PRINCIPLES OF IMPROVISED EXPLOSIVE DEVICES

TOP SECRET

A PALADIN PRESS BOOK

Principles of Improvised Explosive Devices

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INTRODUCTION

The purpose of this manual is twofold. First and foremost it is to inform those individuals involved in EOD work of additional methods that may be employed by both terrorists and EOD operators in their respective areas.

The second purpose is that of a dedication to the EOD operators of the Rhodesian Army. It was my good fortune to have served with them and learn with them from 1976-1978. I have not used the word "expert" but rather "operator." Our chief instructor, the late Captain Charles Small, maintained that there were no experts in EOD work, but those who were very careful and lucky might someday come close to that title. It is my sincere hope that the information imparted in the following pages will give the operators using it just a little more luck than they had before.

M. J. DeForest

For Charlie, Frans, A. J., Craig, and all unremembered.

1. PRINCIPLES OF IEDs

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PRINCIPLES OF IMPROVISED EXPLOSIVE DEVICES

INTRODUCTION

1. For many years RAOC technical ammunition personnel have been involved in the neutralization of Improvised Explosives Devices (IED), both in the United Kingdom and overseas.

2. From this experience, and from that of various foreign agencies, a large amount of information on the principles of terrorist device construction and operation has been obtained.

3. A high proportion of devices encountered are of relatively simple design, but there is evidence of a drift towards a greater degree of sophistication.

AIM

4. The aim of this precis is to describe the design principles of terrorist devices with emphasis on the methods of triggering and/or switching which may be encountered.

CATEGORIES OF DEVICE

5. There are four categories of device used by terrorists. These are:

   a. **Non-Explosive Anti-Personnel Devices**

      Intended for local effect against one or more persons, these contain no explosives, but depend on the action of acids, chemicals, or sharp sections of materials such as broken razor blades, steel fragments, glass slivers, pointed stakes, etc., arranged so that they are projected by some initiating action. They are not necessarily contained in packages, but may also be found in the ground, on trees, etc.

      This category of device is not an IED and is not dealt with in this precis.

   b. **Explosive Devices**

      Normally designed to effect maximum injury to personnel and/or destructive damage to property, they consist of:

      i. Initiation system—may be manual, chemical, mechanical or electrical.

      ii. Detonator.

      iii. Main explosive charge.

   c. **Incendiary Devices**

      These are normally designed to destroy property by burning and consist of:

i. Initiation System—May be manual, chemical, mechanical or electrical.

ii. Detonator.

Not usually contained.

iii. Explosive charge.

iv. Incendiary material.

d. **Explosive/Incendiary Devices**

These are multi-purpose devices designed to cause injury to personnel, and damage to property by a combination of blast and burning. They consist of:

i. Initiation System—May be manual, chemical, mechanical or electrical.

ii. Detonator.

iii. Explosive charge.

iv. Incendiary material.

6. IEDs are manufactured with the intention that they are sent to, or deposited in, locations where they can function at the appropriate time with the desired effect. Functioning can be triggered by one, or more, of the following actions:

a. When the device is handled or disturbed. These are referred to as *anti-handling actions.*

b. At a predetermined time. These are referred to as *delay or time actions.*

c. At the terrorist's command. These are referred to as *command actions.*

d. By a change in *ambient conditions.*

7. The list of devices and components described in this precis is not exhaustive and personnel engaged in render safe operations must be prepared to deal with other types.

8. For ease of reference, all initiation actions, electrical or otherwise, are referred to as switches.

9. It is important to remember two facts:

a. *A device may contain more than one switch or firing circuit.*

b. *The switch is not necessarily in the device. It may be remotely connected by some means (e.g. electric cable, detonating cord, etc.).*

PART 1 – EXPLOSIVE DEVICES

INITIATION

10. The initiation systems of explosive devices may be electrical, chemical, mechanical, friction, or ignition by the terrorist.

SECTION 1 – ELECTRICAL SWITCHES

11. The most common system of initiation is the electrical method using some form of dry battery, since these are both efficient and readily available.

12. Initiation from main power supplies is not popular with the terrorist as it limits the tactical use of devices, but if the situation is suitable, main power supplies may well be utilised.

13. The basic electrical circuit of an explosive device is shown in Figure 1. From this diagram it can be seen that the flow of current from the power supply to the detonator is controlled by:

a. **An Arming Switch**

Whilst open, ensures safety to the terrorist. Closed by some means after dispatch or placing of the device.

b. **A Firing Switch**

The final link in the circuit. When closed, the initiating current is passed to the detonator.

14. The functions of arming and firing within a device may be carried out by several components or by one component only.

15. From the functional aspect, electrical switches can be classified into four groups as shown below:

a. **Anti-Handling**

Pull
Pressure
Release
Lift
Tilt
Trembler/Pendulum
Collapsing Circuit
Thermal
Anti-Probe

b. **Delay**

Clockwork
Thermal
Collapsing Circuit
Electronic
Electro-Chemical
Material Fatigue
Chemical
Water Drip
Expanding Seed

c. **Ambient Conditions**

Temperature Sensitive
Smoke/Gas Sensitive
Metal Sensitive
Acoustic
Proximity
Transient Sensitive
Light/Infra-Red Sensitive
X-Ray Sensitive
Barometric
Humidity

d. **Command**

FM Transmission
Command Wire
Radio Control
Ultrasonic Control
Infra-Red Beam
Radar Beam
Post Office System

16. Certain electrical components used in devices cannot be specifically classified. These are dealt with as individual components in Part 1, Section 5.

PULL

17. The following switches and switching arrangements utilise a pulling movement:

a. **Spring-Type Wooden Clothes Peg** (Figure 2)

An electric lead is connected to the inside face of each jaw by means of a drawing pin, the switch being kept in the open position by a piece of insulating material. When the insulator is removed, the spring forces the jaws to close and the circuit is completed.

Some examples of use are:

i. Simple arming switch in many devices.

ii. **Misfired Nail Bomb** (Figure 3)

A piece of burnt safety fuze is inserted between the jaws as an insulator, and when withdrawn, allows device to function.

iii. **Book Device** (Figure 4)

Two clothes pegs are connected in parallel, one to act independently of the other if either the back or front cover of the book is opened. The insulators are glued, one on the inside of each cover.

iv. **Pull/Trip Switch** (Figure 5)

Attached to the insulator is a pull/tripwire which protrudes through the outer casing of the device. When used with small devices, the wire is attached to some immoveable object nearby. With large, heavy devices the wire can be used as a true tripwire. With some car bombs the wire is secured to a part of the vehicle.

v. **Door Boobytrap** (Figure 6)

The clothes peg is nailed to the door and kept open by an insulator attached to a pull wire secured to the door frame.

A similar arrangement can be used for hinged windows, sash windows, cupboards, drawers, etc.

b. **Household Mousetrap** (Figure 7)

One lead wire is connected to the flyover bar, the other to a drawing pin pushed into the wooden base. An insulator is inserted between flyover bar and drawing pin. It is used in similar manner to the clothes peg.

c. **Bared Wires** (Figure 8)

This method utilises two pieces of insulated wire, from each of which a section of insulation is removed. When the bared sections are brought together, the circuit is completed. Examples are:

i. **Cache Boobytrap Switch** (Figures 9 and 10)

ii. **Anti-Open Switch in Parcel** (Figure 11)

d. **Wire Loop on Battery** (Figure 12)

One lead to the firing circuit is secured to one battery terminal, the other lead having the insulation stripped off and formed into a loop placed around the other battery terminal. When pulled, the loop touches the terminal and the circuit is completed.

e. **Toggle Switch and Pull-Wire** (Figure 13)

The toggle switch, secured inside or on the outside of the device, has a pull wire tied to the toggle. Can be used as anti-open, trip., etc.

f. **Foil Contacts with Insulator**

The switch consists of two foil contacts separated by an insulator. When the insulator is withdrawn the foil contacts touch and the circuit is completed. Alternatively the contacts may be separated by an air gap.

Used in:

i. Book Devices (Figure 14)

ii. Letter Bombs (Figure 15)

NOTE: Some letter bombs have foil contacts at each end of the device, the two pairs being connected in parallel.

iii. Bamboo Pole Device (Figure 16)

g. **Tube and Ball** (Figure 17)

The switch consists of a fixed metal tube with one lead wire attached, and a metal object, e.g. bolt, ball-bearing, etc., suspended on a string which passes through the tube, the other lead wire being connected to the metal object. When the string is pulled, the metal object contacts the tube and the circuit is completed. Can be used as anti-open in devices, and on doors and windows, or as a trip-switch.

h. **Knife Switch** (Figure 18)

A flexible dinner knife is secured to a base board which also has two contact nails (connected together). A pull or trip cord is tied to the knife blade. If the cord is correctly tensioned, the blade will touch one of the contact nails on either pull or release thus completing the firing circuit.

PRESSURE

18. In general, pressure switches are mainly used in mines and boobytraps.

19. The following switches and switching arrangements utilise pressure to operate:

a. **Spring-Type Wooden Clothes Peg** (Figure 19)

In this mode the leads are secured by drawing pins to the inside surfaces at the other end of the peg and the pressure of the spring must be overcome to complete the circuit. Used under vehicle wheels.

b. **Household Mousetrap** (Figure 20)

One lead is connected to the flyover bar, the other to a drawing pin pushed into the wooden base at the end opposite to the normally closed position of the flyover bar. The flyover bar is held against the tension of its spring by a captive plunger in the lid of the device. When pressure is applied to the plunger via a pressure plate, the flyover bar is pushed, against its spring, on to the drawing pin and the circuit is completed.

c. **Microswitch** (Figure 21)

The microswitch is designed to operate on pressure or release. A common contact is connected to a spring loaded plunger and is normally in contact with a normally closed (NC) contact. When pressure is applied to the plunger, it moves down against its spring and the common contact touches the normally open (NO) contact. These switches are very sensitive. Vehicle brakelight systems utilise microswitches and may be incorporated into the firing circuit of a car bomb.

A microswitch can be used in the pressure mode as an arming switch, e.g. when the lid of a container is closed, the microswitch operates and the firing circuit is complete except for the firing switch, or it may be used when a pulse of current is required to trigger an electronic circuit.

d. **Pressure Mat** (Figure 22)

Pressure mats are available commercially for use in burglar alarm systems, and have been used by terrorists. A pressure mat consists of two sheets of metal foil, each with its own lead, separated by perforated fibreglass sheets, all of which are contained in a watertight, airtight, plastic covering. Pressure on the mat causes the foil sheets to touch through the perforations and the firing circuit is completed. Can be used under doormats, stair carpets, etc., and in car seats.

e. **Pressure Chamber** (Figure 23)

This switch is comprised of a wooden block in which is a hollowed-out chamber and air tube. Over the chamber is glued a sheet of latex rubber on top of which rests a metal strip contact. The second contact is a screw mounted in a bridge over the block.

A closed rubber tube is attached to the air tube. Pressure on the rubber tube causes air pressure in the chamber to increase and the strip contact is forced against the upper contact by the expansion of the latex sheet.

This type of switch is ideal for vehicle ambush situations.

f. **Pressure Board** (Figure 24)

The make-up of this type of switch is shown in the diagram and is quite simple. It is normally used as a boobytrap in come-on situations and has an advantage in that it can be concealed beneath gravel, turf, etc.

g. **Door-Bell Push** (Figure 25)

This switch can be used as a boobytrap switch, but its main use is as the command switch in a command wire system. Another use is as an arming switch, e.g., when the lid of a container is closed, the bell-push is depressed, and the firing circuit is complete except for the firing switch.

h. **Wooden Wedge** (Figure 26)

Two pieces of wood are glued and nailed together at an angle of approximately 45 degrees. Each piece of wood has a metal contact plate and lead wire on the inside of its free end. The wood is normally painted black so that it is not noticeable when placed under the forward edge of vehicle tyre. When the vehicle moves off, the wedge is squashed flat, the metal contacts come together and the device, placed beneath the vehicle, is initiated.

j. **Pressured Beer Keg Switch** (Figure 27)

The switch, as shown in the diagram, is part of the beer keg within which is the device. When the bar fitting is applied, the centre of the assembly (A) is pushed into (B) and the firing circuit is completed.

k. **Hacksaw Blades/Torch Bulb** (Figure 28)

A lead wire is attached to each of two pieces of hacksaw blade. The blades are held apart by the glass portion of a torch bulb. Pressure on the switch causes the glass to break, and the contact is made between the two pieces of blade. The switch would normally be covered by a pressure board.

l. **Rocker Lightswitch** (Figure 29)

Many household lightswitches use a rocker action.

These are relatively sensitive and suitable for many applications as pressure switches.

m. **Cigarette Packet**

The inside opposing surfaces of a cigarette packet or similar are coated with metal foil, one circuit wire being connected to each surface. Crushing the packet brings the foil surfaces together, thus completing the circuit.

RELEASE

20. The following switches and switching arrangements utilise a release action:

a. **Knife Switch** (Figure 18)

A flexible dinner knife is secured to a base board which also has two contact nails (connected together). A tension cord is secured to the knife blade. If the cord is correctly tensioned, the blade will touch one of the contact nails on either release or pull thus completing the firing circuit.

b. **Suitcase Catch** (Figure 30)

When used as a switch, the suitcase catch is often used to energise a relay circuit, thus when the catch is released, the magnetic circuit collapses and the device within the suitcase is fired.

The catch may also be used as a simple arming switch.

c. **Vehicle Courtesy-Light Switch**

Most vehicles utilise a microswitch to operate the courtesy light. This switch can be incorporated in a device circuit so that when a door is opened the device fires.

d. **Telephone Switch**

All telephones use a release switch which, when the handset is lifted, allows an energising current to flow. This current is insufficient to fire a detonator, but the phone power supply can be disconnected from the switch and a small 9 volt battery connected in its place.

e. **Microswitch** (Figure 21)

In the release mode, the microswitch can be used to energise a relay circuit, thus when the switch is released the magnetic circuit collapses and the device fires. It can also be used as an anti-open switch in thermos flasks, etc. (Figure 31)

f. **Spring-Type Wooden Clothes Peg**

The clothes peg is prepared in the usual manner, but the jaws are held apart by tension wires on each jaw. Examples of this are:

i. **Release Wire** (Figure 32)

May be inside or outside device.

ii. **Suspended Device** (Figure 33)

In this mode, one jaw is secured to the base of the device, the tension wire on the other jaw passing through the lid of the container and being used to suspend the device. If the tension is taken off of the upper wire, the clothes peg jaws are allowed to close and the firing circuit is complete.

iii. **Release of Pressure** (Figure 34)

The clothes peg, prepared in the normal manner, has its jaws kept apart by pressure on the rear ends. This may be a weighted object or a vehicle wheel. When the peg is released, the spring causes the jaws to close and the device fires.

f. **Household Mousetrap**

Prepared in the normal manner, can be used as:

i. **Release Wire** (Figure 35)

May be within or outside device.

ii. **Suspended Device** (Figure 36)

In this mode, the mousetrap base is secured to the inside of the device, either base or side. A tension wire on the flyover bar passes through the lid of the container and is used to suspend the device. When the tension is released, the flyover bar is allowed to touch the drawing-pin contact and the firing circuit is completed.

iii. **Anti-Open** (Figure 37)

The flyover bar is held away from the drawing pin contact by the lid of the container. When the lid is opened, the flyover bar is released and the firing circuit is completed.

LIFT

21. A lifting movement can activate the following types of switches:

a. **Microswitch** (Figure 21)

Using the common and normally closed contacts, can be used as an extremely sensitive anti-lift switch. (Figure 38)

b. **Wooden Block and Plunger** (Figure 39)

A wooden block is secured to the inside base of the device. A hole passes through both the block and base, the top of the block accommodating a metal washer to which one lead wire is attached. Located within the hole is a wooden or plastic plunger through which is secured a contact wire and lead. When the device is lifted, the plunger is allowed to move downwards, the contact wire touches the washer, and the device fires.

Devices have been encountered with two of these switches, one being concealed beneath a false base. (Figure 108)

c. **Hinged Base** (Figure 40)

When the container is lifted, the loose hinged lid drops, and the contacts complete the firing circuit.

d. **Mousetrap** (Figure 41)

The mousetrap is prepared in the normal manner and attached to the underside of the device in and upside-down position with the flyover bar under tension. When the device is lifted, the flyover bar is allowed to contact the drawing pin and the device fires.

TILT

22. Certain switches utilise a tilting action for their operation. Examples are:

a. **Ball-in-Tube**

A metal ball-bearing is contained within a non-conducting glass or plastic tube. Contact wires protrude into one or both ends of the tube through cork, plasticine, etc., and when the device is tilted, the ball-bearing short-circuits across the contacts.

i. **Single-Ended** (Figure 42)

ii. **Double-Ended** (Figure 43)

b. **Mercury Switch**

Home-made and commercial mercury switches are similar to the single-ended switch in Figure 43, but the ball is replaced by a small amount of mercury.

i. **Home-Made** (Figure 44)

ii. **Commercial** (Figure 45)

c. **Microswitch** (Figure 21)

Due to its extreme sensitivity, a microswitch in the anti-lift mode can also be considered as a tilt switch.

d. **Ball and Wire** (Figure 46)

A metal ball sits in a shallow depression in the centre of a wooden block. Two "U"-shaped bare wires, each with a lead attached, are used to cage the ball bearing (without touching it or each other).

This switch is known as the "Allways" switch, because regardless of the direction of tilt, the ball will short-circuit across the wires and complete the firing circuit.

e. **Trembler** (Figure 47)

One side of the firing circuit terminates in a loop of bare wire, the other side terminating in a length of flexible metal positioned within the loop. Movement of the device causes the flexible metal to tremble and touch the loop whereupon the firing circuit is completed.

A commercial version of this switch is the car burglar alarm system.

f. **Pendulum** (Figure 48)

The principle of operation is similar to that of the trembler switch but the moving component is suspended within the encircling contact.

COLLAPSING CIRCUITS

23. Many electromagnetic transducers will keep two contacts apart whilst an electric current is passing through an energising coil. When the energising current is cut off or becomes insufficient due to battery decay, the contacts will close to complete a separate firing circuit.

24. This type of mechanism is known as a collapsing circuit and has a dual role:

a. **Anti-Handling**

When any part of the energising circuit is cut. The terrorist adopts many devious ways to entice the operator into cutting the circuit, e.g. a short-circuited clock or a dummy detonator in series with the energising circuit.

b. **Delay Action**

When the battery runs down until it cannot supply sufficient energising current to hold the contacts apart. The life duration of the battery can be lengthened or shortened within certain limits by respectively connecting a suitable resistor in series or parallel with the energising coil.

25. The most common electromagnetic transducers are:

a. **Relays** (Figure 49)

When current is passed through the relay coil a magnetic field is produced through the iron core, yoke, and armature. The lower end of the pivoted armature moves towards the iron core, the upper end of the armature moves the normally closed contact away from the common contact. The detonator is then connected into the firing circuit by some means.

When the energising current is removed, the relay reverts to its normal condition and the common and normally closed contacts close to complete the firing circuit. A simple collapsing circuit is shown in Figure 50. The arming action is as follows:

i. When arming switch 'A' is closed manually, the relay coil is energised by battery '1' and the relay contacts 'B' open.

ii. Arming switch 'C' is then closed by some means. Relays are also used in some radio control receivers.

b. **Double Interlocked Relays** (Figure 51)

Arming is carried out as follows:

i. Post Office Fuze F2 is shorted and blown, Relay 'A' becoming energised and making the shorting link of Relay 'B' open circuit.

ii. Post Office Fuze F2 is shorted and blown. Relay 'A' is open circuited at the contacts of Relay 'B'.

iii. Post Office Fuze F3 is shorted and blown and that part of the shorting link is completed.

When any wire of either circuit is out, that circuit collapses and the shorting link of the other circuit is closed allowing that circuit to fire.

c. **Reed Switches** (Figure 52)

The reed switch consists of a small glass tube, containing a set of contacts, within an energising coil. The normally open and common contacts are made of a ferrous metal, and when the coil is energised, are drawn together by a magnetic field. The external firing circuit is then connected to the normally closed and common contacts and the collapsing circuit principles then apply.

d. **Solenoids**

These are basically pieces of soft iron around which are wound energising coils. When energised, a solenoid produces a magnetic field which can be used to attract moveable parts. Examples are:

i. **Solenoid and Car Contact-Breaker** (Figure 53)

A bell solenoid is energised by Battery 'A'. The lever on the contact breaker is pulled against the solenoid, and the detonator connected into the firing circuited by the same means.

When the circuit collapses, the contact breaker spring causes the lever to fly back against contact 'B', thus completing the firing circuit.

ii. **Doorbell Circuit** (Figure 54)

The doorbell solenoid is energised by battery 'A' through switch 'B' and the contacts at 'C' are separated by movement of the striker. The detonator is then connected. When the circuit collapses, contact is made at 'C' and the firing circuit from battery 'D' is completed.

THERMAL

26. Bi-metal strips from thermostats of electric toasters and steam-irons can be used as switching mechanisms when heat or cold is applied. For example, if liquid nitrogen was applied as a device to de-energise batteries were affected.

ANTI-PROBE

27. These switches depend on two contacts being pushed together, but the materials used depend on the type of container into which the device is built, i.e.:

a. For lightly constructed containers, e.g., cardboard boxes, a connecting lead is attached to each of the two sheets of metal foil which are separated by a non-conductive material or air space. The firing circuit is completed when the container is penetrated by a metal knife or probe.

b. For more robust containers, such as wooden boxes, holes are deliberately left in the walls of the container. Inside the device, behind the holes, are flexible metal contacts which complete the firing circuit when pushed together by a probe. (Figure 55)

DELAY SWITCHES

28. In the ensuing paragraphs, various forms of time delay switch are discussed. They may be used for arming, firing, or both.

a. **Clockwork Delay Switches**

i. **Hand and Pin** (Figure 56)

One lead is secured to a drawing pin which protrudes through the plastic lens, the other lead being secured to the body of clock or watch. Contact is made by the selected hand, the leading side of which is scraped clear of paint. The use of the hour hand gives 11 1/2 hours max delay, the minute hand gives 58 minutes max. The hand not in use is normally removed.

ii. **Hand and Wire** (Figure 57)

The glass front is removed from the clock and a lead wire, partly bared, is taped across the face. The other lead wire is secured to the casing of the clock. The clock hand which is not required is removed, the other hand has its front edge scraped and the end bent at right angles. Contact is made when the edge of the hand touches the bared wire. Depending on the hand used, it can give up to 30 minutes or 6 hours delay.

iii. **Alarm Winder and Wire** (Figure 58)

One lead wire is taped to, but insulated from, the clock body. The other lead wire is similarly attached to the alarm winder after alarm has been wound. When the alarm operates, the winder revolves and the wires contact thus completing the circuit. This method can give up to 11 1/2 hours delay.

iv. **Alarm Winder and Microswitch** (Figure 59)

The alarm is wound and the stop button is depressed. A microswitch, using the common and normally open contacts, is then glued to the back of the clock with its plunger beneath one end of the alarm winder. When the alarm operates, the winder revolves and depresses the microswitch plunger thus completing the circuit.

v. **Alarm Winder and Toggleswitch** (Figure 60)

The alarm is wound and the stop button is depressed. A thin pull wire is then attached to alarm winder and toggle switch. When alarm functions, the pull wire is wound in and the toggle switch is pulled to the 'on' position.

vi. **Parkway Timer**

This is a timer designed to give a motorist with a parked car an audible warning when a maximum of two hours has elapsed. It is a mechanism which is automatically wound up when the central section is turned clockwise to the required time. The centre section then rotates anticlockwise as the time elapses. There are two methods of use:

(a) **Figure 61a**

A lead wire and contact lead are glued to the centre section, the other lead terminating on a nail at point 'A'. After setting to the required delay time, the timer unwinds until contact is made and the circuit is completed.

