic flux due to the quick break of the electric circuit coupled with a quick change in the reluctance of the magnetic path as the magnetic path consists substantially solely of magnetic material, and at the instant the electrical circuit is broken an air gap is formed in the magnetic path. Thus not only the breaking of the electric circuit but also the mechanical motion of parts of the apparatus assists in the production of a very high secondary impulse.

The device consists of a very small number

of relatively rugged and easily produced parts. It is cheap to construct and is substantially foolproof. It may be carried in a sealed container or in any other way to afford the requisite protection and will insure a long life for the battery, if it is battery operated.

Obviously the device may be employed where access to other sources of power is practically prohibitive. It also may be operated from any other source of power desired where such is available. It has a wide variety of uses and it is intended that the few uses for the device given hereinabove be understood as merely suggestive of the many uses and not in any sense as limiting the device to any one particular type of service. Therefore, although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. An automatic impulse producing device comprising an electromagnet having a substantially U-shaped pole structure and having primary and secondary windings, an armature for said electromagnet normally out of contact with said electromagnet and adapted to be drawn into contact with the pole structure of said electromagnet when said electromagnet is energized to bridge the gap of said pole structure and to move away from said pole structure when said electromagnet is de-energized, inertia means operated by said armature and having a periodic motion, power supply means for energizing said electromagnet, and means for interrupting the power supply to said electromagnet substantially simultaneously with the motion of said armature away from said pole structure, said movement of the armature introducing an air gap in the magnetic path of said pole structure to promote a more rapid decay of the magnetic flux and thereby cause transient phenomena of greater amplitude than normal to be deliberately produced.

2. An automatic impulse producing device comprising an electromagnet having a pair of poles, means formed of magnetic material at one end of said poles for connecting said ends, a primary winding on one of said poles, a secondary winding on the other of said poles, an armature for said electromagnet normally spaced therefrom and movable towards and from the unconnected ends of the poles of said electromagnet, inertia means actuated by said armature and having a periodic motion, power supply means for energizing said electromagnet, and means for interrupting the power supply to said electromagnet substantially simultaneously with the motion of said armature away from the poles of said electromagnet, said movement of the armature introducing an air gap in the magnetic path formed by the poles to promote a more rapid decay of the magnetic flux and thereby cause transient phenomena of greater amplitude than normal to be deliberately produced.

3. An automatic electric switch comprising a conducting elongated slanting member, a metal ball adapted to roll on said member, an electromagnet having an energizing winding, an armature operated by said electromagnet for periodically driving said ball up said slanting member, said armature having a conducting member mounted thereon against which said ball strikes, and an electric circuit for said electromagnet, said electric circuit including said slanting member, said ball, and the said conducting member of the armature against which said ball strikes.

4. An automatic electric switch comprising a frame having an arcuate slot, a conducting elongated slanting member, means pivotally connecting one end of said slanting member to said frame, a metal ball adapted to roll on said member, an electromagnet having an energizing winding, an armature operated by said electromagnet for periodically driving said ball up said slanting member, said armature having a conducting member against which said ball strikes, an electric circuit for said electromagnet, said electric circuit including said slanting member, said ball, and the said conducting member against which said ball strikes, and means providing for quick adjustment of the angle of said slanting member, said means comprising a lateral extension projecting from the slanting member into said arcuate slot of the frame, and means for removably securing said extension at a desired position in said slot.

5. An automatic electric switch comprising a conducting elongated slanting member, a metal ball adapted to roll on said member, an electromagnet having an energizing winding, an armature operated by said electromagnet for periodically driving said ball up said slanting member, said armature having a conducting member against which said ball strikes, an electric circuit for said electromagnet, said electric circuit including said slanting member, said ball, and the said conducting member against which said ball strikes, said conducting member being positioned off center with respect to said ball whereby the ball will be slightly turned at each impact to present varying face portions to the conducting member and thereby avoid pitting of the ball.

6. An impulse producing device comprising a pole structure forming a normally open and non-continuous magnetic path, a primary winding on said pole structure, a secondary winding on said pole structure, an armature formed of magnetic material and movable into contact with said pole structure when the primary coil is energized to complete the magnetic path and render the same continuous and endless, said armature being automatically movable away from said pole structure when the primary coil is de-energized, inertia means operated by said armature and having a periodic motion, power supply means for energizing said primary coil, and means for interrupting said power supply substantially simultaneously with the movement of the armature away from said pole structure, said movement of the armature breaking the continuity of said magnetic path to promote a more rapid decay of the magnetic flux and thereby cause transient phenomena of greater amplitude than normal to be deliberately produced.

7. An automatic electric switch comprising an elongated slanting tube formed of conducting material, a metal ball adapted to roll within said tube, an electromagnet having an energizing winding, an armature operated by said electromagnet for periodically driving said ball up said tube, said armature having a conducting member carried thereby against which the ball strikes, and an electric circuit for said electromagnet, said electric circuit including said tube, said ball, and said conducting member of the armature against which said ball strikes.

8. An impulse producing device comprising a pole structure forming a normally open and non-continuous magnetic path, a primary winding on

said pole structure, a secondary winding on said pole structure, an armature formed of magnetic material and movable into contact with said pole structure when the primary coil is energized to complete the magnetic path and render the same continuous and endless, said armature being movable away from said pole structure when the primary coil is de-energized, power supply means for energizing said primary coil, and means for interrupting said power supply and for causing substantially simultaneous movement of the armature away from said pole structure, said movement of the armature breaking the continuity of said magnetic path to promote a more rapid decay of the magnetic flux and thereby cause transient phenomena of greater amplitude than normal to be deliberately produced.

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