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A. H. DELL ET AL
THERMAL CIRCUIT BREAKER

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FIG. 2

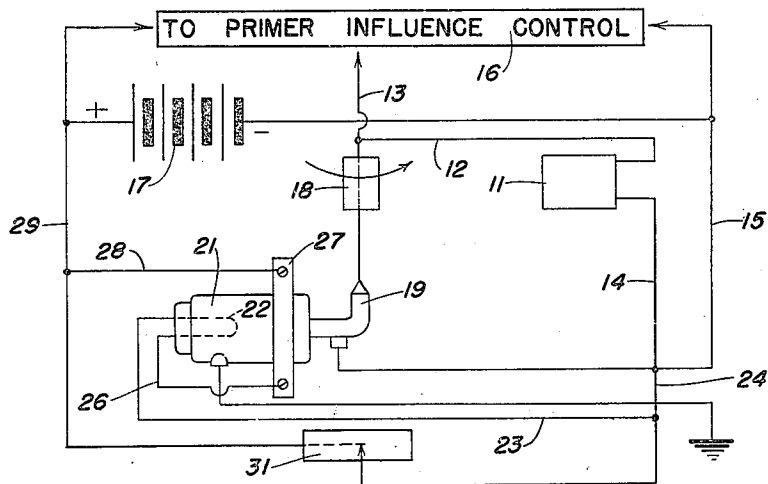


FIG. 3

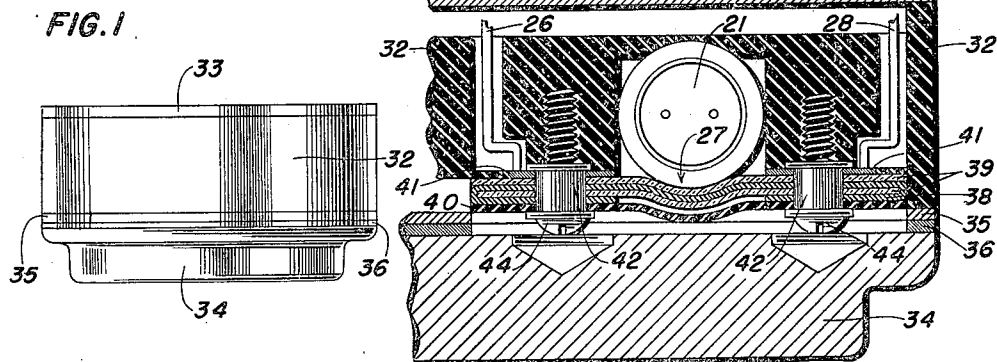
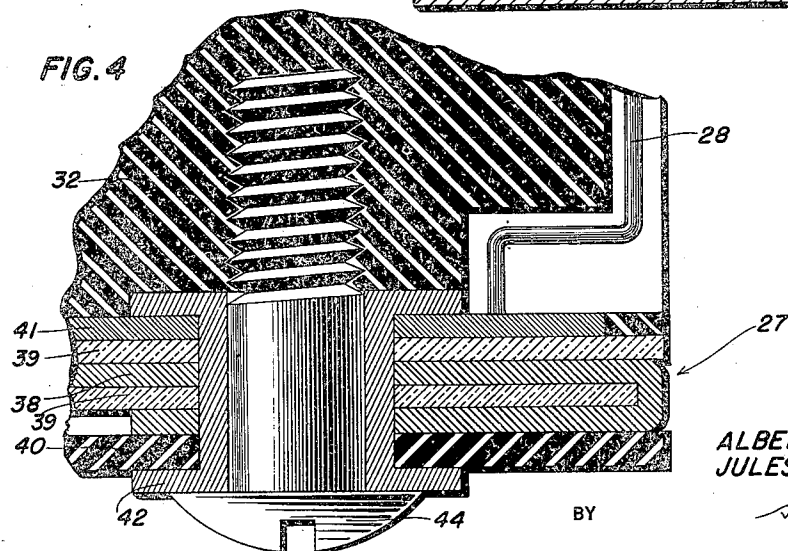


FIG. 4



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THERMAL CIRCUIT BREAKER

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2 Claims. (Cl. 102—70.2)

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The present invention relates to circuit breakers and specifically to those of the type employed in proximity fuzes.