(b) **Figure 61b**

When this method is used, modifications must be made to the timer. A section of the plastic outer wall is cut away and an extension piece is soldered to an internal lever. At cut-off, this lever moves across to terminal 'A' and completes the circuit.

vii. **Other Mechanical Timers**

From electric crockers, etc. can be used in similar modes to those already described.

vii. **Clock and PO Fuze** (Figure 62)

The operation of the PO Fuze is described in Section 6. With this switching arrangement a maximum delay of 23 hours is possible. Two leads, 'A' and 'B', with their ends bared and bent upwards are laid on, but insulated from, the face of the clock from which the glass has been removed. The hour hand is utilised and has its leading edge scraped clear of paint. It begins its travel at point 'C'. The action of the circuit is as follows:

(a) The hand travels round and brushes over wire 'A'. No reaction.

(b) The hand then brushes over wire 'B' and PO fuze blows, switching the circuit from point 'D' to point 'E'.

(c) The hand continues to travel round to wire 'A' again and when contact is made the firing circuit is completed from positive side of battery, through the detonator, wire 'A', clock body, PO fuze, point 'E', then to the negative side of the battery.

ix. **Clock and Hairpin** (Figure 63)

The arrangement is as shown in the diagram. The hands are removed from the clock and replaced by a plastic arm, which starts its travel at 6 o'clock (a). After 11 hours, side 'A' of the hairpin is slowly pushed to the left and the arm continues to travel (b). After 22 1/2 hours, side 'B' of the hairpin is slowly pushed to the left (c) until, after 24 hours, side 'A' of the hairpin shorts across wires 'C' and 'D', thus completing the firing circuit (d).

x. **Electric Clock Long Delay** (Figure 64)

This system, using a day and date indicating, battery operated clock, can give a maximum of 217 days delay. The selected day and date are covered by thin metal foil. The circuit is completed when wire contacts 'A' are shorted by the date and wire contacts 'B' are shorted by the day simultaneously.

NOTE: The terminals for contacts 'A' and 'B' are secured on a plastic insulating strip.

b. **Rodent Delay** (Figure 65)

This delay system utilises a rodent (rat or mouse), a mousetrap of clothes peg, and a length of string soaked in beef dripping or a similar substance. Before using this clever method, devised by the Chinese, which entails the rodent chewing through a release cord, the terrorist must ensure careful selection of his materials:

i. **Size and Origin of Rodent**

The rodent must be small enough to fit into the device without discomfort. Since Australian rodents prefer eating explosives to beef dripping, and American rodents eat canned food, the European rodent is most suitable.

ii. **Mousetrap or Clothes Peg**

A clothes peg held open by a piece of fat-soaked string wrapped around its rear end is preferable to the use of a mousetrap. The reasons for this are two-fold:

(a) Rodents have an inherent dislike of mousetraps.

(b) They prefer to stand on the base board of the trap when eating, and if the rump or tail is caught between the drawing pin and flyover bar, the circuit will not be completed.

iii. **Type of Fat**

The religion of the rodent must be determined before selecting the fat in which the string is to be soaked. The reasons for this are obvious. Similarly, if the device is to be laid on a Friday, fish fat should be used.

d. **Collapsing Circuit**

This type of switching arrangement is adequately explained in paragraphs 23 and 25 inclusive.

e. **Chemical Delay**

Whilst the chemical method of delay is normally employed in non-electrically initiated devices, it is possible to construct an electrical switch using acid to erode a safety device holding a circuit open.

f. **Water Drip Delay** (Figure 66)

The switch is constructed as shown in the diagram. When the water level is reduced by leakage through the small hole in the base of the container, the bare sections of wire make contact and the circuit is completed.

g. **Expanding Seed Delay** (Figure 67)

The construction of this switch is shown in the diagram. The seed, peas or beans absorb water and push the contact plate upwards until it short circuits the two contacts and the circuit is completed.

h. **Clothes Peg Delays**

Two methods by which a clothes peg can be utilised as a delay switch are:

i. **Mousetrap Solder Delay** (Figure 70)

The flyover bar is held away from the drawing pin by a piece of solder which is stretched and fully overcome, allowing the flyover bar to strike the drawing pin and complete the circuit. Delays can range from 4-8 hours.

ii. **Mousetrap, String and Cigarette** (Figure 71)

The flyover bar is held away from the drawing pin by a short length of string threaded through a cigarette. The cigarette (King-size) is lit by the terrorist and after approximately ten minutes the string is burnt through and the mousetrap operates.

k. **Electronic Delays**

Electronic delays utilise the charging properties of a capacitor and may be used for delayed arming or delayed arming and firing. Examples of use are given below:

i. **Delayed Arming** (Figure 72)

The relays in radio-control receivers are notoriously unstable. The system shown allows the relay to stabilise without danger to the person arming the device.

The RC receiver energising current is switched on. When switch 1 is closed, the capacitor C is charged by battery 1, the rate of charging being governed by the ohmic value of resistor R.

Closure of the relay contacts will only allow the firing circuit to initiate if capacitor C is sufficiently charged.

ii. **Firing Delays**

(a) **Integrated Circuit** (Figure 73)

The resistor/capacitor combination determines the time delay. When a trigger (arming) pulse is applied, the capacitor charges and after a predetermined time, the integrated circuit produces an electrical output which causes the thyristor to switch on the main firing current. This method can give reliable delays varying between five minutes and ten days.

(b) **Commercial Firing Delays**

Electronic Demolition Firing Delays are available commercially which give reliable delays between 1 1/2 hours and 32 days. They are expensive but extremely accurate.

(c) **Alka-Seltzer Electronic Delay** (Figure 74)

A coil of wire is wound around a full tube of A.S. tablets, the coil forming the inductive part of a transit oscillator tuned circuit. The oscillations are rectified and the resultant do is applied as a reverse bias to a second transistor which uses a relay or thyristor as its load.

The devise is energised and the cap removed from the tube of A.S. The tablets gradually absorb moisture until sufficient water content is present to affect the tuned circuit and oscillation ceases. The bias is then removed from the second transistor and the relay or thyristor completes the firing circuit.

This type of electronic delay is obviously dependent on ambient humidity and delays can vary between a few hours and several weeks.

l. **Electrochemical Delays**

These delays relay on the electrochemical properties of certain components, the best-known of which is the 'E' cell or microcoulometer. (Figure 75)

When a current is passed from anode to cathode, silver from the case is deposited on the gold anode and the internal resistance of the cell is low.

When the current flow is reversed, i.e. cathode to anode, the silver leaves the gold anode, and when it is all removed, the internal resistance is very high and a voltage is developed across the cell.

In the circuit in Figure 76, this voltage is used to cause transistor TR2 to conduct, the thyristor is then triggered and the firing circuit is completed.

AMBIENT CONDITIONS

29. Changes in ambient conditions can be used to trigger firing circuits, the sensors not necessarily being within the device. Most systems require delayed arming.

a. **Temperature Sensitive** (Figure 77)

This circuit uses a thermistor as a sensor. A thermistor is basically a resistor whose resistance changes with variations of temperature. In the circuit shown, as the temperature increases, the resistance of the thermistor decreases until eventually a triggering current is applied to the gate of the thyristor which then switches on the firing circuit.

b. **Smoke/Gas Sensitive** (Figure 78)

There is available commercially an electronic sensor which is sensitive to carbon monoxide and inflammable vapours. When the concentration of smoke or gas reaches a certain value an electrical output is applied to the gate of a thyristor or to a relay, and the firing circuit is completed.

Many industrial installations use this method for alarm systems.

c. **Metal Sensitive**

There are many types of metal detector on sale, some costing as little as $3. These can be easily modified to fire a circuit in a device when metal is brought into the proximity of the device. Sensitivity, and thus range, depends greatly on the cost of the system.

Metal sensitive systems normally require a method of delayed arming.

d. **Acoustic** (Figure 79)

The circuit shown uses a loudspeaker as a sensor. It is sensitive to speech and other sounds at normal conversation levels up to approximately 30 feet, and to mechanical vibrations up to 10 feet. In practice, the sensor can vary from a miniature microphone to a large loudspeaker. The system requires delayed arming.

e. **Proximity**

Many commercial alarm systems are based on the capacitive effect of the human body. When a person approaches the sensor, which may be a length of wire or a metal plate, a tuned electronic circuit is unbalanced, thus causing an alarm to sound.

It is possible to replace the alarm with a firing circuit.

f. **Transient Sensitive**

The effect of transient currents from an unsuppressed vehicle engine on a television receiver is a well known phenomenon. Similarly, transients are produced when electrical machinery and lights are switched on.

The older models of radio control receiver of the regenerative type are affected by transients, which, when the receiver is energised, can cause an integral relay to function, thus completing the firing circuit.

g. **Light Sensitive**

The sensor in the circuit shown is a light-sensitive resistor whose ohmic resistance drops when exposed to white light. This allows a trigger current to flow to the gate of the thyristor thus switching the firing circuit on.

Other circuits may utilise light-sensitive diodes, transistors, integrated circuits, or photographic light meters.

Using a relay with change-over contacts as the switching device (Figure 81), the firing circuit can be made to function on application of either light or shadow.

h. **Infra-Red Sensitive** (Figure 82)

There are many X-Ray-sensitive meters available which can be modified to fire a device, but most are relatively expensive.

The circuit shown in Figure 83 is a simple and cheap alternative. The light-sensitive components are covered by a sheet of material which fluoresces when exposed to radiation (X or Gamma). This fluorescence is detected and the relay functions, thus completing the firing circuit.

k. **Barometric**

These are switches caused to function by changes in ambient air pressure. Examples are:

i. **Pressure Can** (Figure 84)

When the ambient air pressure decreases, the air in the can expands and the plastic sheet rises to press contact 'A' against contact 'B' thus completing the circuit. This type of switch operates at approximately 5000 ft. a.s.r.

ii. **Altimeter Switch** (Figure 85)

This switch can be used to function at any required altitude in impressurised conditions.

Depending on whether leading or rear edge of needle is scraped clear of paint, can be used to function on either rise or fall in altitude.

l. **Humidity Sensitive**

Two examples of humidity-sensitive switches are given below:

i. **Alka-Seltzer Tablet** (Figure 86)

The thyristor trigger lead is cut and the ends inserted into a A.S. tablet. When dry, the tablet has a high ohmic resistance. As it absorbs moisture, the resistance drops and a trigger current is applied to the thyristor which switches on and completes the firing circuit.

ii. **Contact Plats** (Figure 87)

The thyristor trigger lead is cut and the ends soldered to two adjacent strips on a piece of 'Veroboard' circuit board or similar. Moisture builds up and eventually bridges to gap between the strips, thus causing the thyristor to be triggered.

COMMAND SYSTEMS

30. The various types of command systems are outlined below:

a. **Command Wire**

The IED is separated from the firing point by the required length of firing cable. The power supply may be at the firing point or contained within the IED. At the optimum moment, the firing line is completed by means of a manually-operated switch, e.g. a bell-push.

b. **FM Radio Link**

There are, readily available, commercial FM transmitters with a range of 500 meters. The output of any FM radio receiver can be modified to operate a small relay in place of its loudspeaker, the relay being used to complete a firing circuit in response to a transmission by the terrorist.

At the time of writing the FM spectrum has several clear zones, and as the transmitter is tuneable, selection of a frequency free from commercial transmissions is relatively easy.

c. **Ultrasonic Command**

Ultrasonic transducers are peizo-electric devices which have rather unique properties, i.e. when a low-voltage ac is applied, the transducer produces a radio frequency of approximately 40 KHz, and conversely, when it detects a 40 KHz radio frequency, it can produce a low-voltage ac.

Ranges are limited to a maximum of approximately 100 metres, but since large objects, such as vehicles, will interrupt the beam, it can also be used with a relay in the collapsing circuit mode. Ultrasonic systems are widely used and readily available.

d. **Radio Control**

The subject of radio control and its use in IEDs is dealt with comprehensively in Army School of Ammunition Precis AP 12.

e. **Infra-Red Command**

IR-sensitive switches are discussed in paragraph 29. h. The application of a command signal in the form of an IR beam is practical up to distances of approximately 100 metres.

f. **Radar Command**

Miniature radar transmitters are commercially available for use in small boats, etc. Although expensive, they provide the facility for long-range command detonation of IEDs.

g. **Post Office Bleeper System**

There is available on hire from the Post Office a personal calling system whereby a person can be informed whenever he is required to contact his base organization.

He carries a small radio receiver and when a 10-digit number is dialed on any PO telephone, a PO transmitter transmits a selected frequency around 147 MHz which causes the personal receiver to emit a bleeping tone.

It may be possible for the receiver to be modified to activate an IED firing circuit, and thus a receiver and telephone number could be hired by a terrorist, the IED laid at the target and initiated by a telephone call hundreds of miles away.

SECTION 2 – CHEMICAL SWITCHES

31. Chemical switches in explosive devices are normally used to ignite a length of burning fuze inserted into a non-electric detonator. The chemical make-up of the substances used is given in Army School of Ammunition Precis AP 239C. Refer to notes.

a. **Glass Tube/Contraceptive** (Figure 88)

When the glass tube containing the acid is crushed, the acid eats through the contraceptive and reacts with the sugar chlorate mix. The resulting ignition then ignites the burning fuze. This type of switch may be used for delay strength and quality of contraceptive. There is also the possibility that slivers of glass may penetrate the rubber immediately.

b. **Table Tennis Ball** (Figure 89)

A table tennis ball is pierced, acid injected, and the hole taped over. The ball is then placed in a container of sugar chlorate mix, into which the end of the burning fuze is inserted. The acid eats through the plastic ball and ignition occurs. This method gives delays of between two and six hours. Longer delays (10-12 hours) can be obtained by using two table tennis balls as shown in figure 89.b.

SECTION 3 – MECHANICAL SWITCHES

32. Mechanical switches are generally used in the boobytrap role, functioning when some form of handling of the IED takes place. Some examples are described below.

a. **Hand Grenade with Fly-Off Lever** (Figure 90)

The grenade, with safety pin in position, is placed into a container with the fly-off lever upwards. The lid of the container is taped in position to hold the fly-off lever secure. The safety pin is then removed with a piece of thin wire through a hole in the side of the container, the hole being then taped over.

Opening of the container releases the fly-off lever and the grenade detonates.

b. **Mousetrap Gun** (Figure 91)

A .22 inch rimfire cartridge, with the projectile removed, is inserted into a non-electric detonator. The whole assembly is then secured to the baseboard of a mousetrap, the fly-over lever of which is held back against spring tension by a length of solder. The solder eventually releases the fly-over bar which strikes the base of the cartridge. The cartridge fires and initiates the detonator by flash.

c. **Service-Type Release Switches** (Figure 92)

These switches may originate from many countries, and although varying in appearance, their basic operation is identical.

They consist of an outer container, inside which is a spring-loaded striker, held under spring tension by a release catch and poised over a percussion cap and/or a non-electric detonator.

When the release catch is operated by some means, the striker is driven on to the percussion cap or detonator by the tensioned spring, resulting in initiation.

Another type uses a soft wire to restrain the striker. Adjacent to this wire is a glass phial containing acid. When the glass is crushed, the acid gradually weakens the wire until the striker spring overcomes it.

Service-type pressure switches are similar in design to that shown in the diagram, but require the application of pressure to fire.

Very resistant to disruptors.

d. **Cigarette Lighter Device** (Figure 93)

This device, designed to maim rather than kill, has been encountered in many countries.

When the wheel is rotated, a spark from the flink ignites a short length of burning fuze, which in turn ignites a small quantity of confined low explosive.

SECTION 4 – FRICTION SWITCHES

33. With the exception of manually initiated IEDs, e.g. nail bombs, the friction type of switch is not popular with terrorists. Examples of those encountered are given below:

a. **Sandpaper Flap** (Figure 94)

The device make-up is as shown in the diagram. When the hinged lid of the container is opened, the sandpaper flap attached to it is drawn across the matchheads and the burning fuze is ignited and in turn the detonator and explosive are initiated.

b. **Clock Friction Switch** (Figure 95)

At the time set for alarm operation, the alarm winder rotates, and the matches attached to it are drawn across the sandpaper on the underside of the lid. The combustible material is ignited and the heat generated causes the detonator to initiate. The main charge may be explosive or petrol.

c. **Needle in Detonator** (Figure 96)

When the card is withdrawn from its envelope, leverage is applied to the needle via the thin cord, and the needle is projected into the non-electric detonator.

SECTION 5 – SPECIAL COMPONENTS

34. Certain components used in IEDs do not fall into any clear category. These components are dealt with in this section.

a. **Thyristor** (Silicon Controlled Rectified) (Figure 97)

This component is a form of electronic switch. It has no moving components, its action being governed solely by electron flow.

The thyristor is connected into the positive supply line of a device, but does not allow the passage of current.

To make the thyristor conduct, a positive going pulse must be applied to its gate. This pulse can be generated by most eletronic circuits used in devices.

Even if the gate pulse is removed, the thyristor continues to conduct until one or the other of the main supply lines is broken.

b. **Post Office Fuze** (Figure 98)

This fuze is used in PO telephone exchanges as a non-reversible switch to activate alarm systems in the event of equipment breakdown. In some countries it is known as a "grasshopper" fuze.

When sufficient current is passed through the fuze, the fuze wire melts and the metal fuze wire supports spring outwards. One or both of these can be used to complete another part of the electrical circuit by placing a contact in a suitable position.

PO fuzes are normally used as arming devices, and a simple circuit showing its use is at Figure 99. The action is as follows:

i. The device is placed so that the anti-lift microswitch is open.

ii. When a metal object is placed across shorting links 'SS' current flows from the battery through the fuze 'A' to 'B'.

iii. The fuze-wire melts, the contacts move outwards, and the contact connected to point 'A' touches a contact at point 'C'. The line from 'B' to the shorting links is now out of circuit.

iv. When the microswitch is operated by some means, current flows from battery negative to points A, C, the detonator, through the switch to battery positive and the device functions.

35. Whilst, generally, batteries are easily recognisable as such, certain types can pose difficulties in identification.

a. **Polaroid Battery**

This battery is contained in cassettes of coloured Polaroid film to provide power for flash photography.

i. Dimensions overall—4 inches x 3 inches x 0.1 inches in depth.

ii. Voltage—6 V

iii. Appearance—Contained in a protective envelope, one side of which is clear plastic, showing metal jacket of battery, the other side being of thick grey paper with two oval cut-outs exposing the contacts.

iv. Is capable of firing an electric detonator even after use with entire cassette of film.

v. Manufacturer—Ray-O-Vac, USA

b. **Photovoltaic Solar Cell**

These cells were initially developed for space-work, but are now available commercially. They produce a small electrical current when exposed to light. For use in an IED about six of these cells would be required.

i. Dimensions—1.5 inches square x 0.2 inches in depth.

ii. Voltage—0.5 to 1.5 V, varying with type.

iii. Current—Maximum of 20 mA, varying with type.

iv. Appearance—Thin metal frame and backing. Front window of ribbed plastic. One wire to casing, and one to an insulated contact. Another type has metal backing, with a brown selenium facing and two lead wires connected at one corner.

SECTION 6 – DETONATORS AND ACCESSORIES

36. In the main, detonators and accessories used in IEDs are commercial types, originating from many countries.

Full details of all commercial detonators and accessories known to have been used in IEDs are given in Army School of Ammunition Precis AP 5.

37. There have been instances of improvised detonators being used in devices. Details of these are given below.

a. **FLM Electric Detonator** (Figure 100)

Consists of a torch bulb having a hole in the glass and being filled with gunpowder, to which is taped a non-electric detonator.

b. **Modified Electric Igniters**

The Igniter Safety Fuze Electric and Powder Fuze 5 gr. detailed in Part 2, Section 2 of this precis can be modified by taping a non-electric detonator on to them.

SECTION 7 – EXPLOSIVES

38. Explosives used in IEDs are normally of the commercial or home-made types, very little service explosives being used. These will be covered in a separate precis.

PART 2 – INCENDIARY DEVICES

39. Incendiary devices are normally designed to destroy property by burning although exceptionally they may be used in the anti-personnel role.

SECTION 1 – SWITCHES

40. Switching components and arrangements used in incendiary devices are similar to those used in explosive devices and are detailed in Part 1, Sections 1-5 inclusive, of this precis.

SECTION 2 – IGNITERS

41. Igniters used in incendiary devices may be of the simple chemical composition/burning fuze type or of an electrical component type. Details of chemical igniter compositions are given in Army School of Ammunition Precis AP 239C, with details of the electrical components being given below.

a. **Igniter Safety Fuze Electric** (Figure 101)

This component is available from both service and commercial sources, being designed specifically to ignite burning fuzes but can also ignite incendive compositions.

It consists of an open ended copper tube, 1.25 inches long and 0.25 inches diameter, containing an electrically initiated matchhead. The electrical lead wires protrude through a rubber sealing plug crimped into one end of the tube.

b. **Powder Fuze, 5 gr.** (Figure 102)

This is a commercial electric igniter designed for the initiation of black powder. It is often referred to as a 'puffer'.

It consists of a cardboard tube, 1.25 inches long and 0.25 inches diameter, closed at both ends by a yellow wax-like composition. The tube contains an electric matchhead and 5 gr. of black powder, the electrical lead wires protruding through the wax sealant at one end of the tube.

c. **Broken Torch Bulb** (Figure 103)

This is a normal torch bulb, the glass of which has been broken but the filament left intact. Electrical connection is either by leads soldered to the bulb or by the bulb being screwed into a holder.

d. **Gas Lighter Element** (Figure 104)

This is a commercially available component designed for the ignition of gas cookers, etc. It consists of a slotted metal tube containing an igniter filament, one end of the tube being open, the other end accommodating a screw-threaded bulb-type connection.

e. **Hot Wire Igniter** (Figure 105)

A home-made igniter, consisting of a wooden block through which are driven two nails. A piece of thin wire is either wound on, or soldered to, the two nails, acting as a bridgewire igniter. The electrical lead wires are connected to the other ends of the nails. A variation of this type of igniter has the bridgewire cut. The small gap between the ends is bridged by wire wool which glows when power is applied. Sometimes referred to as "wire wool igniter".

f. **Post Office Fuze** (Figure 99.b)

When the bridgewire end of the new type PO fuze is inserted into an incendive composition it will also act as an igniter.

SECTION 3 – INCENDIVE MATERIALS

42. Incendive materials are normally home-made chemical mixtures, the details of which are contained in a separate precis. Additionally, lighter fuel in either plastic capsules or tins is sometimes included.

PART 3 – EXPLOSIVE INCENDIARY DEVICES

43. Explosive incendiary devices are similar in composition to the incendiary devices detailed in Part 2 of this precis but in addition contain detonators or detonators or explosives, the detonators being initiated by the heat generated from the incendive materials.

PART 4 – COMPLETE DEVICES

44. It is impracticable to illustrate every type of device which may be encountered. As a compromise, a number of the more complex devices have been selected to show the techniques employed by the terrorist.

a. **Double Anti-Lift Switch Device** (Figure 106)

A false bottom to the device conceals a second battery, anti-lift switch, detonator and explosive. If the container is opened and the exposed firing circuit neutralised, it was hoped by the terrorist that the container would then be lifted, thus causing the concealed firing circuit to function.

b. **Doorbell Collapsing Circuit Device** (Figure 107)

The electrical circuit was similar to that in Figure 55, but an electric detonator was connected in series with the solenoid energising coils.

Whilst the relay, power supply and primary detonator were concealed beneath the explosive, the leads and part of the body of the series detonator were visible. The aim of this arrangement was obviously to encourage the cutting of these leads, thus causing the collapsing circuit to function.

Variations on this theme which have been encountered in other devices are:

i. Leads to the relay energising coil left exposed.

ii. Leads to the relay energising coil passing through a short-circuited clock or watch.

iii. Leads to the relay energising coil passing through a microswitch in the anti-lift mode.

iv. Leads to the relay energising coil have formed a loom around the inner surfaces of the sides and top of the container.

c. **Complex Time/Anti-Handling Device** (Figure 108)

A clock was used to give a delayed arming facility. Firing of the device could be caused by the functioning of one of several components connected in parallel. These components were:

i. Clock- Time Switch

ii. Trembler–A/Handling Switch

iii. Microswitch–A/Lift Switch

iv. Microswitch–A/Open Switch

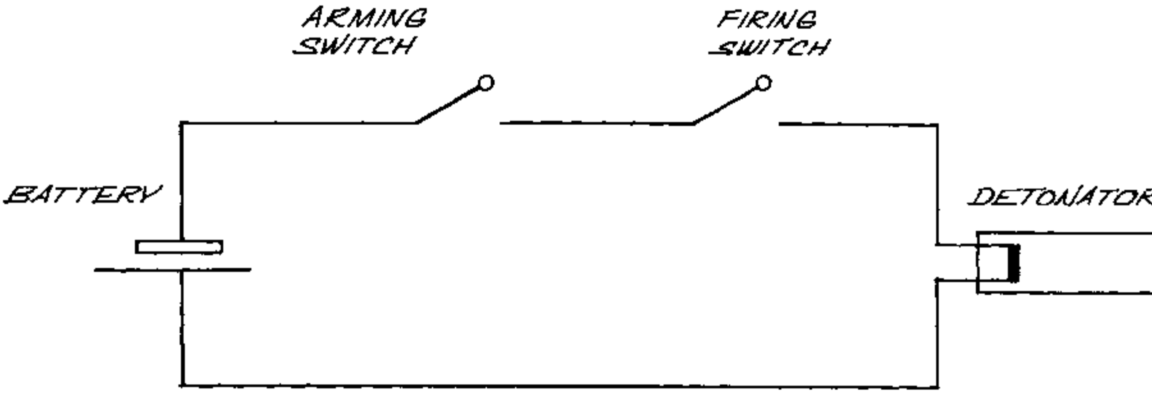

FIG. 1 BASIC I.E.D. CIRCUIT

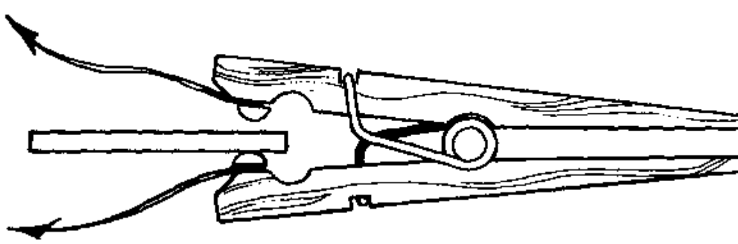

FIG. 2 WOODEN CLOTHES PEG

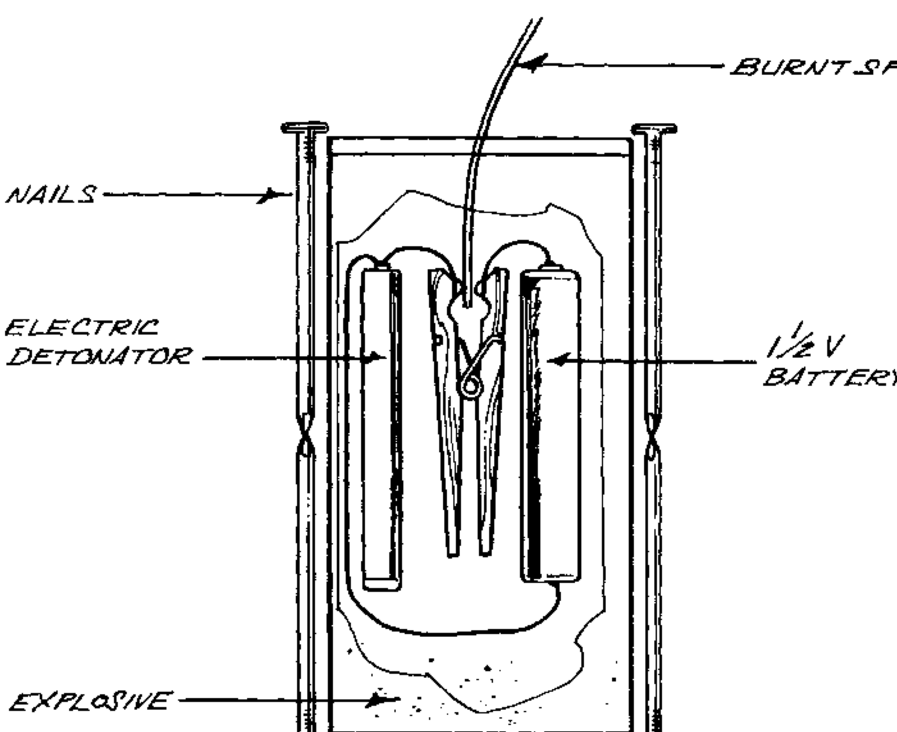

FIG. 3 MISFIRED NAIL BOMB WITH C'PEG

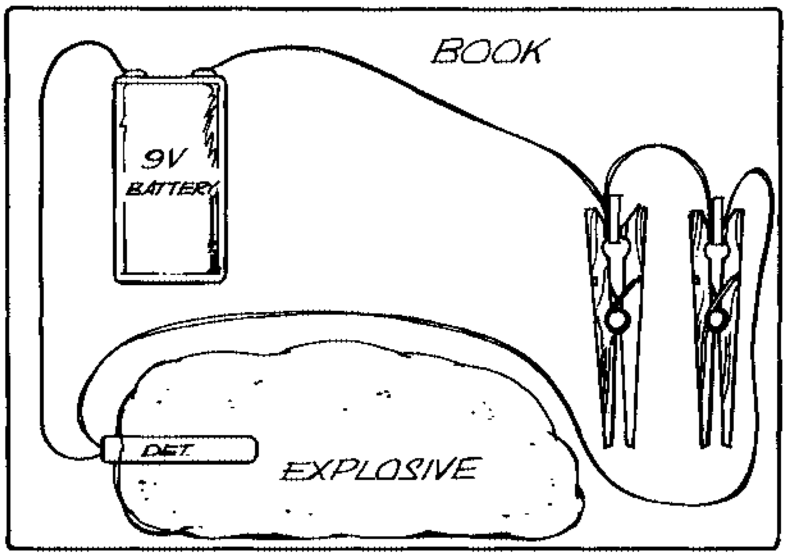

FIG. 4 BOOK DEVICE

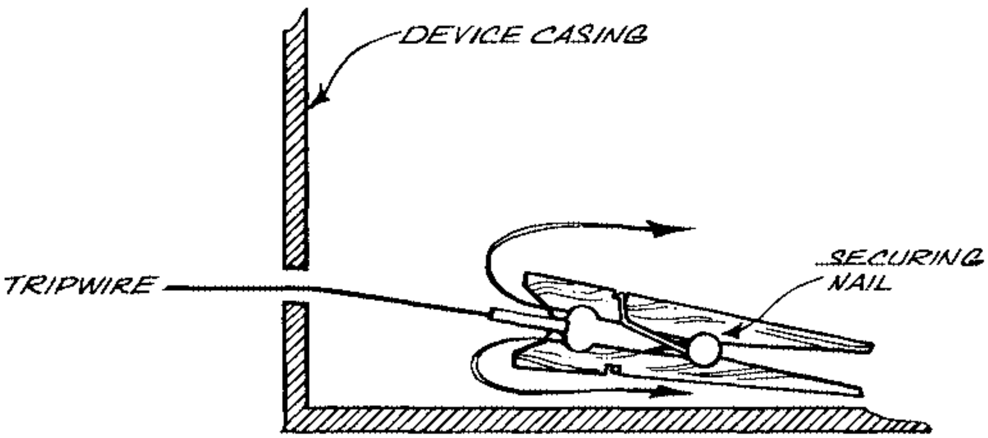

FIG. 5 C' PEG PULL/TRIP SWITCH

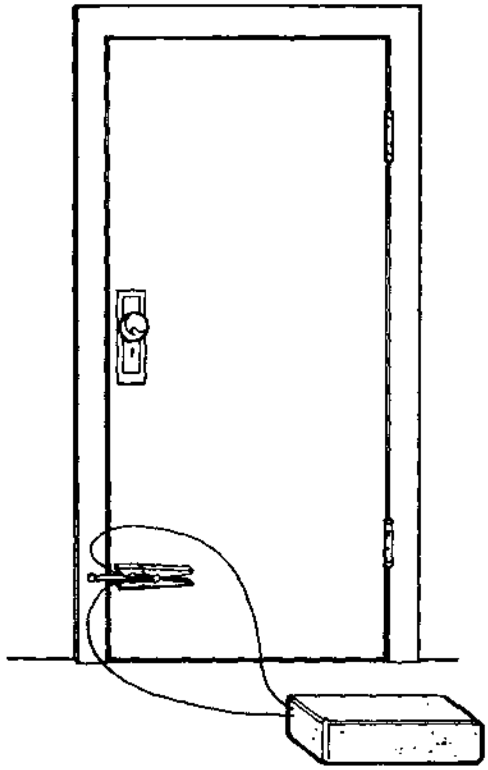

FIG. 6 C' PEG DOOR BOOBY TRAP

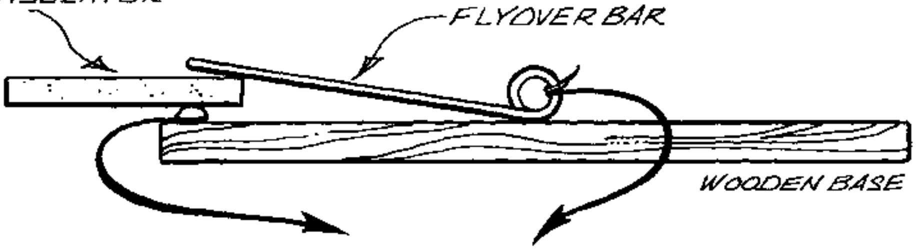

FIG. 7 HOUSEHOLD MOUSETRAP

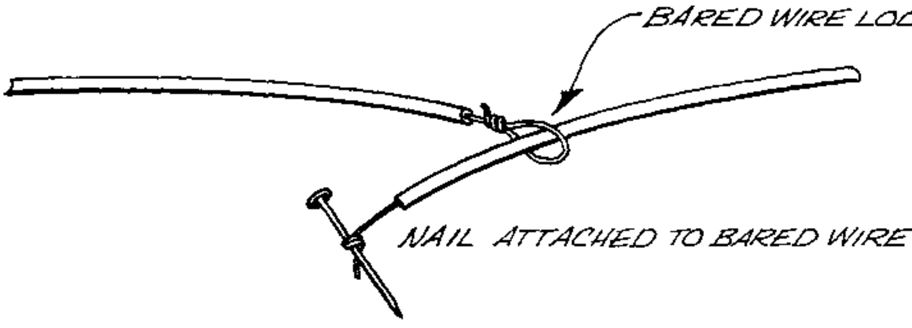

FIG. 8 BARED WIRE

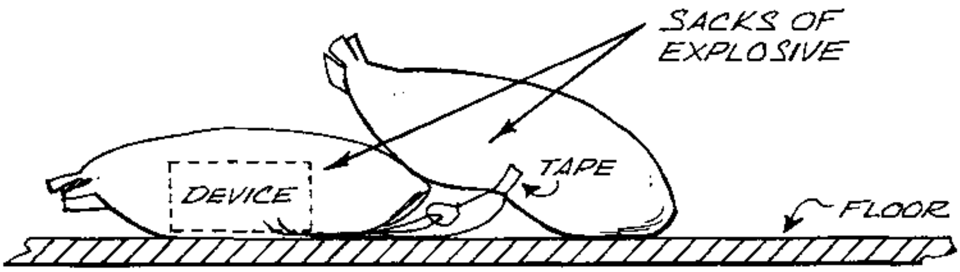

FIG. 9 CACHE BOOBY TRAP SWITCH

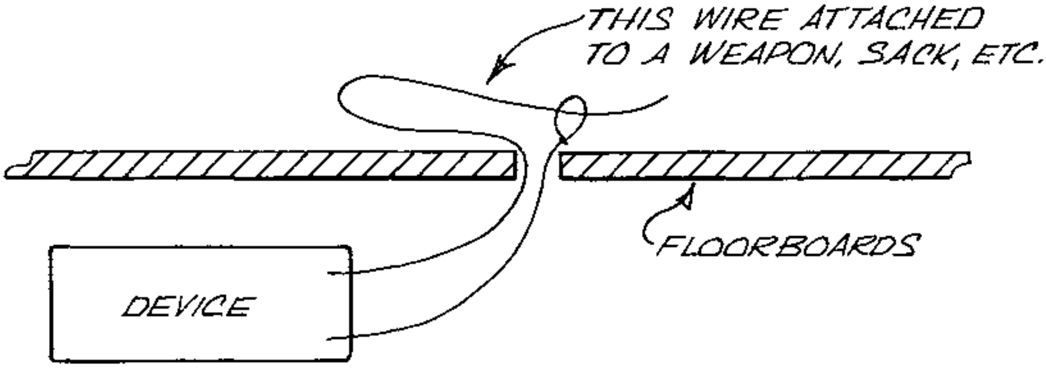

FIG. 10 CACHE BOOBY TRAP SWITCH

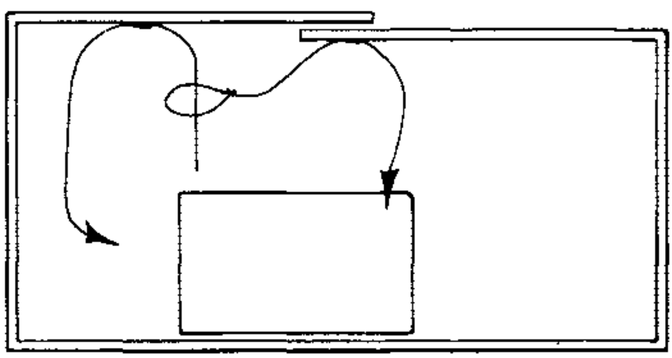

FIG. 11 WIRE ANTI-OPEN SWITCH IN PARCEL

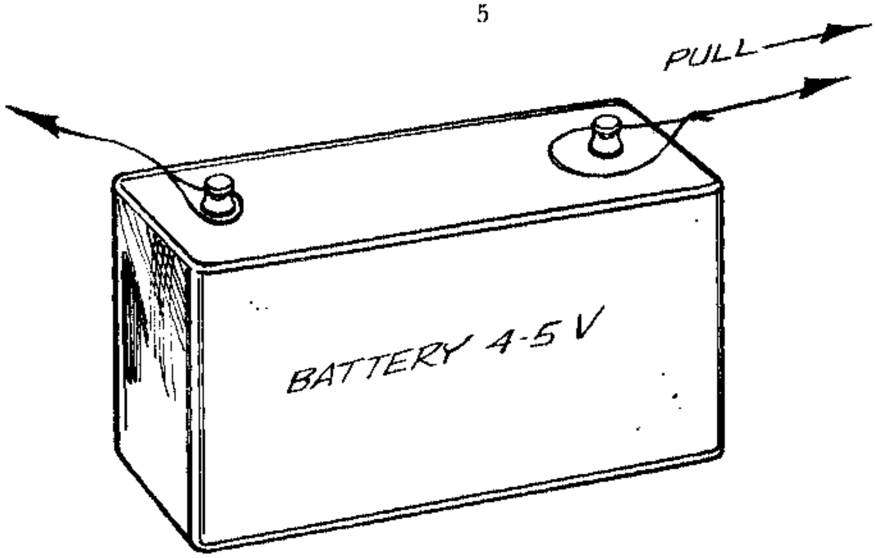

FIG. 12 WIRE LOOP ON BATTERY

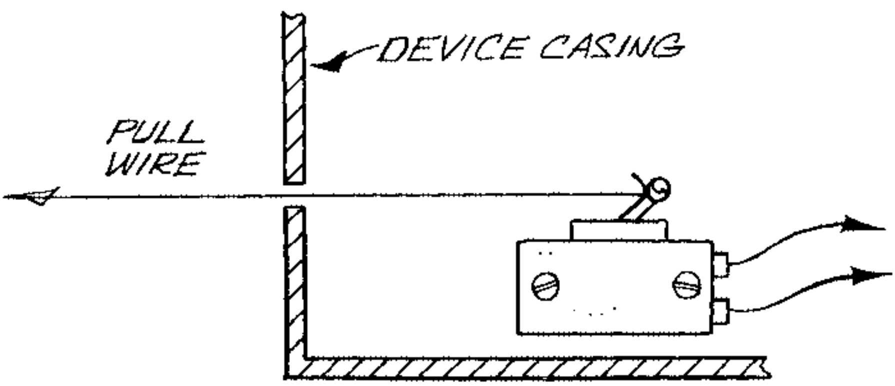

FIG. 13 TOGGLE SWITCH & PULLWIRE

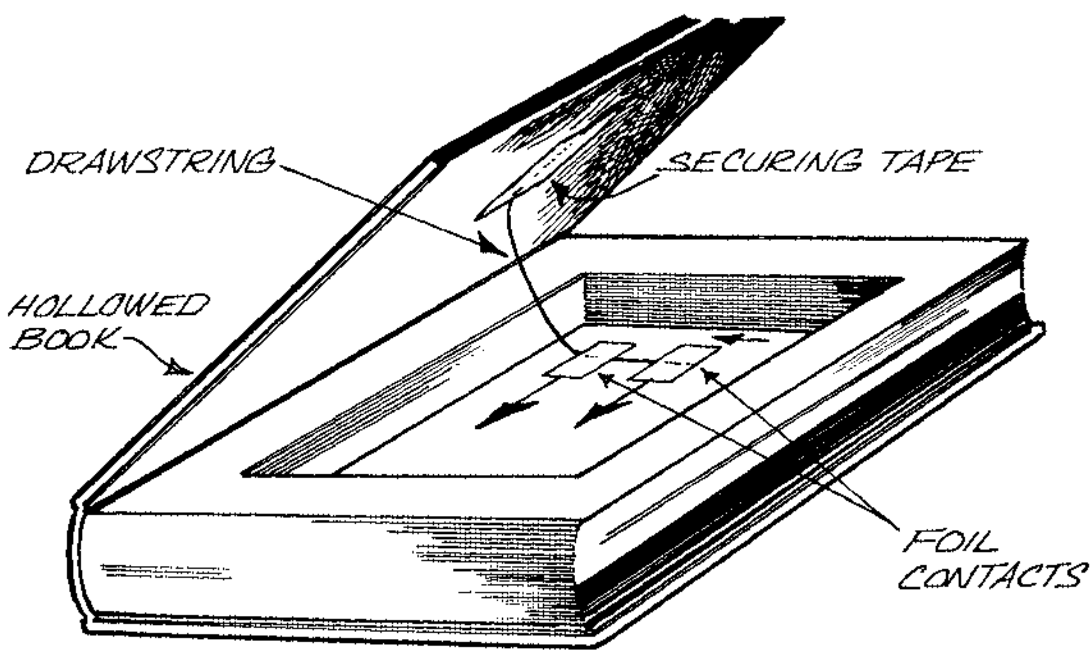

FIG. 14 BOOK DEVICE WITH FOIL CONTACTS

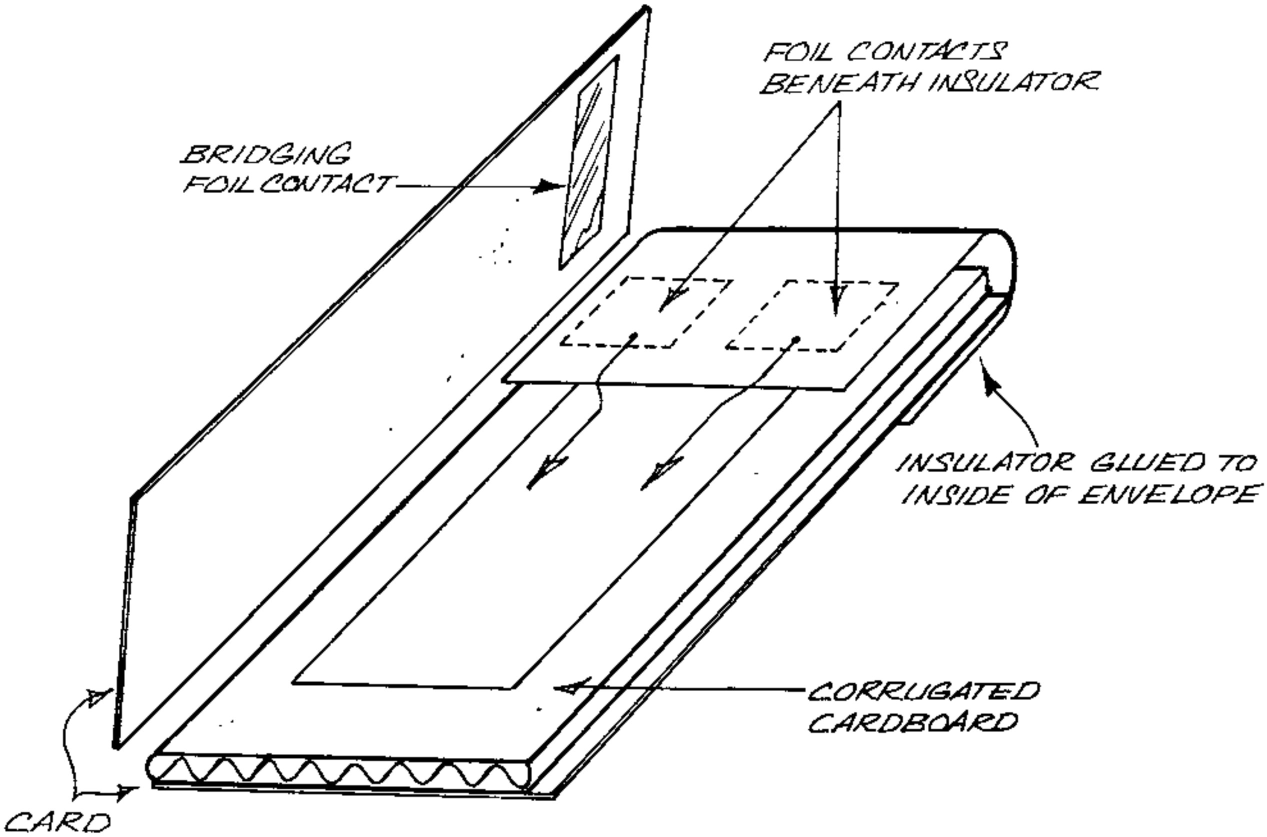

FIG. 15 LETTER BOMB WITH FOIL CONTACTS

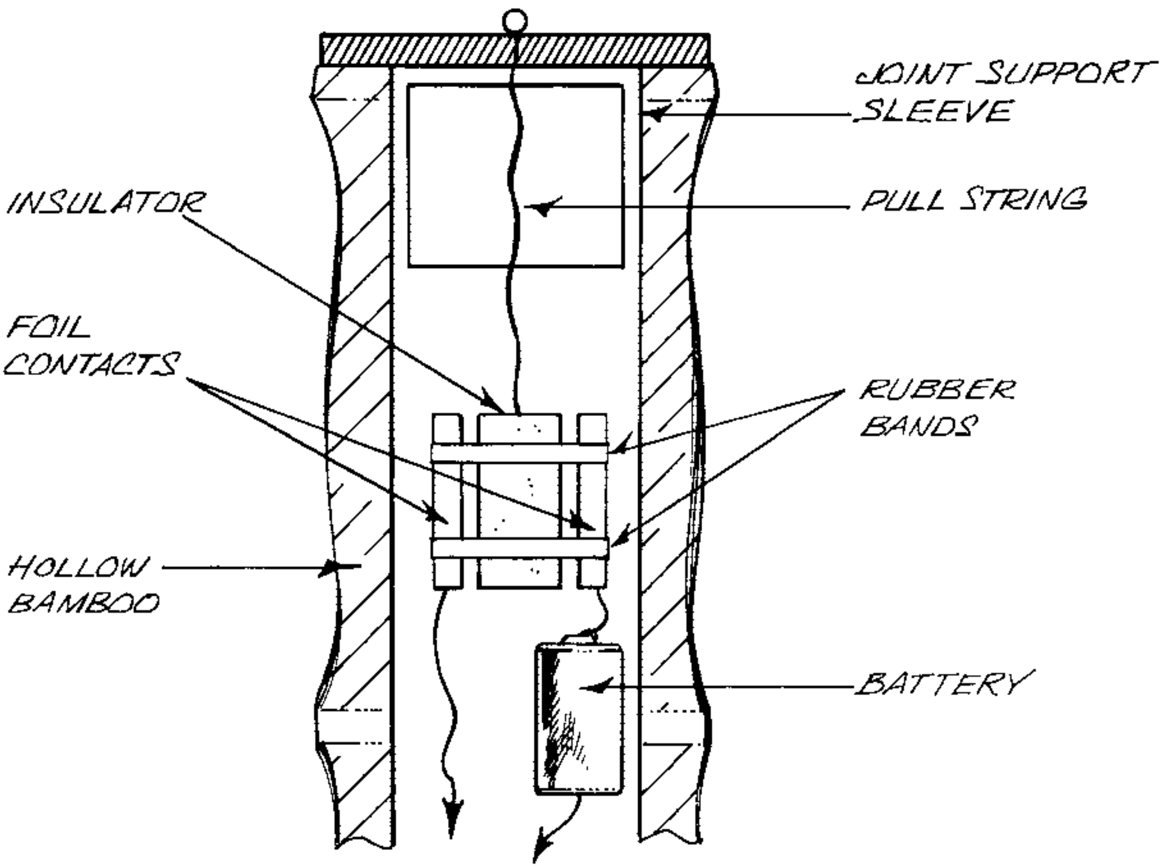

FIG. 16 BAMBOO POLE DEVICE

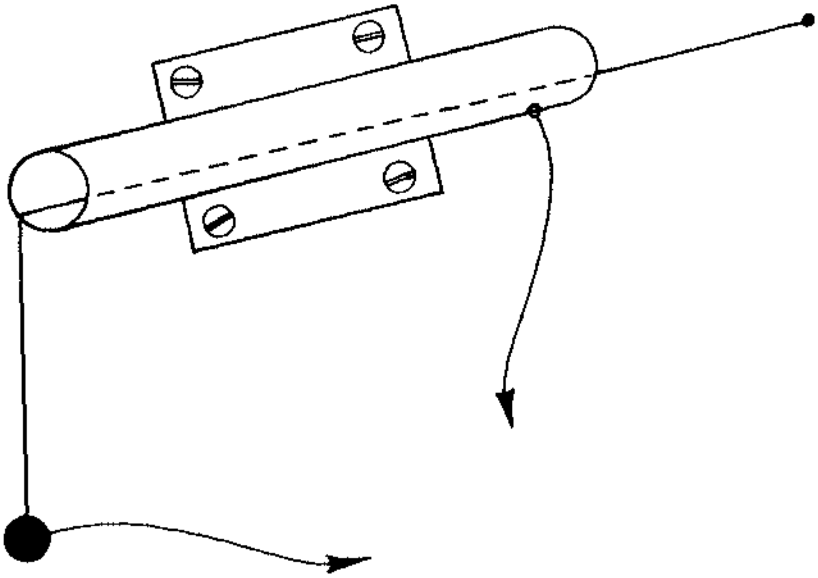

FIG. 17 TUBE & BALL SWITCH

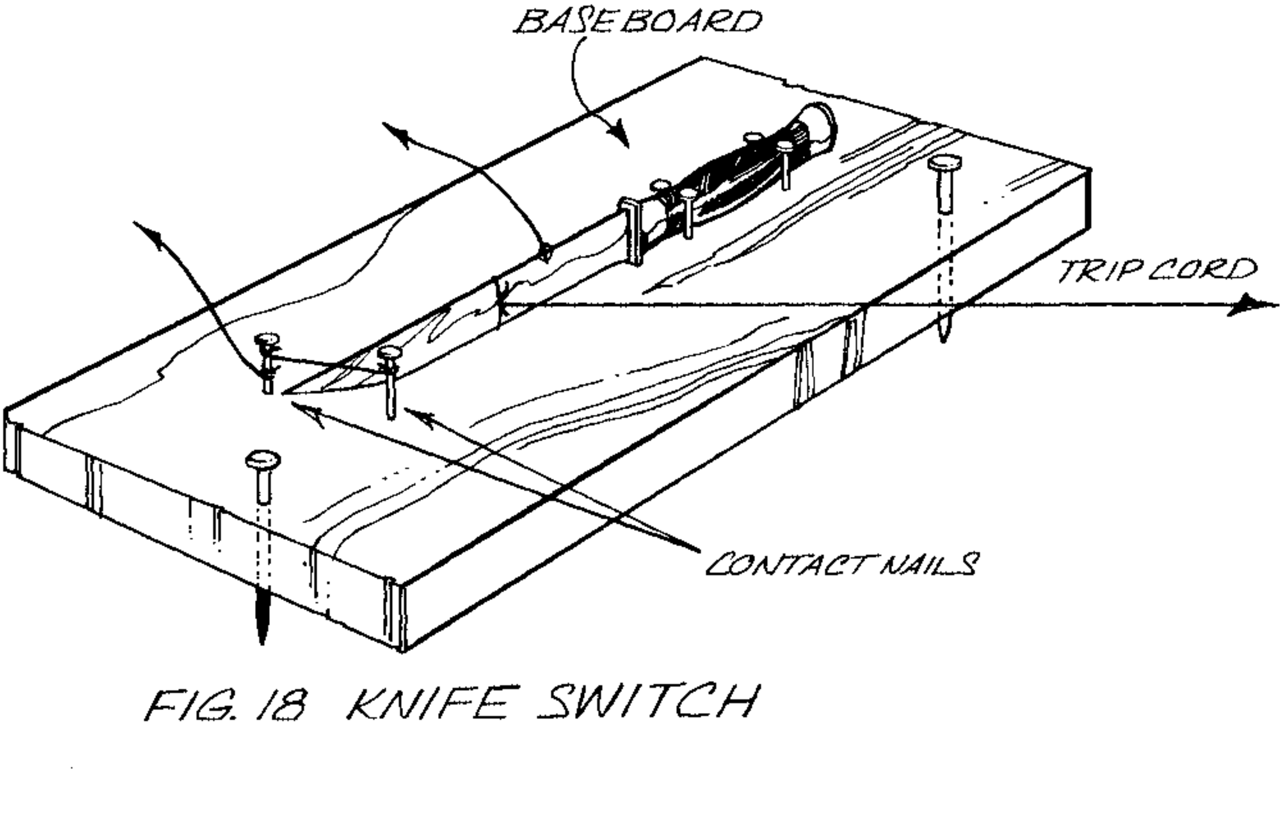

FIG. 18 KNIFE SWITCH

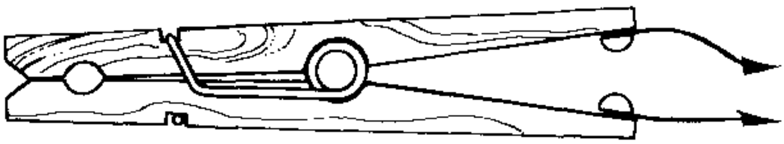

FIG. 19 C'PEG PRESSURE SWITCH

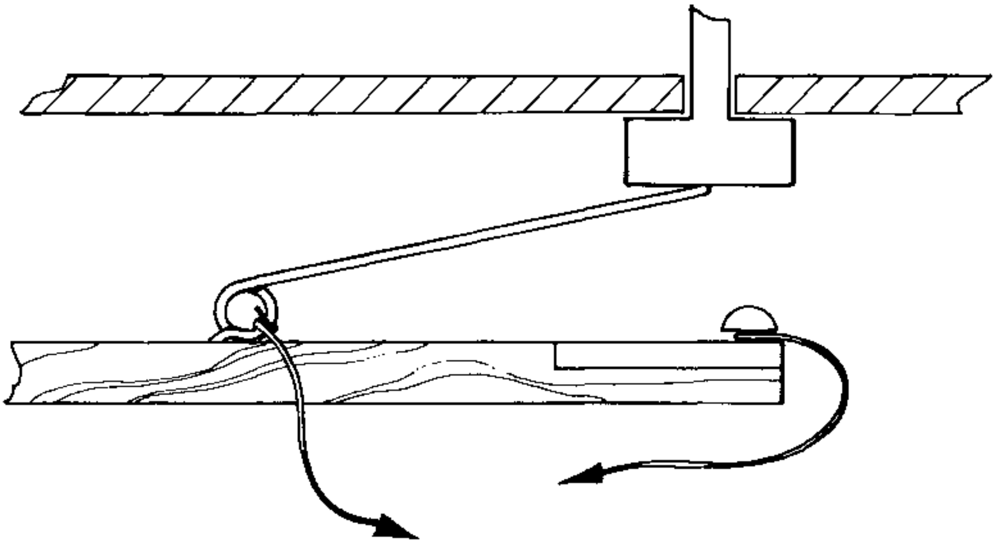

FIG. 20 MOUSETRAP PRESSURE SWITCH

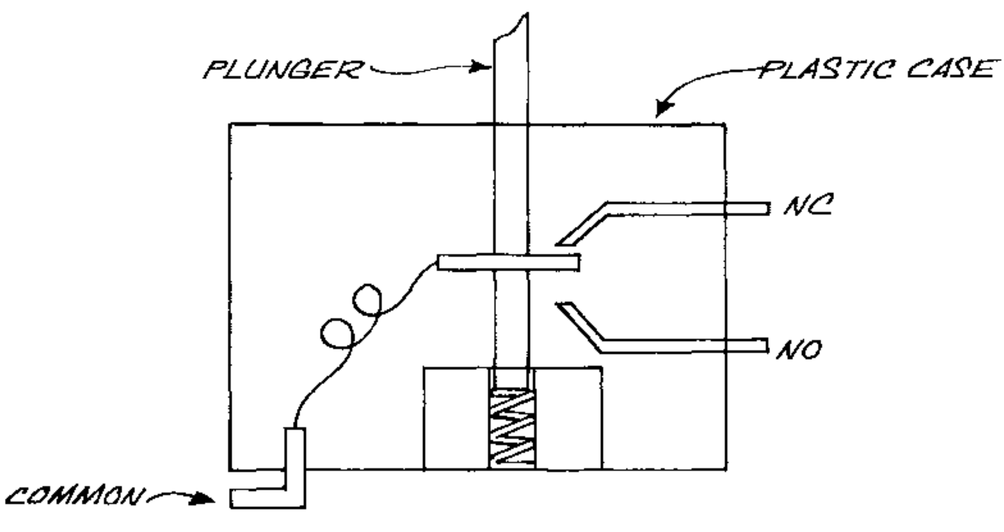