A proximity fuze is a device for detonating an ordnance missile. It comprises electrical control circuits (hereinafter referred to as "influence control") which produce a signal of sufficient strength to fire an electrically ignitable primer when the missile comes close to a target. The primer then detonates the missile. In order to prevent undesired detonation as the missile leaves the point from which it is sent, the primer ignition wire is protectively short-circuited at and before the initiation of flight. The short-circuit is removed after the missile has departed a safe distance from that point. It is desirable that this short circuit be removed after a predetermined delay following the initiation of missile flight. A "shorting" device is placed in shunt with the primer to provide a short circuit. There is an auxiliary device designed to accomplish the removal of this short circuit. This auxiliary "unshorting" device includes a combustible heat-producing element and has an ignition circuit which is essentially in shunt with the primer, for igniting said element. This circuit should be removed after ignition has occurred. Toward this end a fusible conducting member is placed in series with the said ignition circuit. Said fusible conductor becomes melted and dispersed, thus removing the ignition circuit from across the primer and allowing the auxiliary unshorting device to accomplish its function of breaking the primer short circuit after the desired delay.

The fusible member is disintegrated as a secondary action, following said combustion of the heat source by ignition action of the same battery which energizes the influence control. It is important that excessive drains on that battery and impairment of the operation of the influence control be prevented and that the circuit through the fusible member and the battery be broken not later than the time that the short circuit is removed from the primer. To keep said circuit closed would interfere with the proper operation of the influence control circuits and drain the battery.

This object is attained by so arranging the circuits that the battery supplies an initial igniting current to a squib. A squib is a known device comprising an inflammable composition in which an igniting wire is imbedded. The squib is ignited electrically and heat is then produced by its combustion. A metal pin or rod projects out of the squib. The tip of this rod has soldered to it one

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end of a spring wire which constitutes the short circuit across the primer. Time delay is controlled by the character of pin material, its shape and its dimensions, as these affect the temperature-time characteristic at the tip of the pin. The result is that the primer is placed in condition for operation after a predetermined interval following the beginning of missile flight and interference by the squib with the normal operation of the influence control circuits on the primer is prevented.

It will be seen that there are provided a squib, a source of energy for igniting the squib, and means responsive to the heat of the squib for disconnecting the squib from that source. The squib and the last-named means are included in the improved thermal circuit breaker.

It is an object of this invention to provide a battery-actuated arrangement for removing a short circuit from a primer after a predetermined time delay, which arrangement has such operation that it does not impair the operation of influence control circuits, energized by the same battery, for firing the primer.

In the accompanying drawings:

Fig. 1 is a side view of the housing of the improved thermal circuit breaker;

Fig. 2 is a diagram of the electrical circuits with which the improved circuit breaker is associated;

Fig. 3 is an enlarged sectional view of the circuit breaker, showing the thermal delay squib and certain electrical connections associated therewith; and

Fig. 4 is an enlarged sectional view showing details of the circuit breaker fastenings.

Reference is now made specifically to Fig. 2, in which are shown a circuit schematic of a primer, means whereby the primer is coupled to the influence control of a proximity fuze, and means whereby the primer remains safe for a predetermined period following the initiation of flight of a missile in which it is installed. A primer 11 is coupled to the influence control 16 of a proximity fuze by the conductors 12—13 and 14—15. It will be understood that when the missile comes into proximity to a target the unit 16 has such operation that a relatively heavy current flows through circuit 13, 12, 11, 14, 15. This current is the space current of the electronic output tube of the unit 16. The circuits of unit 16 are energized by a battery 17. In order to prevent the primer from being ignited and from causing detonation of the missile when at a point close to the gun or launcher from which it is

fired, the primer is initially short-circuited by a shorter 18. A series combination of the shorter 18 and a heat-conducting member 19 having a fusible terminal is accordingly placed in shunt across primer 11.