FIG. 21 MICROSWITCH

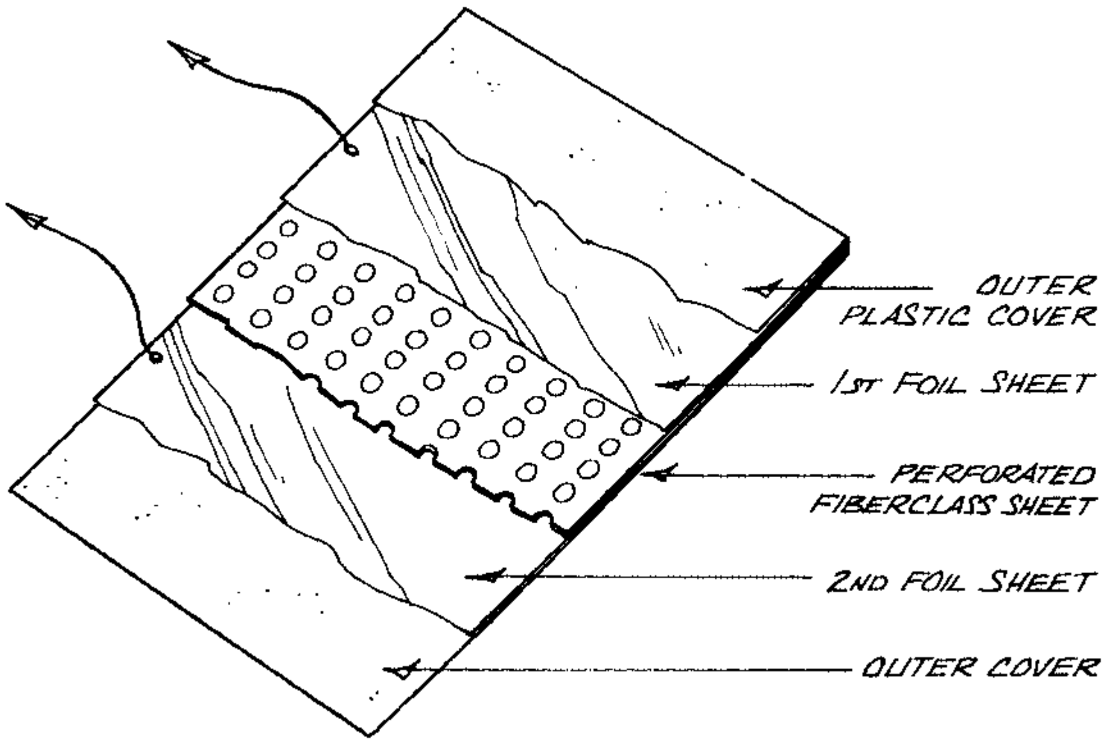

FIG. 22 PRESSURE MAT

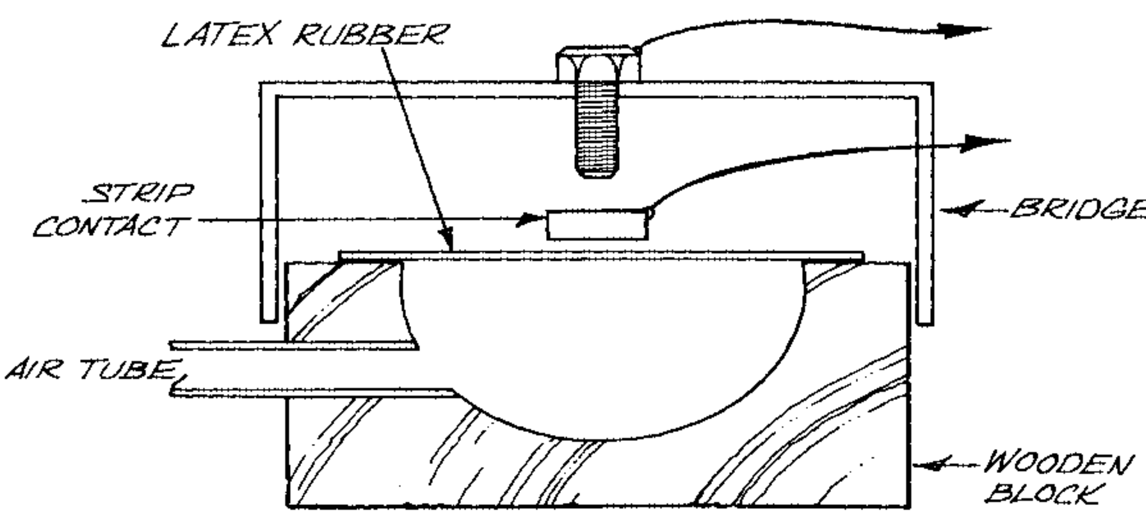

FIG. 23 PRESSURE CHAMBER SWITCH

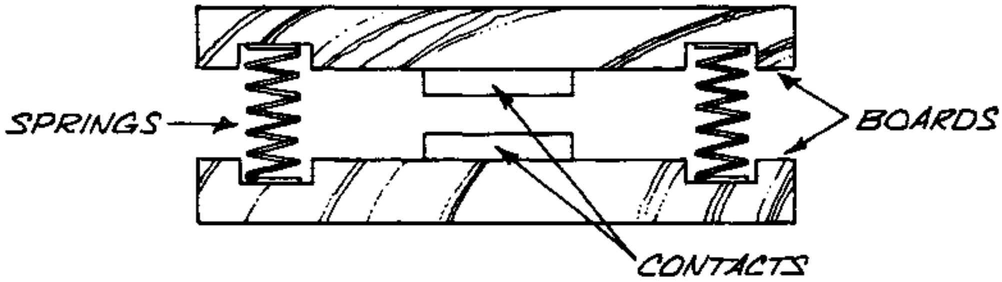

FIG. 24 PRESSURE BOARD

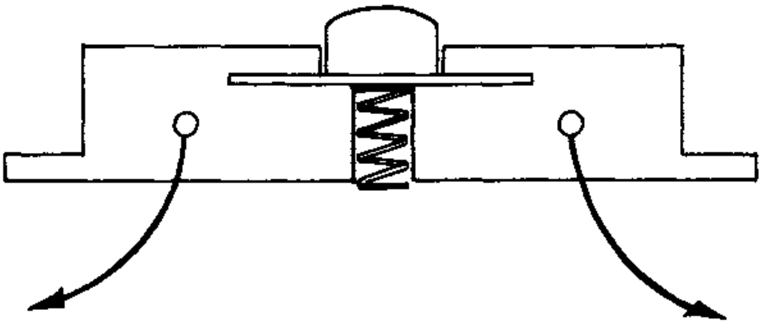

FIG. 25 DOOR BELL PUSH

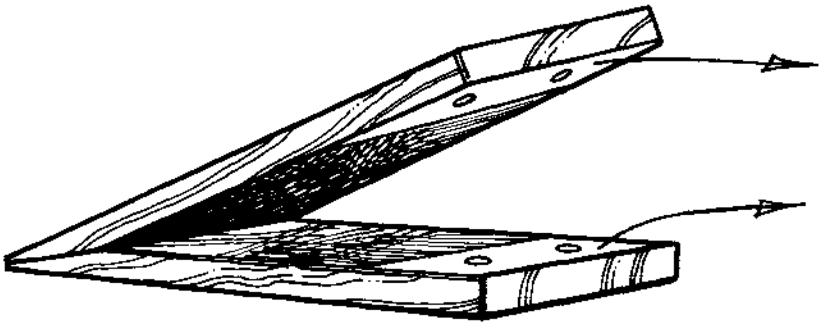

FIG 26 WOODEN WEDGE

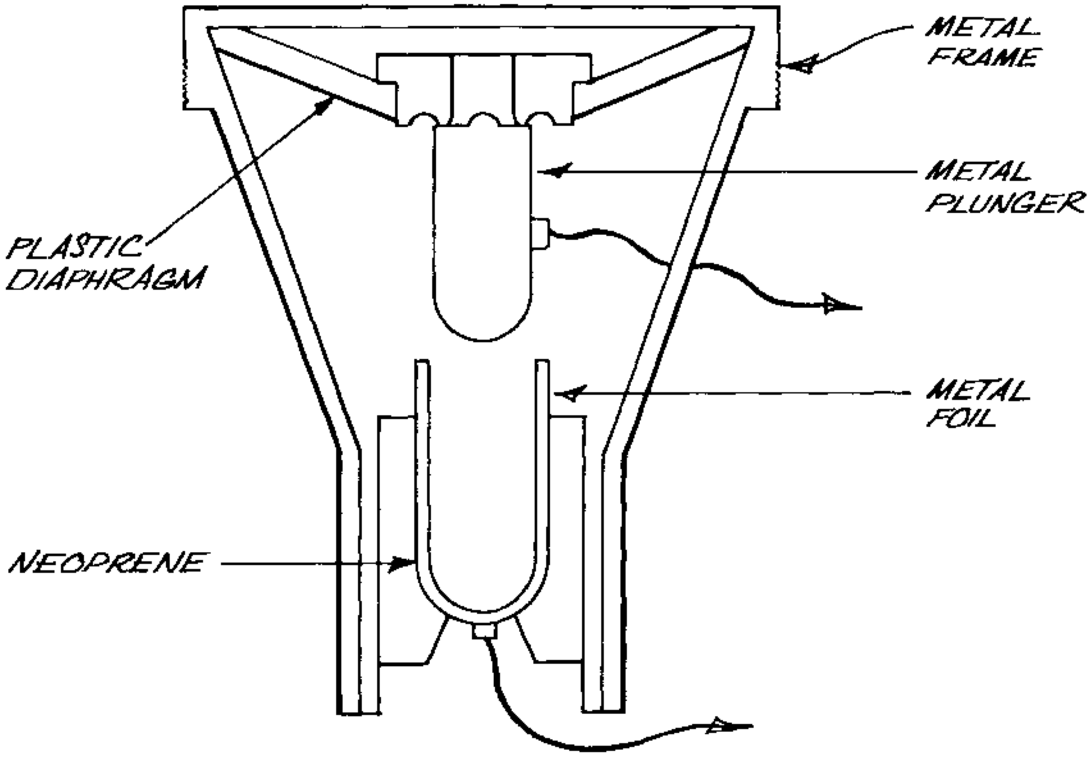

FIG. 27 BEER KEG SWITCH

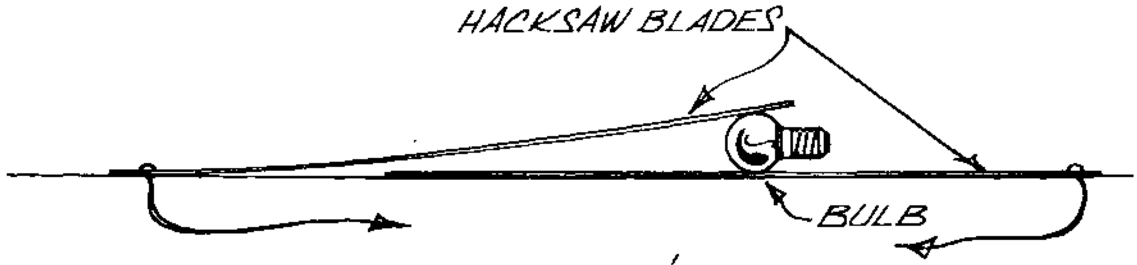

FIG. 28 HACKSAW BLADES/BULB

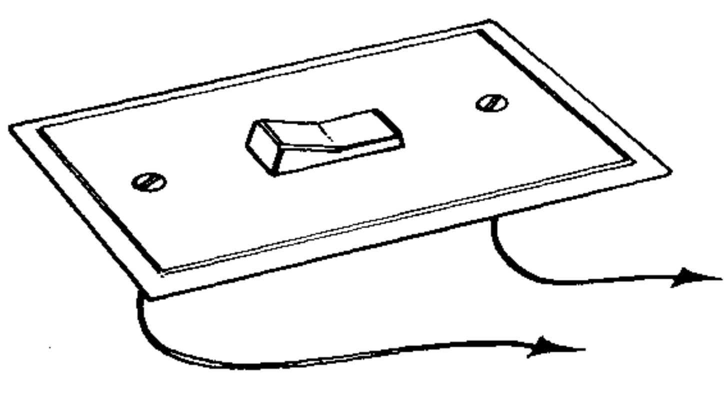

FIG. 29 ROCKER LIGHT SWITCH

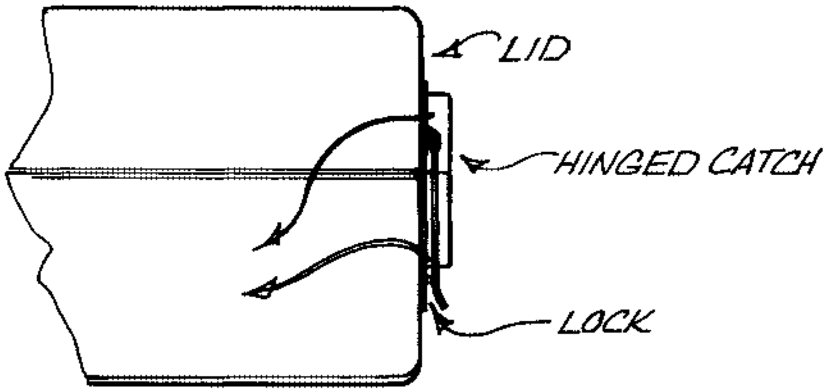

FIG. 30 SUITCASE CATCH

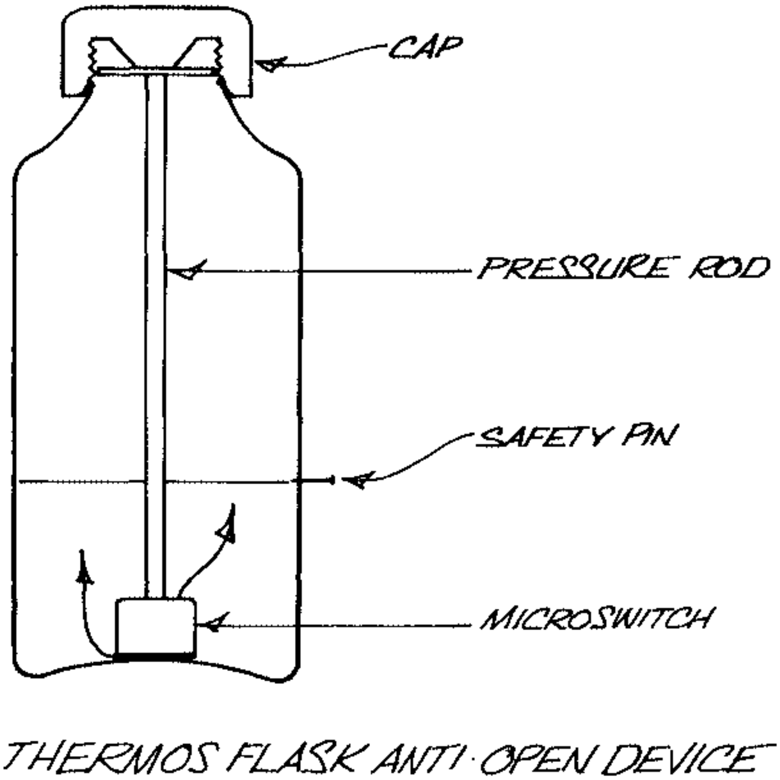

FIG. 31 THERMOS FLASK ANTI-OPEN DEVICE

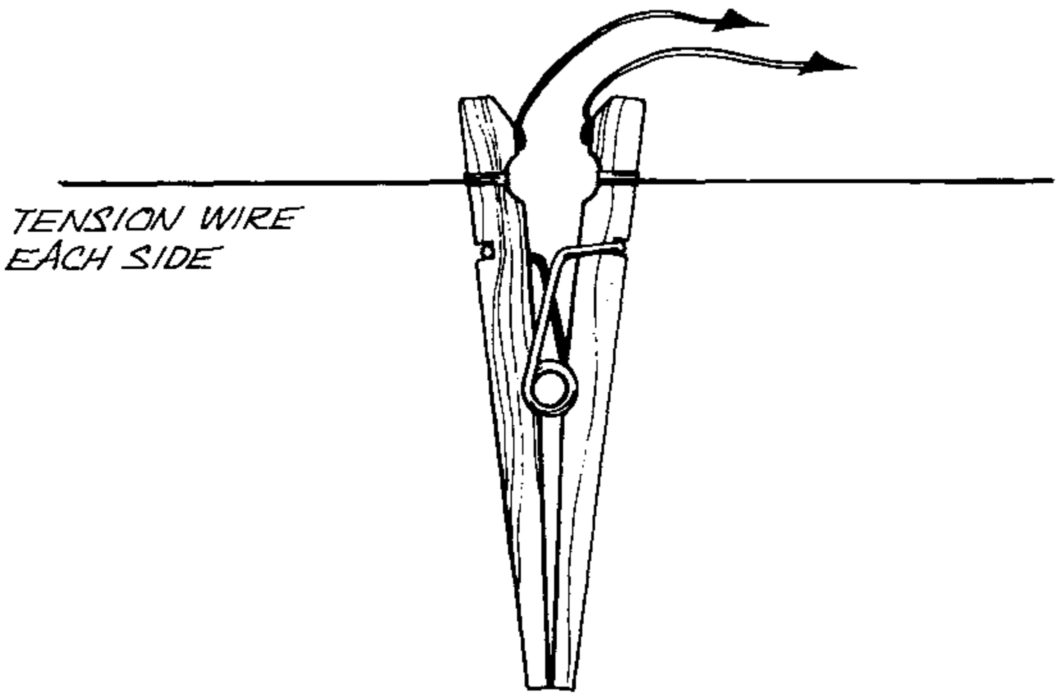

FIG. 32 C' PEG RELEASE SWITCH

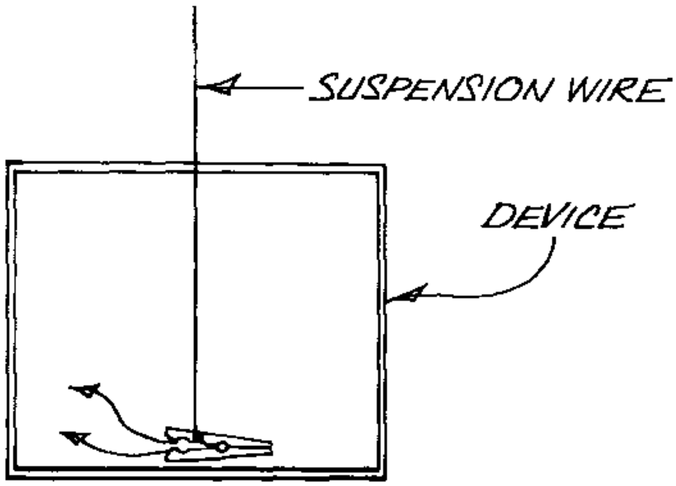

FIG. 33 SUSPENDED DEVICE

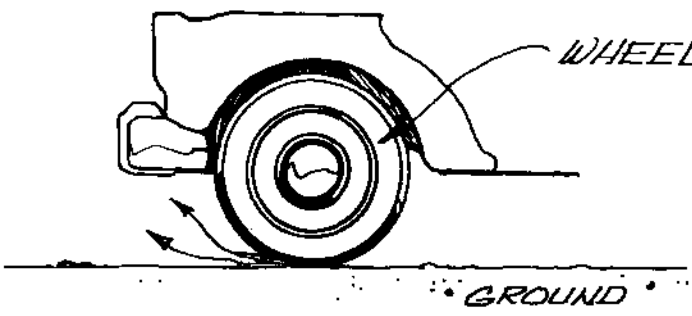

FIG. 34 C' PEG RELEASE SWITCH

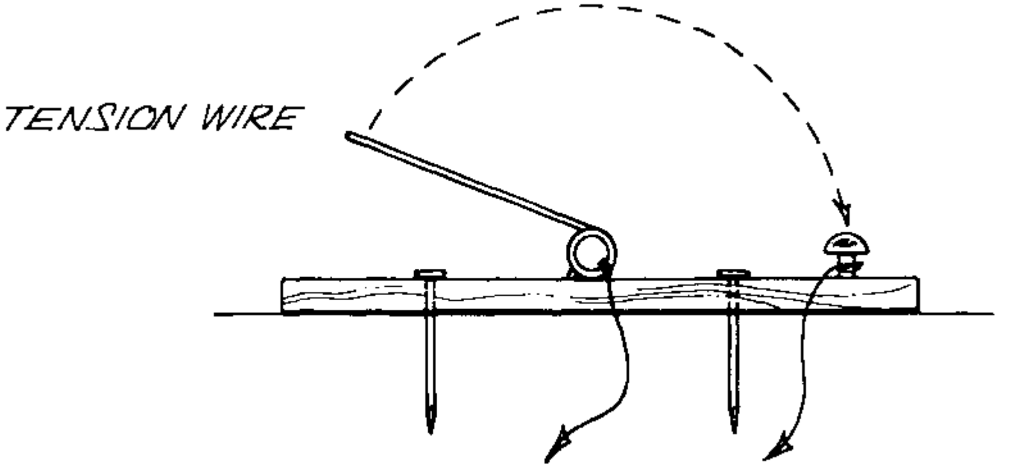

FIG. 35 MOUSETRAP RELEASE SWITCH

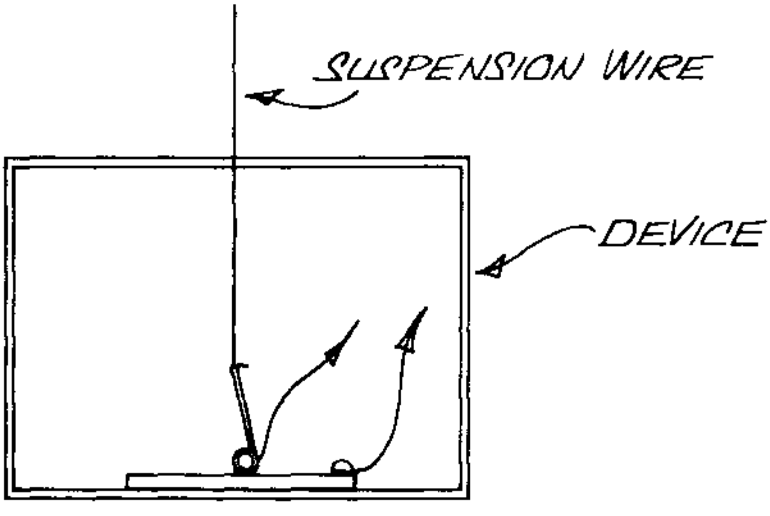

FIG. 36 SUSPENDED MOUSETRAP DEVICE

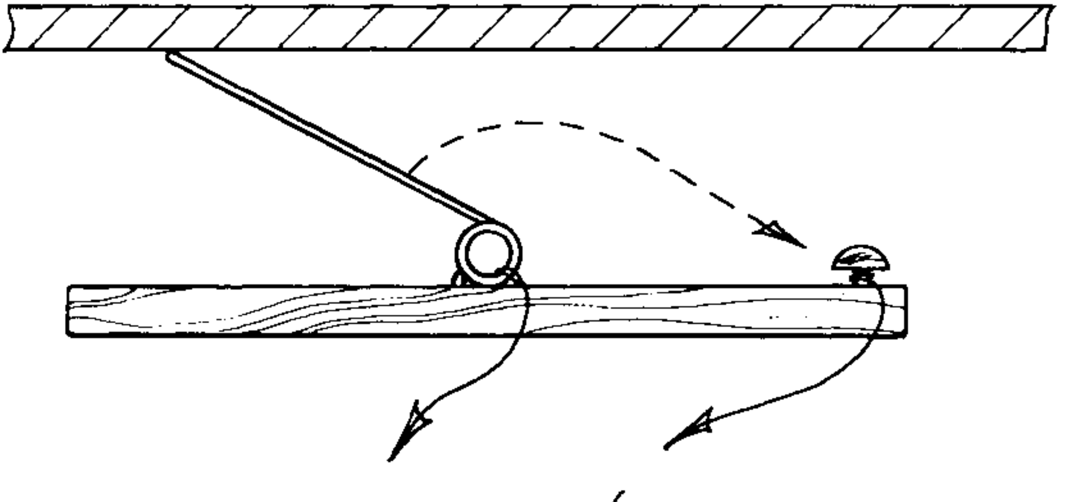

FIG. 37 MOUSETRAP A/OPEN SWITCH

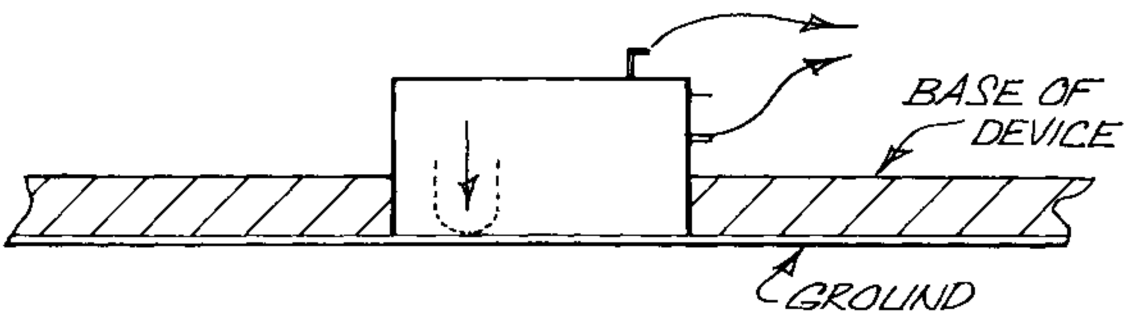

FIG. 38 MICROSWITCH / A LIFT

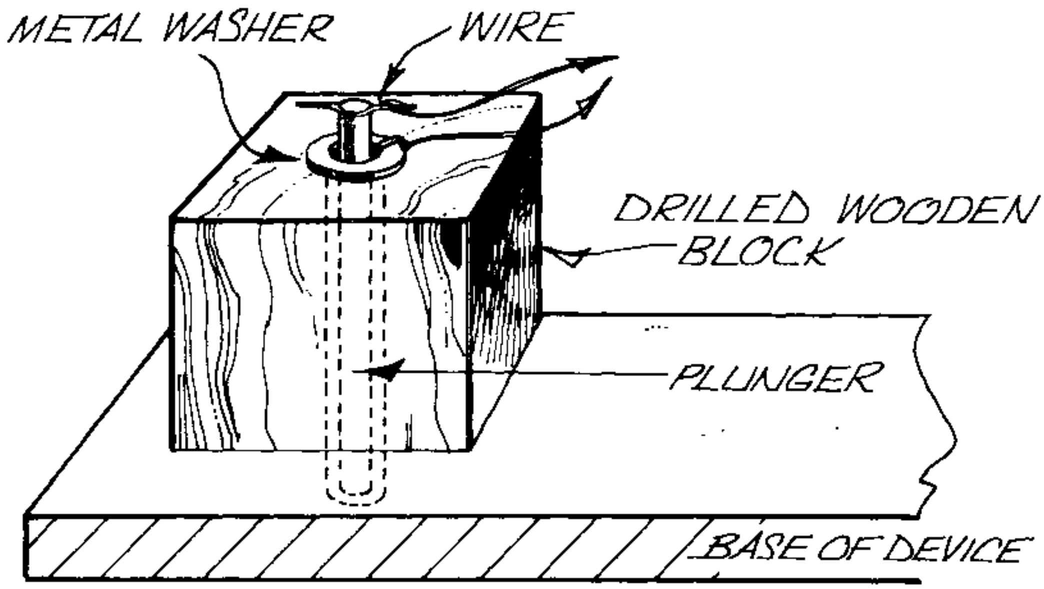

FIG. 39 A / LIFT BLOCK & PLUNGER

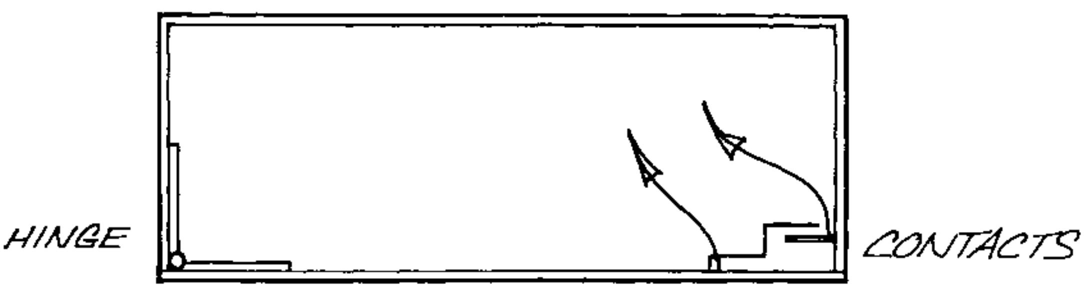

FIG. 40 HINGED BASE DEVICE

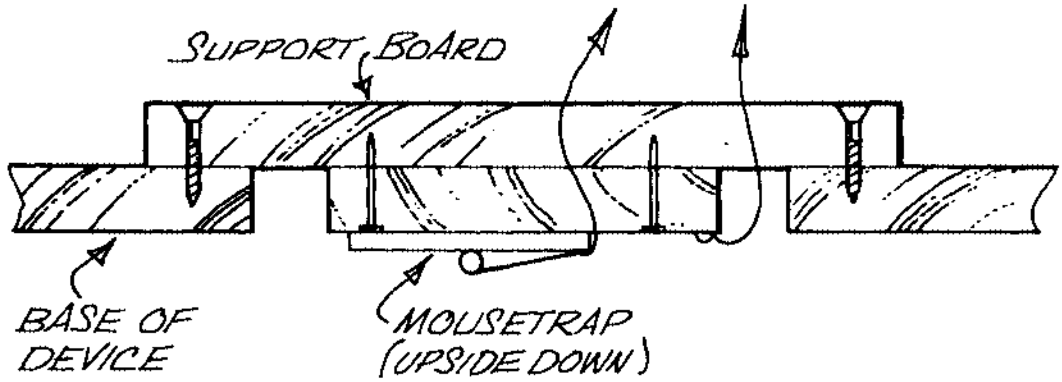

FIG. 41 MOUSETRAP A/LIFT DEVICE

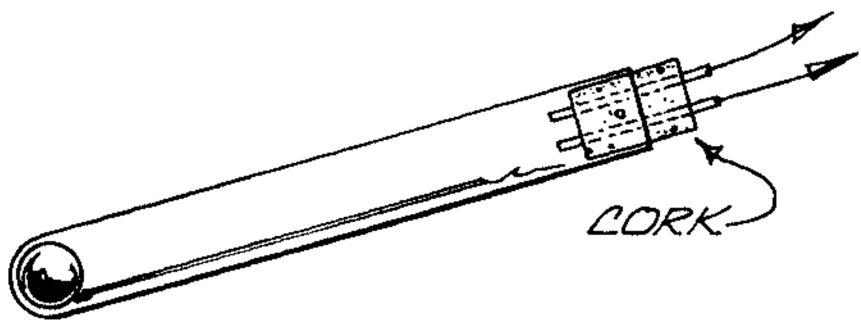

FIG. 42 BALL/TUBE (SINGLE)

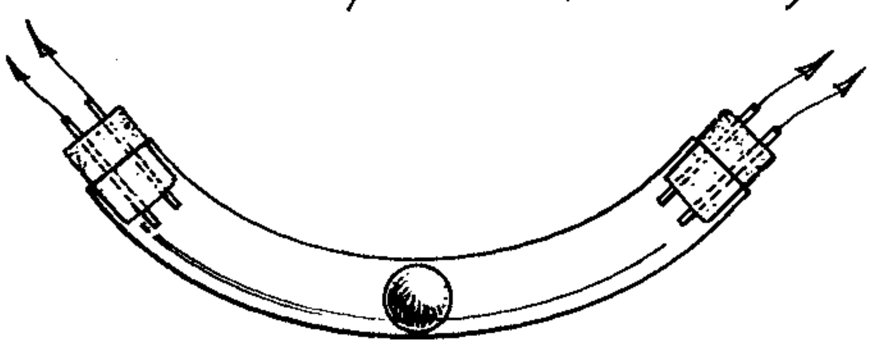

FIG. 43 BALL TUBE (DOUBLE)

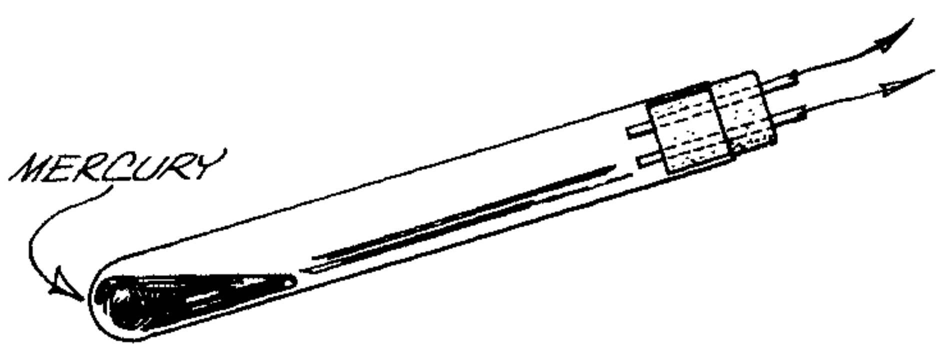

FIG. 44 HOMEMADE MERCURY SWITCH

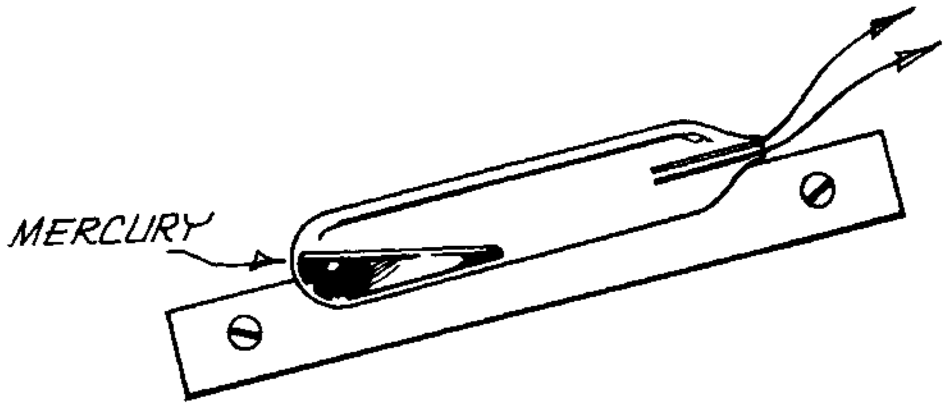

FIG. 45 COMMERCIAL MERCURY SWITCH

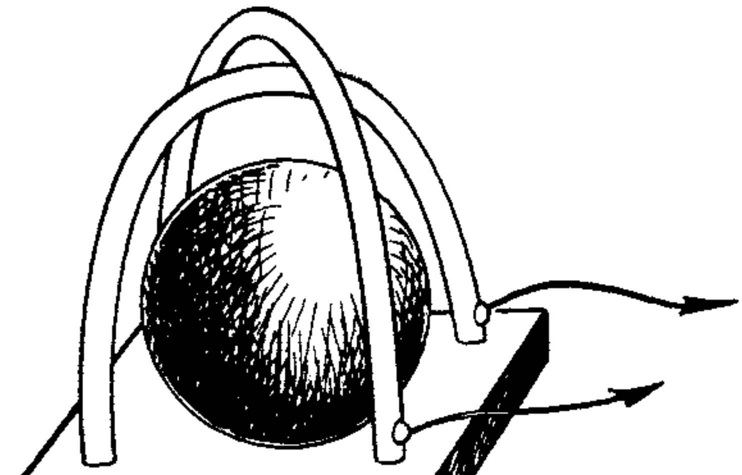

FIG. 46 "ALLWAYS" SWITCH

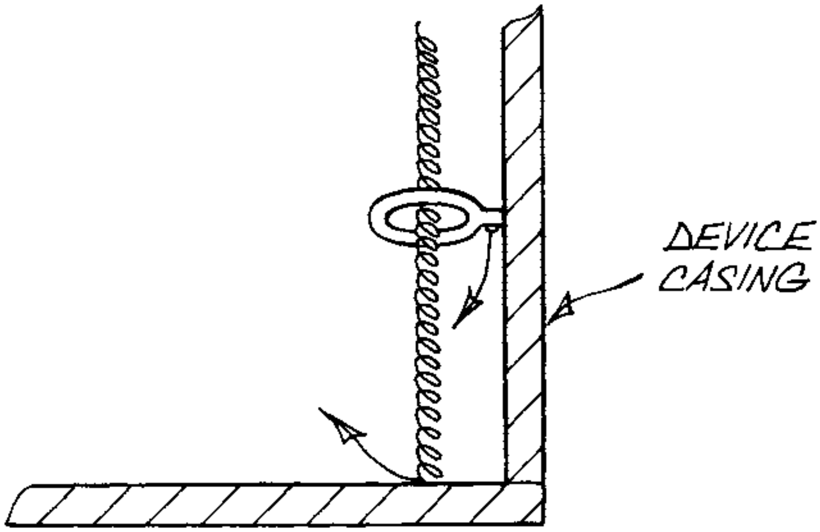

FIG. 47 TREMBLER SWITCH

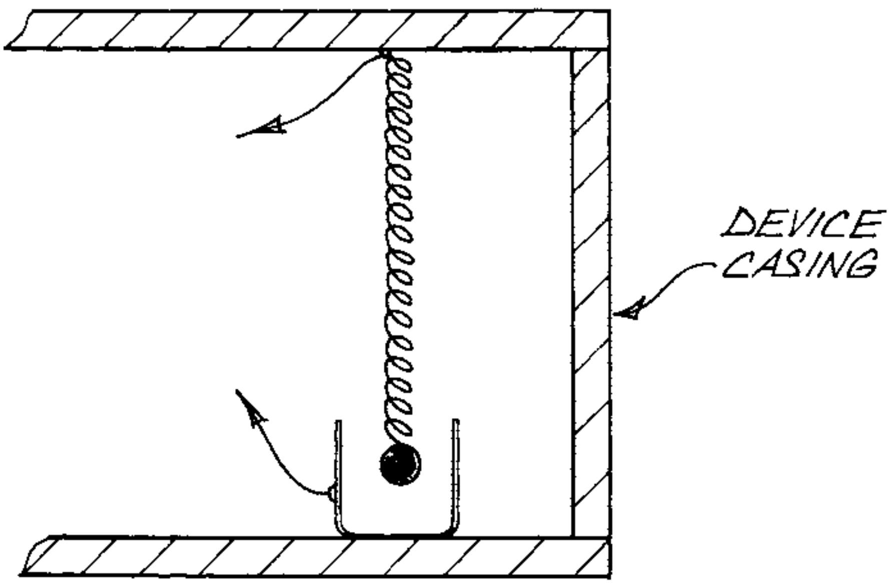

FIG. 48 PENDULUM SWITCH

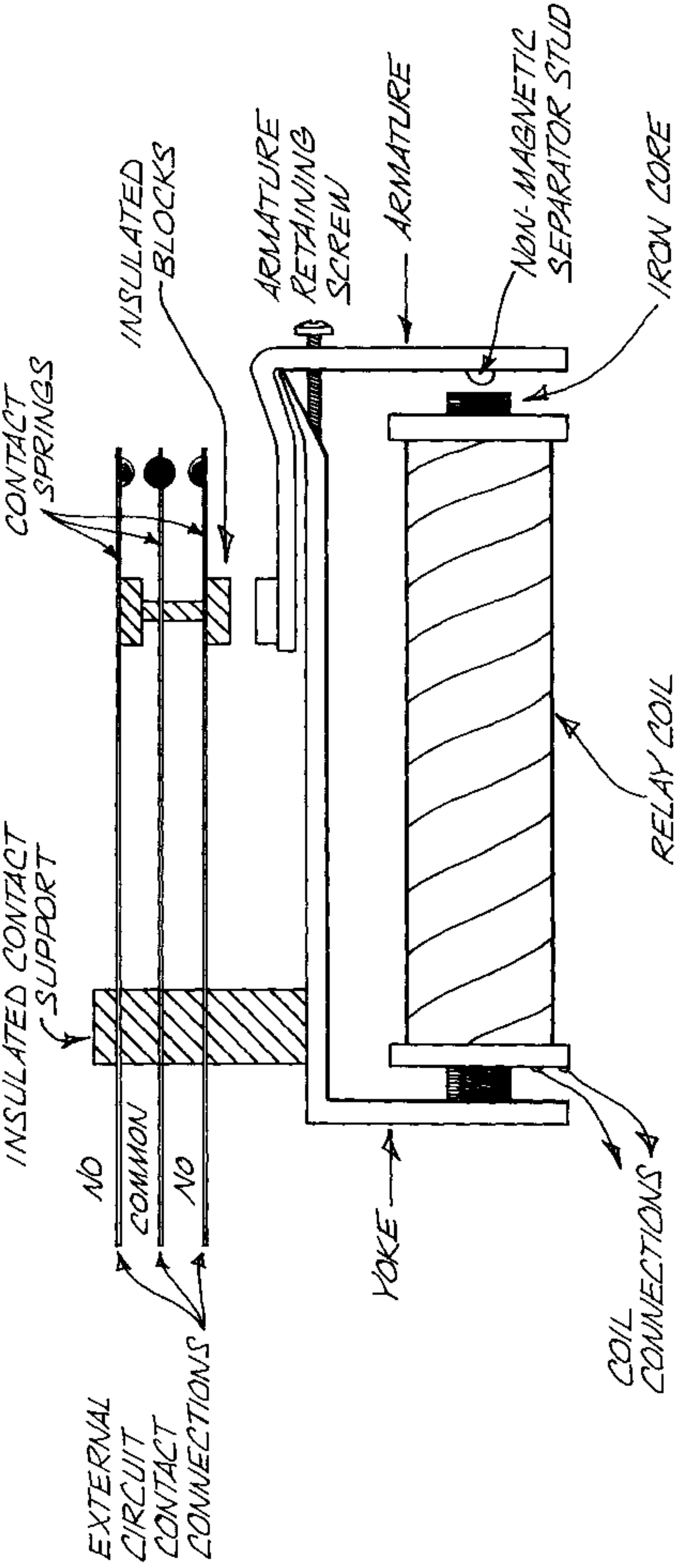

FIG. 49 A TYPICAL RELAY

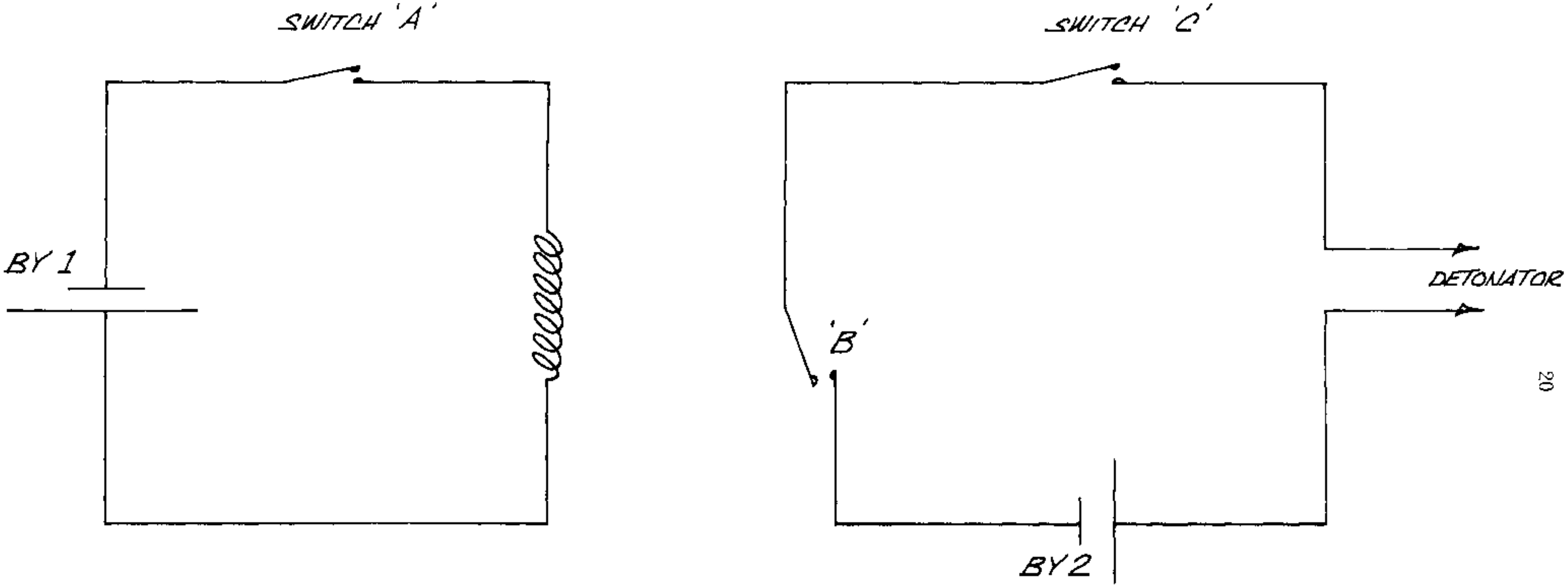

FIG 50 SIMPLE COLLAPSING CIRCUIT

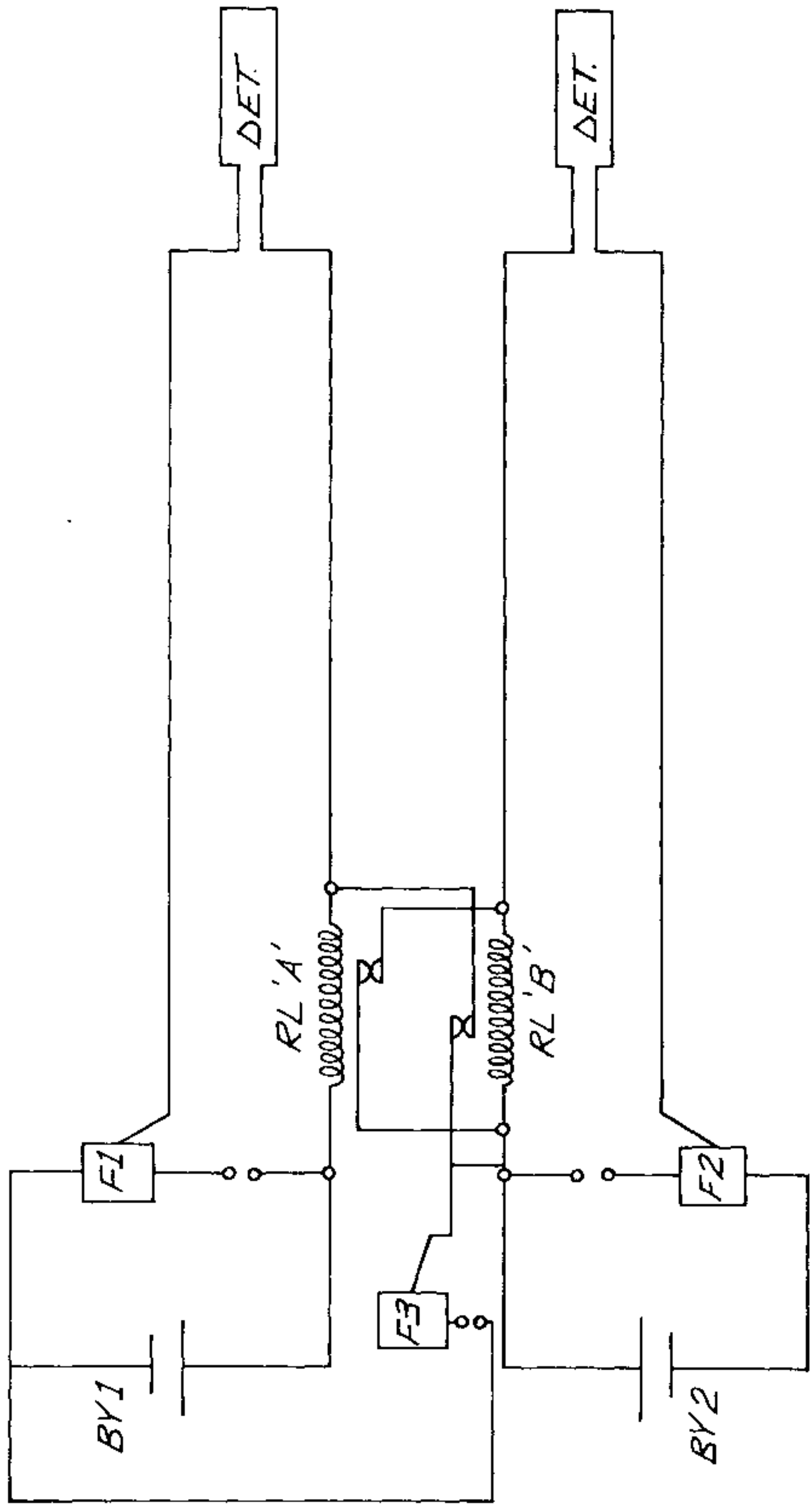

FIG. 51 DOUBLE INTERLOCKED RELAY

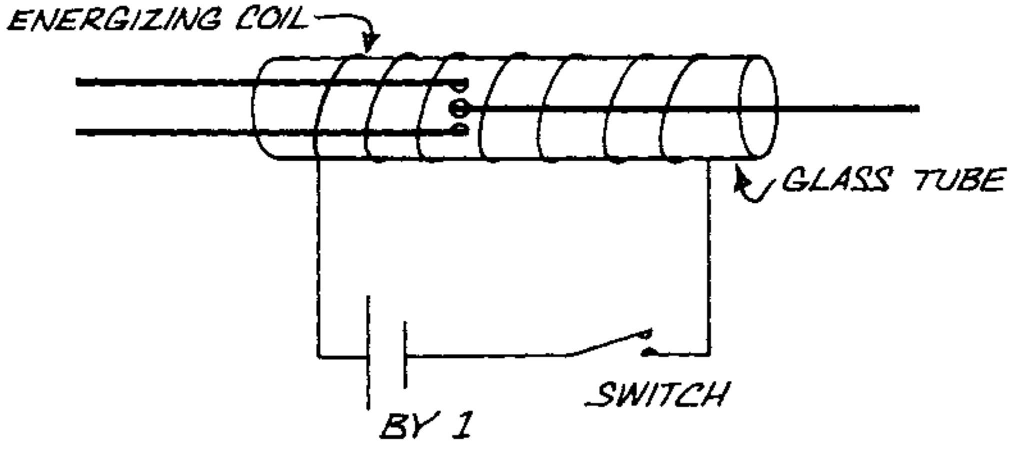

FIG. 52 REED SWITCH

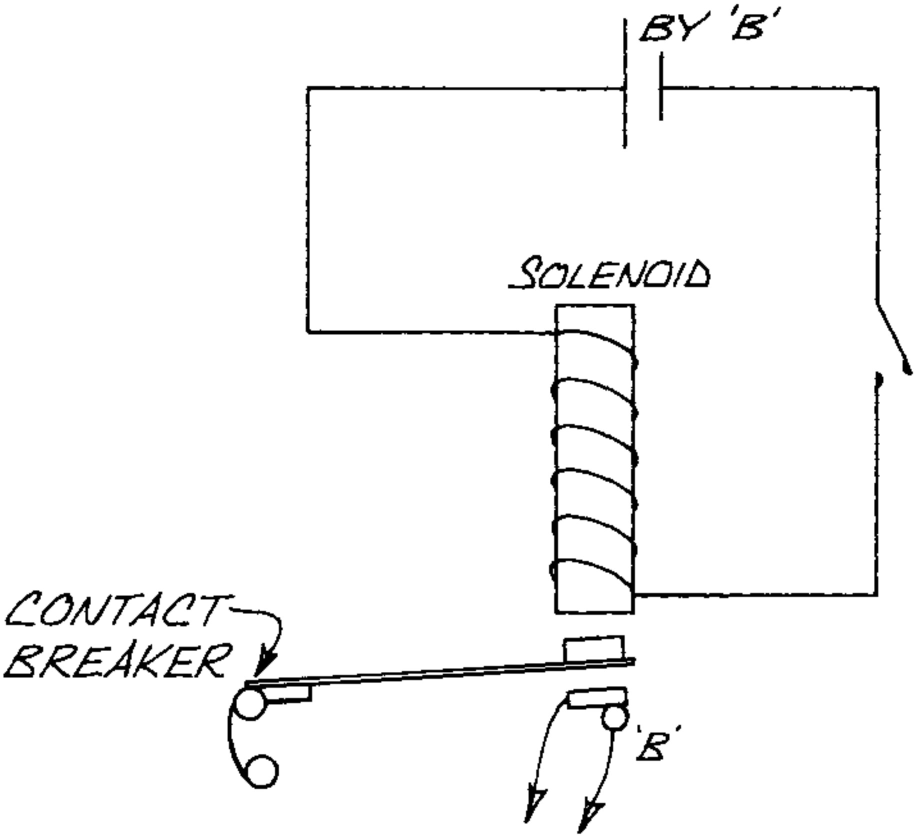

FIG. 53 SOLENOID & CONTACT BREAKER

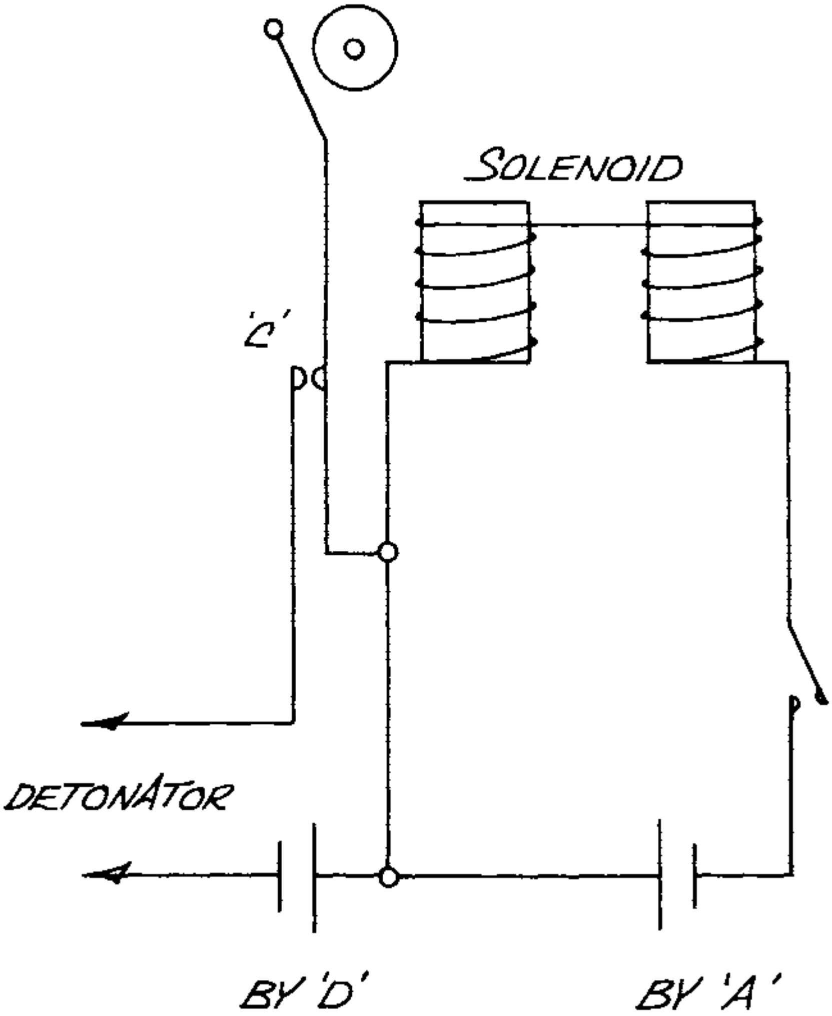

FIG. 54 DOOR BELL CIRCUIT

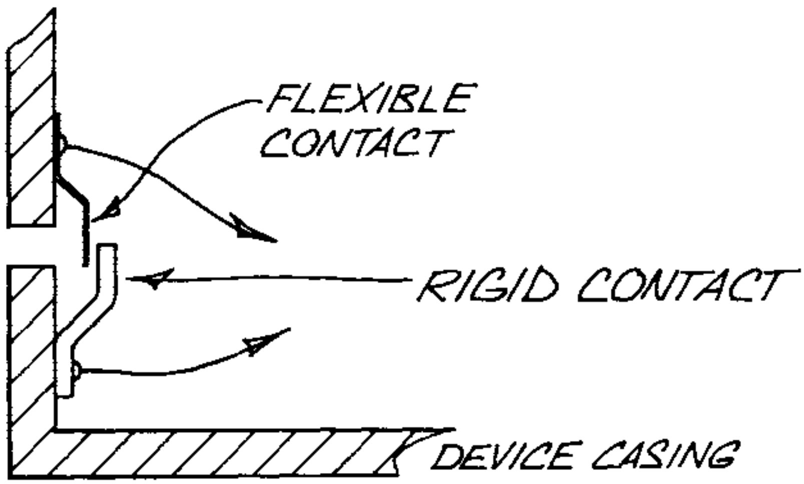

FIG. 55 ANTI-PROBE SWITCH

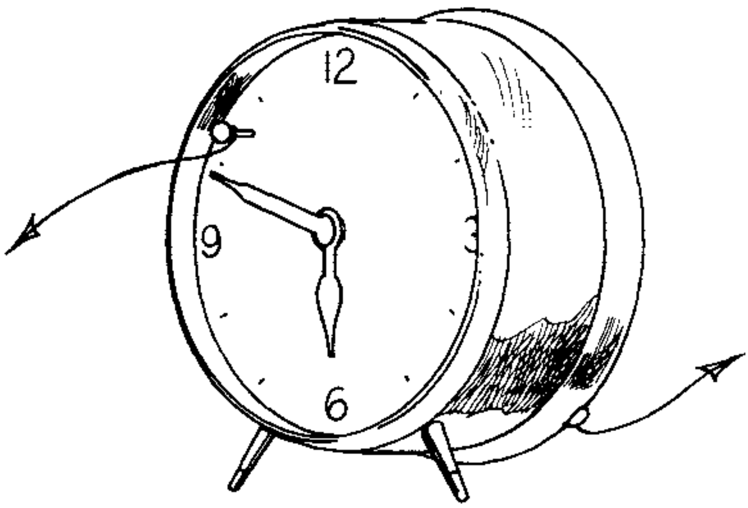

FIG. 56 HAND & PIN