It is desirable that the short circuit provided by unit 18 be removed from the primer after a predetermined delay. That objective is accomplished by melting solder that is at the tip of heat conducting member 19 at a predetermined time after the initiation of flight. To this end, member 19 is secured in heat-receiving connection to a squib 21. The squib includes an igniting wire 22, one lead of which is connected to battery 17 by the conductor 23—24—15, and the other lead of which is connected to the battery through conductor 26, a metal foil member forming part of unit 27 and conductor 28—29. In shunt with the circuit of igniting wire 22 there is placed a low-spin safety switch 31.

The operation of this circuit is as follows: When the missile is fired from a gun, say, the rifling of the gun causes it to spin. The action of the spin is such as to open switch 31 and to remove the short circuit across the igniting wire 22. The igniting wire is then unprotected and battery 17 causes a relatively heavy current flow therein. This current ignites the thermal delay squib 21. After a predeterminable delay, which is a function of the structures and the heat evolved, the heat of the squib causes the foil member 27 to disintegrate and thus separates igniting wire 22 from battery 17, breaking the electrical connection between that battery and the thermal squib. The heat produced by the squib causes solder at the tip of heat conductive pin 19 to melt and, under the influence of mechanical force, in this case force due to spin, the short circuit is removed from across the primer. The primer is now in condition to respond to a signal from the influence control 16 and the operation of the influence control and battery is not impaired by the presence of the former circuit of igniting wire 22.

Reference is now made specifically to Fig. 1. The igniting squib and its associated members are placed in a rear fitting designed to be installed in a fuze. This fitting includes a cylindrical housing 32 of insulating material, a cover 33 closing the front of the housing, and a metallic base 34. The base is attached at the rear of the housing with an interposed spacing disc 35 and a washer 36.

The essential elements of the improved circuit breaker are illustrated in Fig. 3. The foil member 27 includes a laminated mat made up of a sheet 38 of foil, sheets 39 of mica and an external "Bakelite" backing 40. These laminations, together with terminal plates 41, 41 are clamped together by a pair of spaced tubular rivets 42, 42.

The two conductors 26, 28 of the circuit of igniting wire 22 are connected to these terminal plates. By means of screws 44, 44, passing through the tubular rivets, the laminated mat is fixed with the conducting foil 38 insulated from direct electrical contact with the external case of squib 21 by a thin sheet of mica 39. When the circuit of wire 22 is excited and the internal charge of the squib is ignited, the hot squib supplies heat to the foil at a high temperature and the foil is disintegrated thereby and breaks that circuit.

The thermal destruction of the conducting foil 27 and the melting of the fusible joint between member 19 and the shorter 18 are delayed by the time required for thermal conduction from the hot squib to the foil 38 and to the fusible material such as solder on the tip of the heat conducting pin.

After the shorter 18 has been disconnected from the fusible material on the tip of 19, the shorter may be swung away from the fusible member by the centrifugal force due to the spinning projectile, as indicated by the arrow in Fig. 2.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

We claim:

1. In a proximity fuze, an electrical primer, means for short-circuiting said primer, and time-delay means for disabling said short-circuiting means, said time delay means including a squib, a source of energy for igniting said squib, and means initially operative to couple said source to said squib but responsive to heat conveyed from said squib to uncouple said source from said squib.
2. In a fuze including a source of electricity, a primer and an electrical igniter for said primer energizable by said source, a conductor short-circuiting said igniter to prevent operation of the latter, said conductor including a fusible portion, a combustible composition in heat-transferring relationship with said fusible portion, and means for igniting said composition, thereby developing heat to melt the fusible portion and remove the short-circuit.

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REFERENCES CITED

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

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