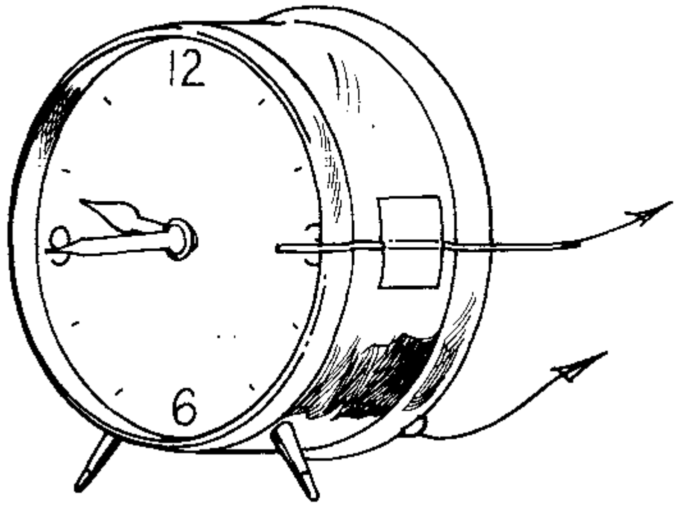

FIG. 57 HAND & WIRE

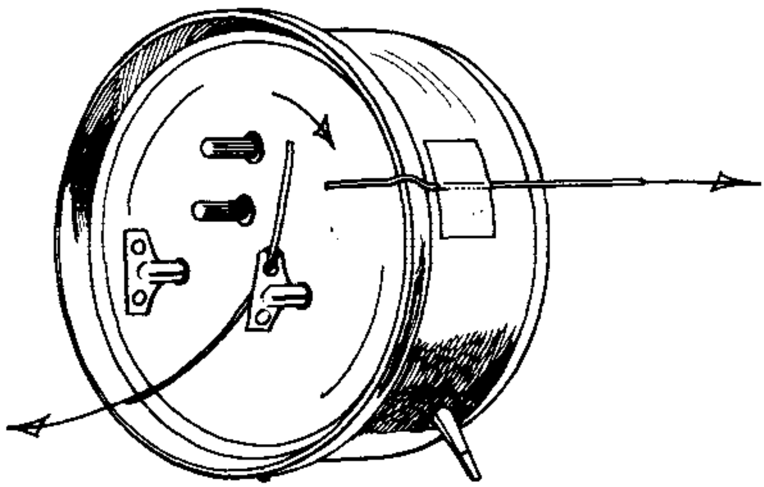

FIG. 58 ALARM WINDER & WIRE

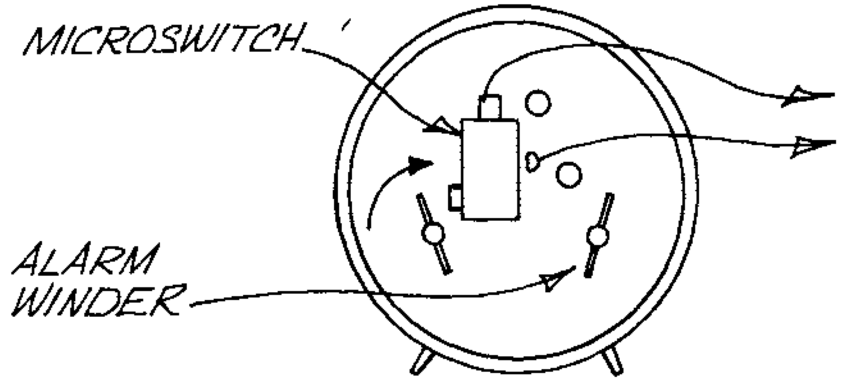

FIG. 59 ALARM WINDER & MICROSWITCH

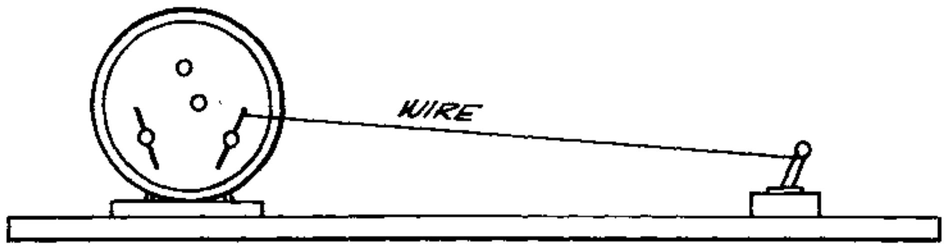

FIG. 60 ALARM WINDER & SWITCH

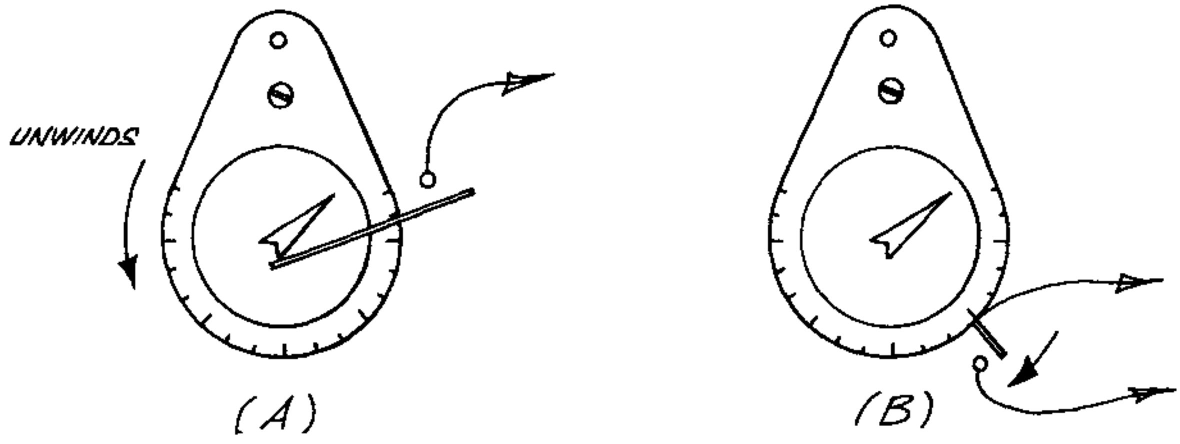

FIG. 61 PARKWAY TIMER

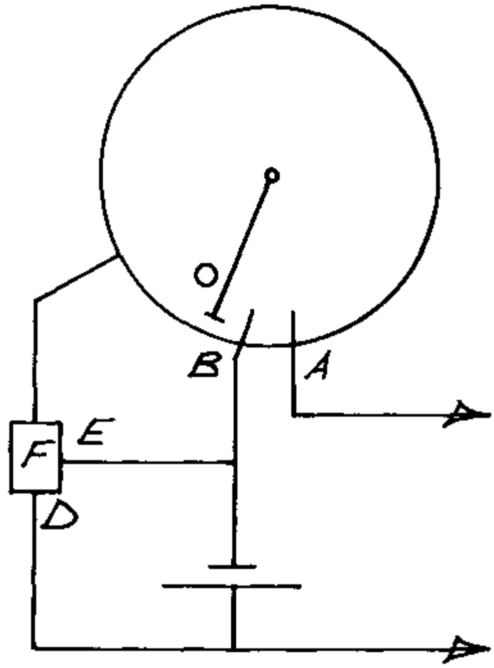

FIG. 62 CLOCK & P.O. FUSE

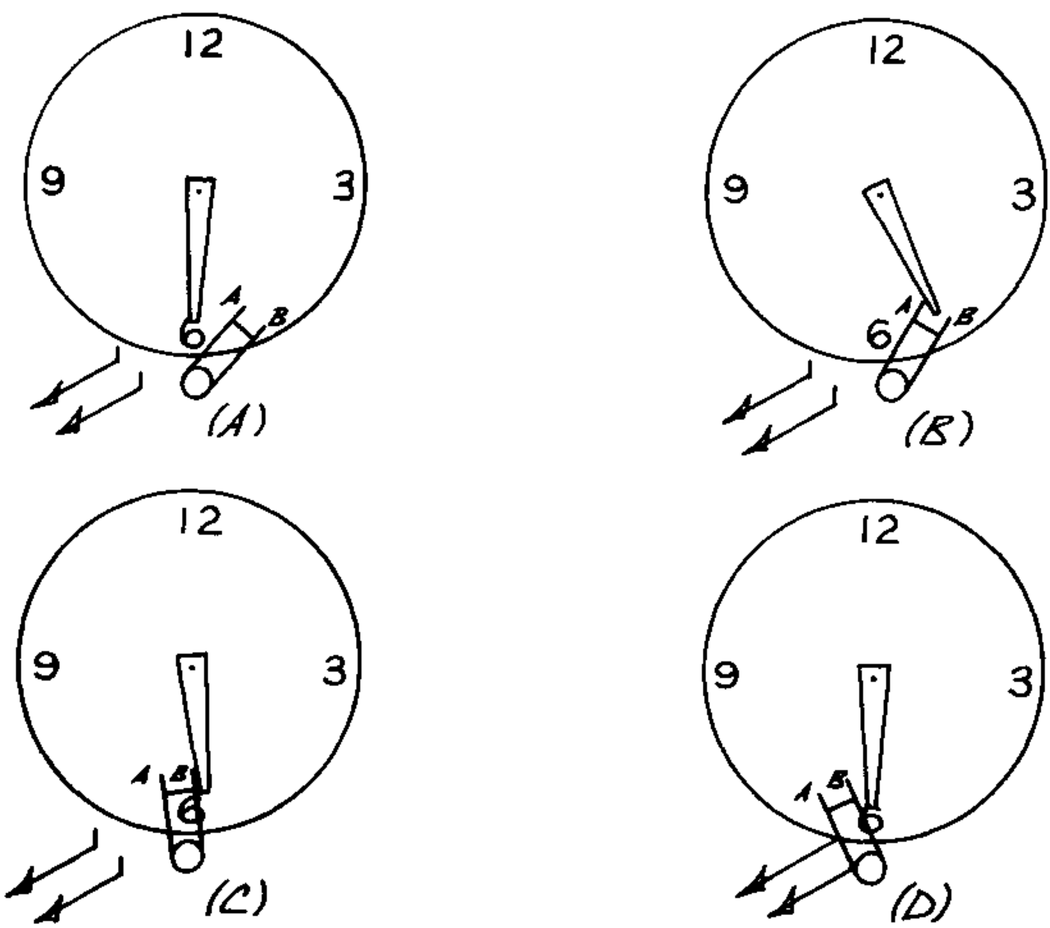

FIG. 63 CLOCK & HAIRPIN

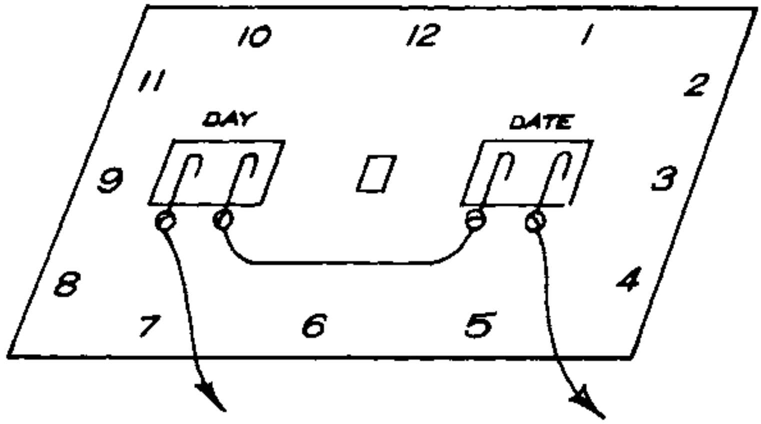

FIG. 64 ELECTRIC CLOCK LONG DELAY

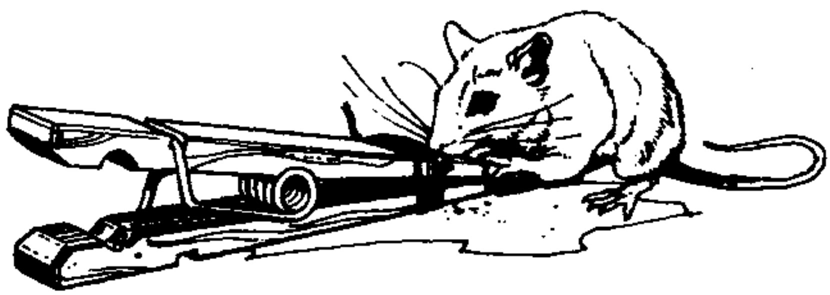

FIG. 65 RODENT DELAY

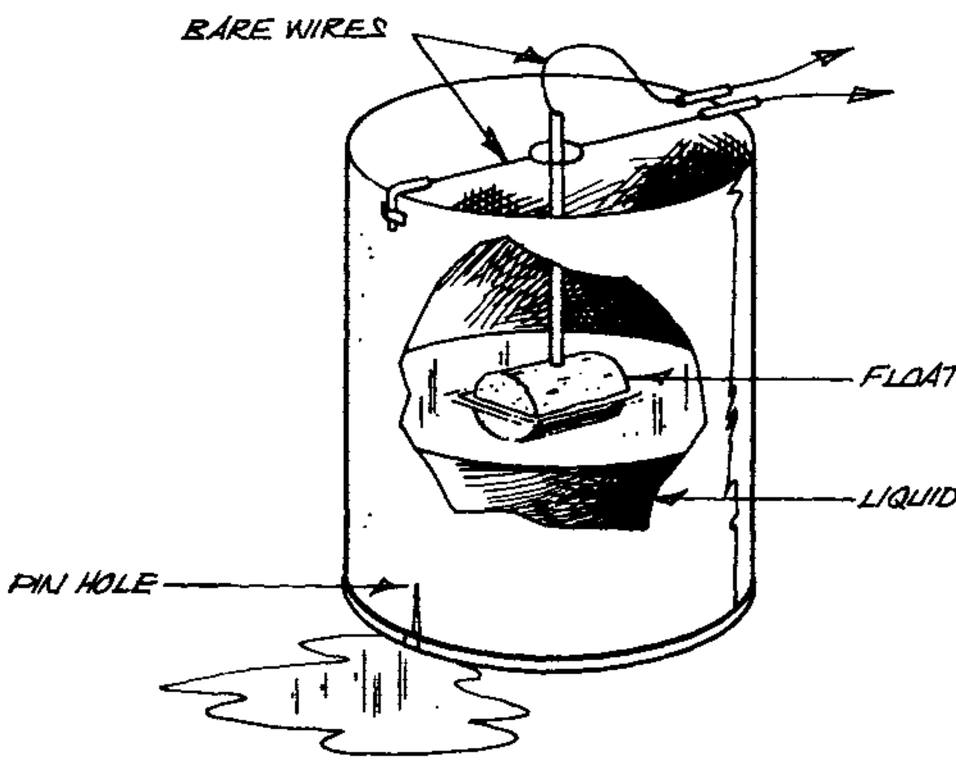

FIG. 66 WATER-DRIP DELAY

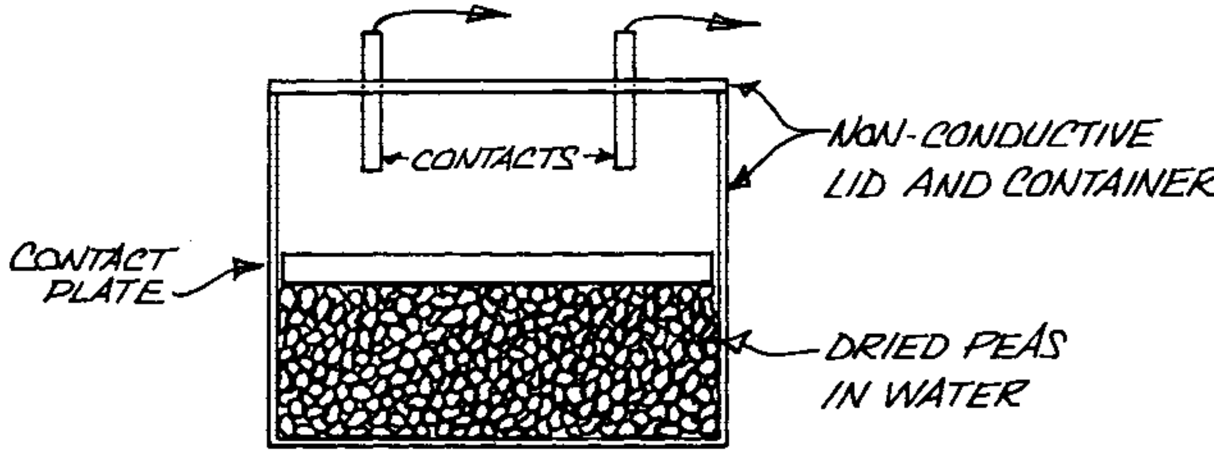

FIG. 67 EXPANDING SEED DELAY

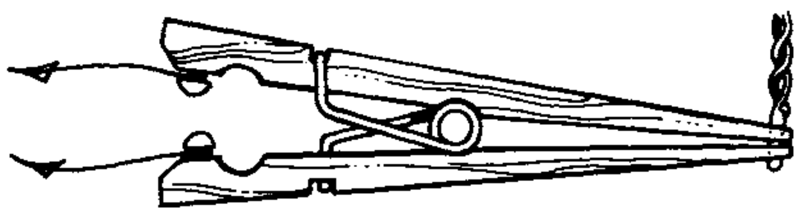

FIG. 68 C'PEG SOLDER DELAY

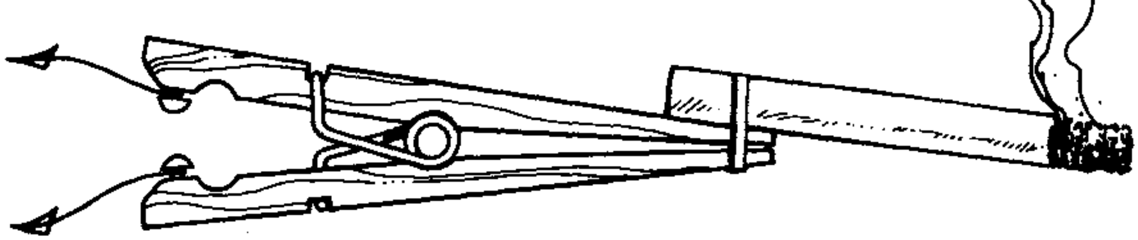

FIG. 69 C'PEG & CIGARETTE DELAY

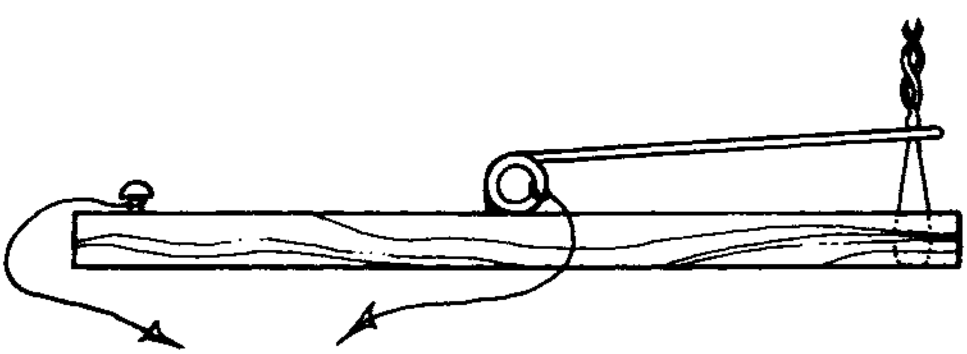

FIG. 70 MOUSETRAP SOLDER DELAY

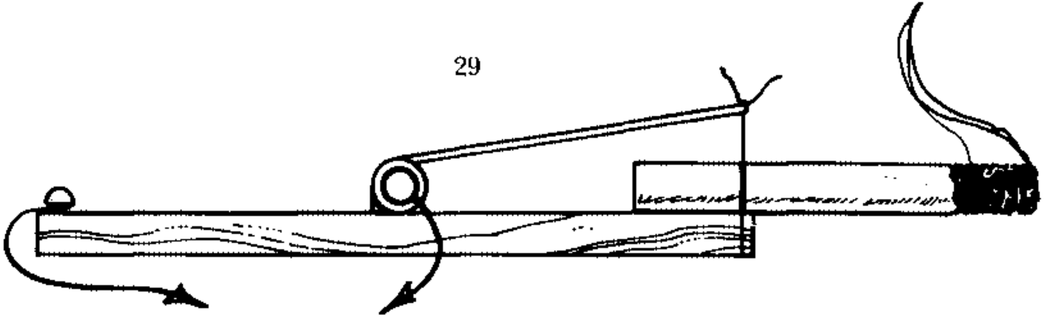

FIG. 71 MOUSETRAP AND CIGARETTE DELAY

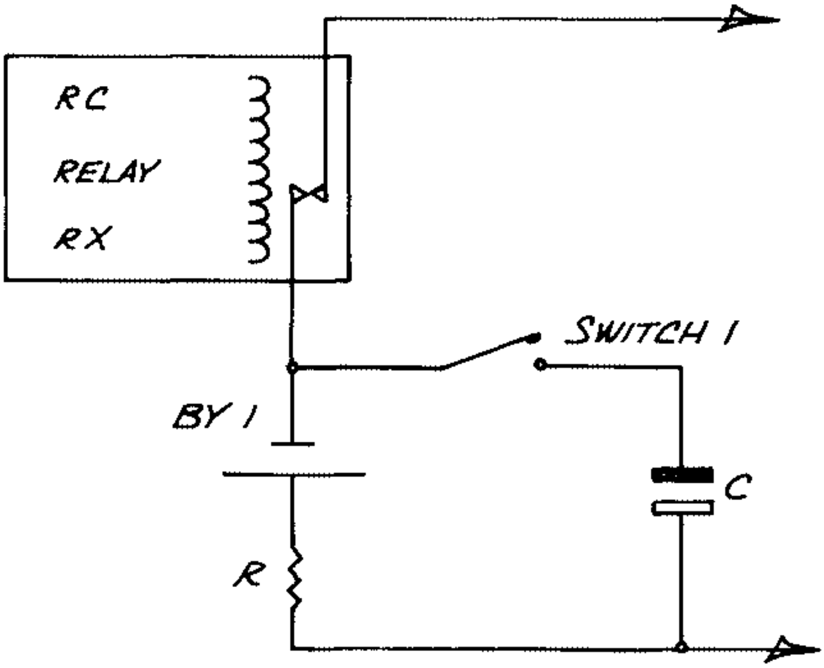

FIG. 72 ELECTRONIC DELAYED ARMING

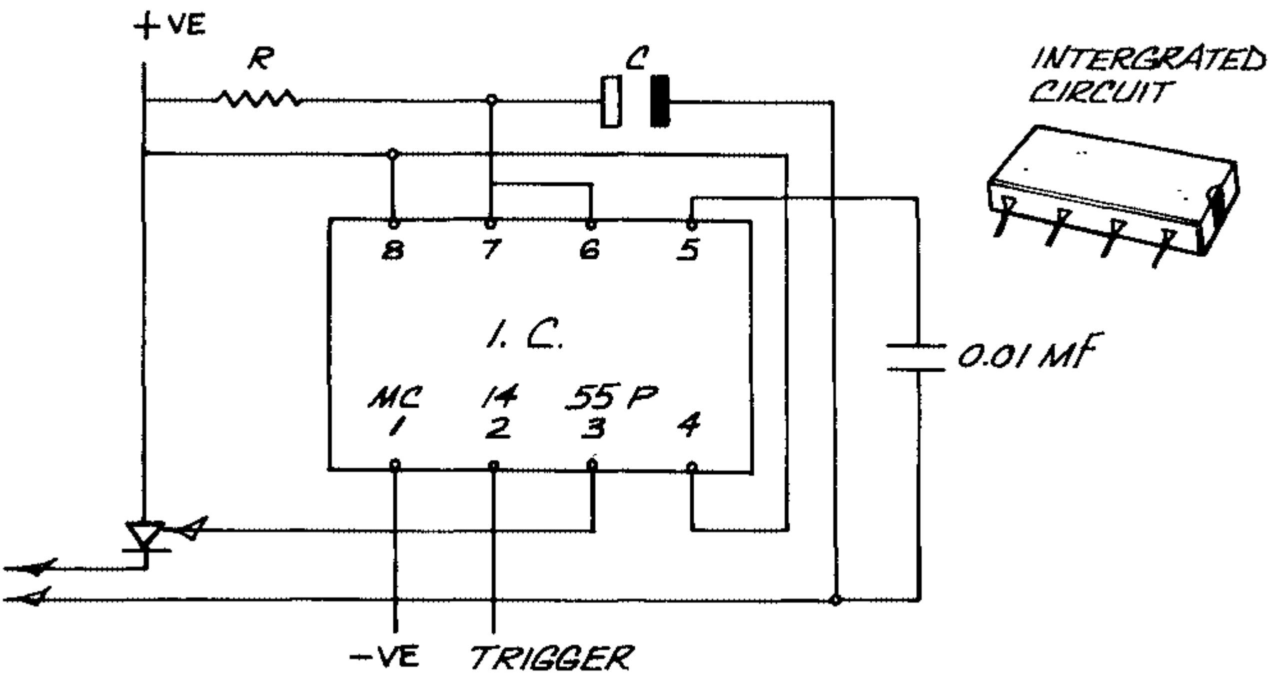

FIG. 73 INTERGRATED CIRCUIT DELAY

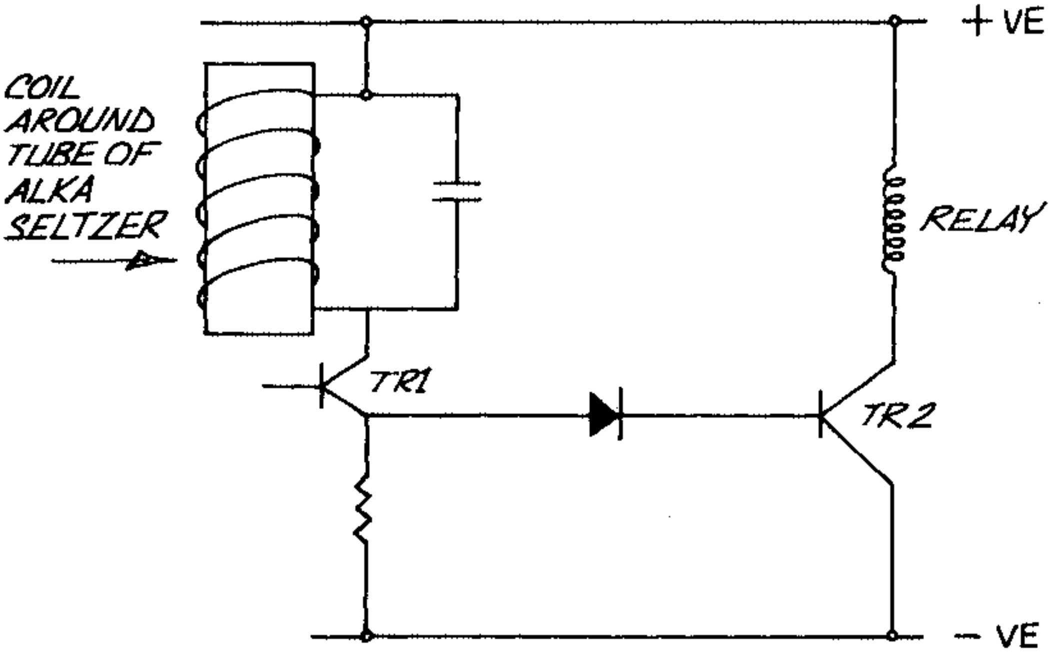

FIG. 74 ALKA SELTZER ELECTRONIC DELAY

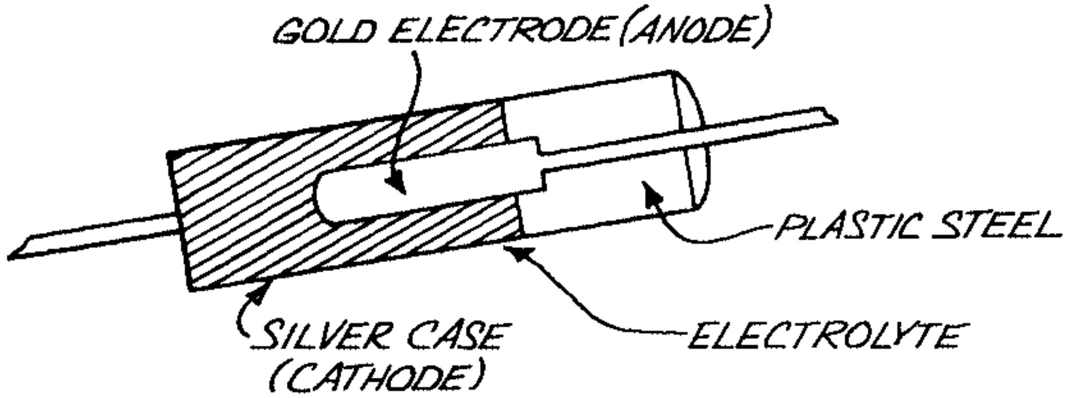

FIG. 75 "E" CELL (MICROCOULOMETER)

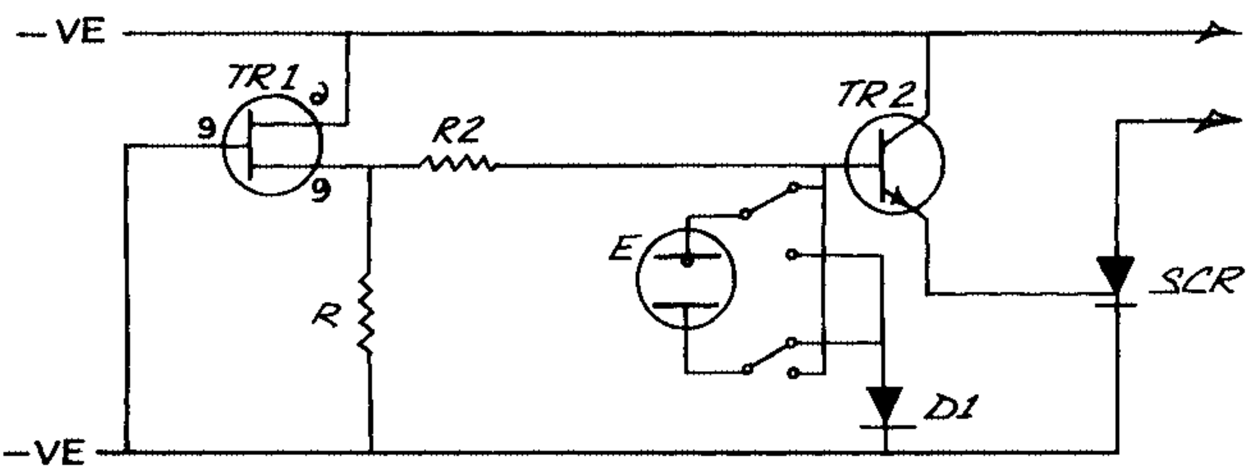

FIG. 76 ELECTROCHEMICAL DELAY

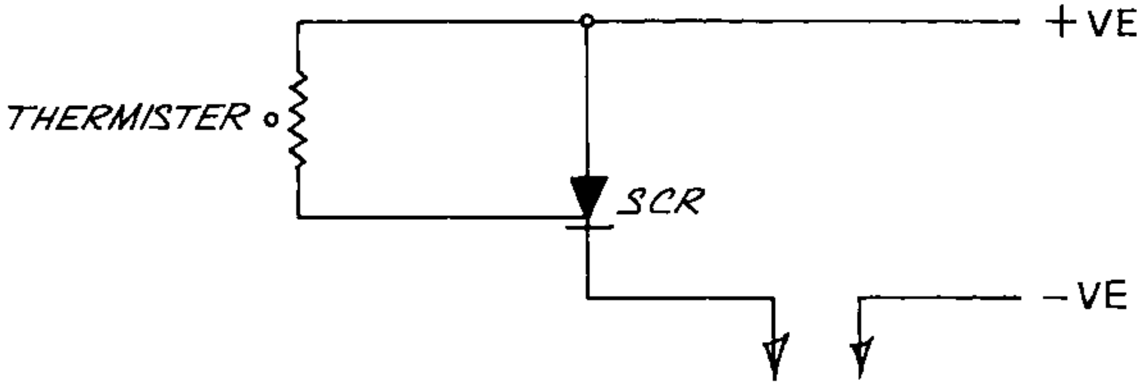

FIG. 77 TEMPERATURE-SENSITIVE SWITCH

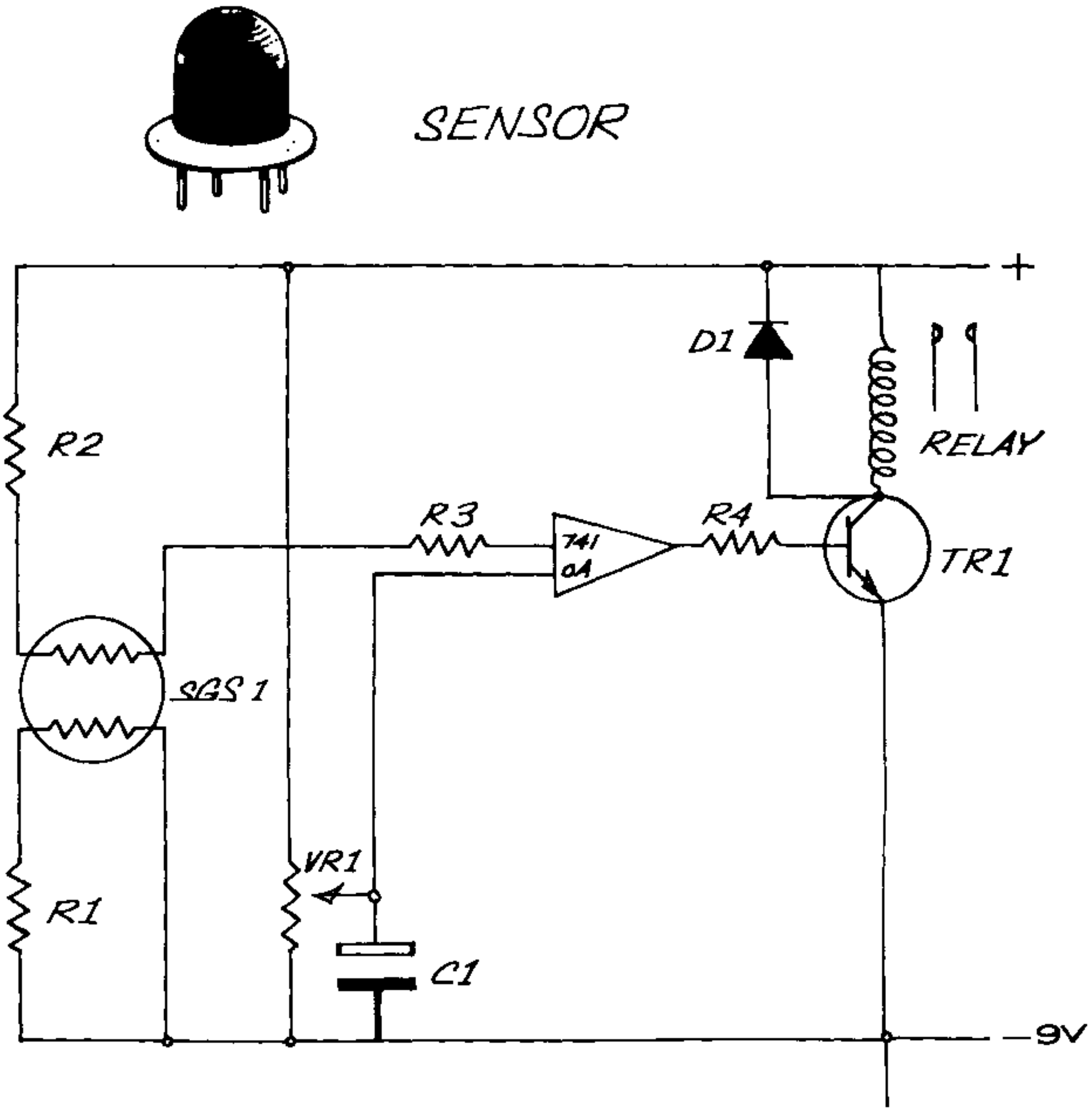

FIG. 78 SMOKE / GAS SENSITIVE

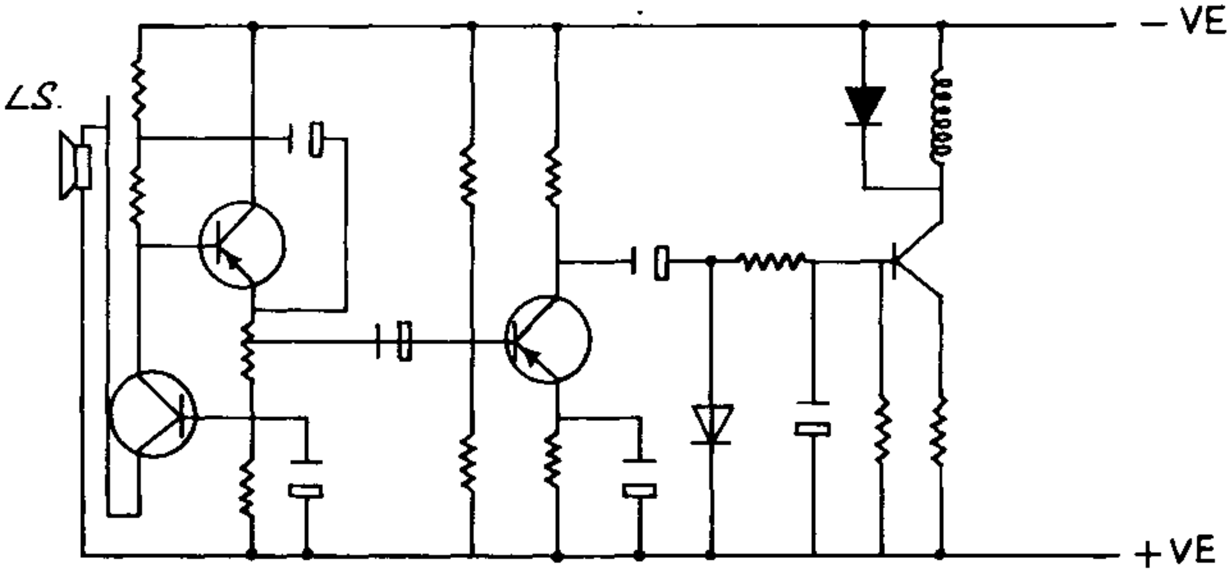

FIG. 79 ACOUSTIC SWITCH

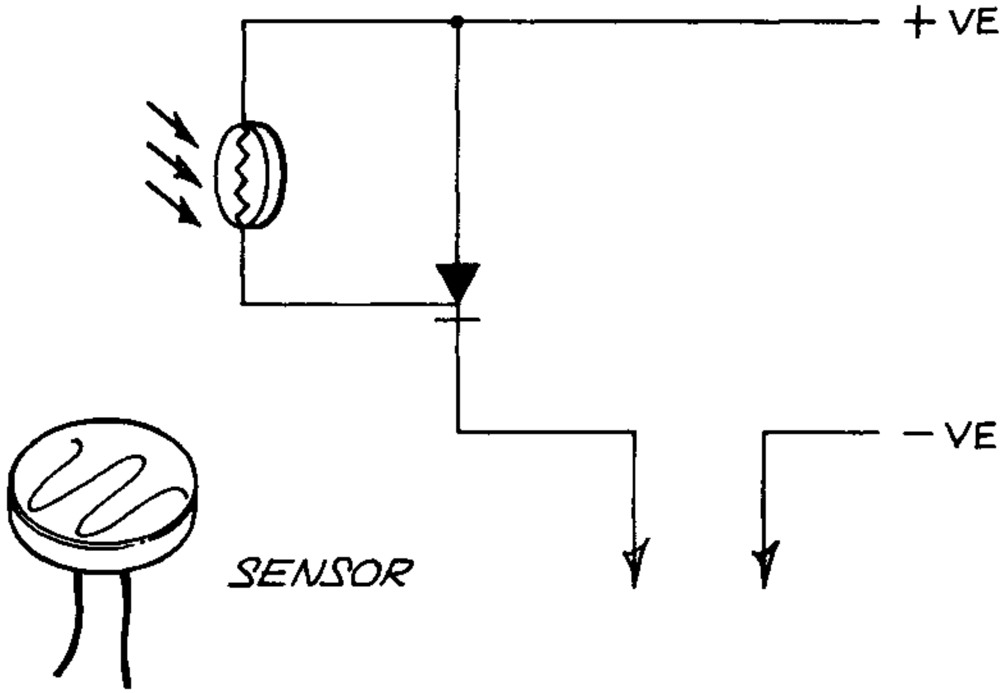

FIG. 80 LIGHT-SENSITIVE SWITCH

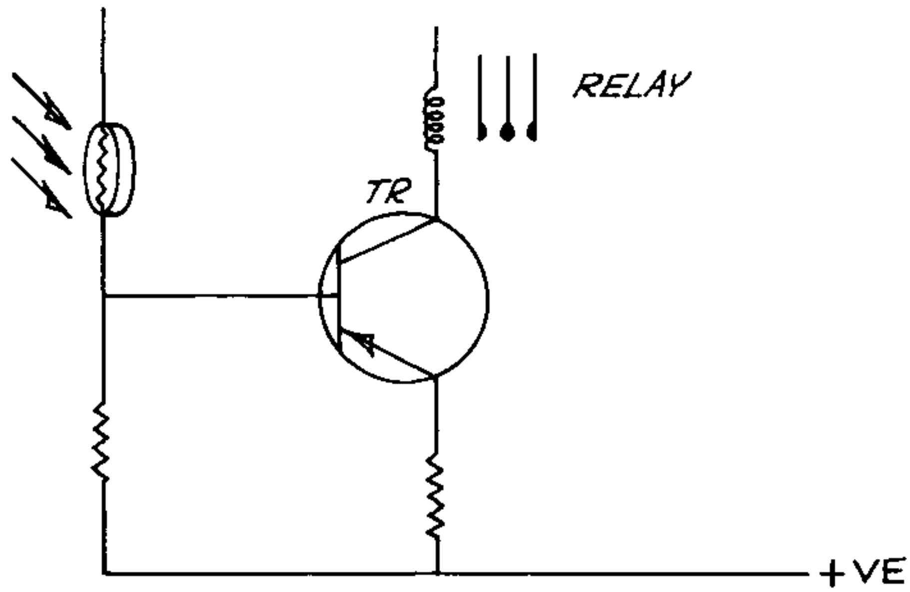

FIG. 81 LIGHT-SENSITIVE SWITCH

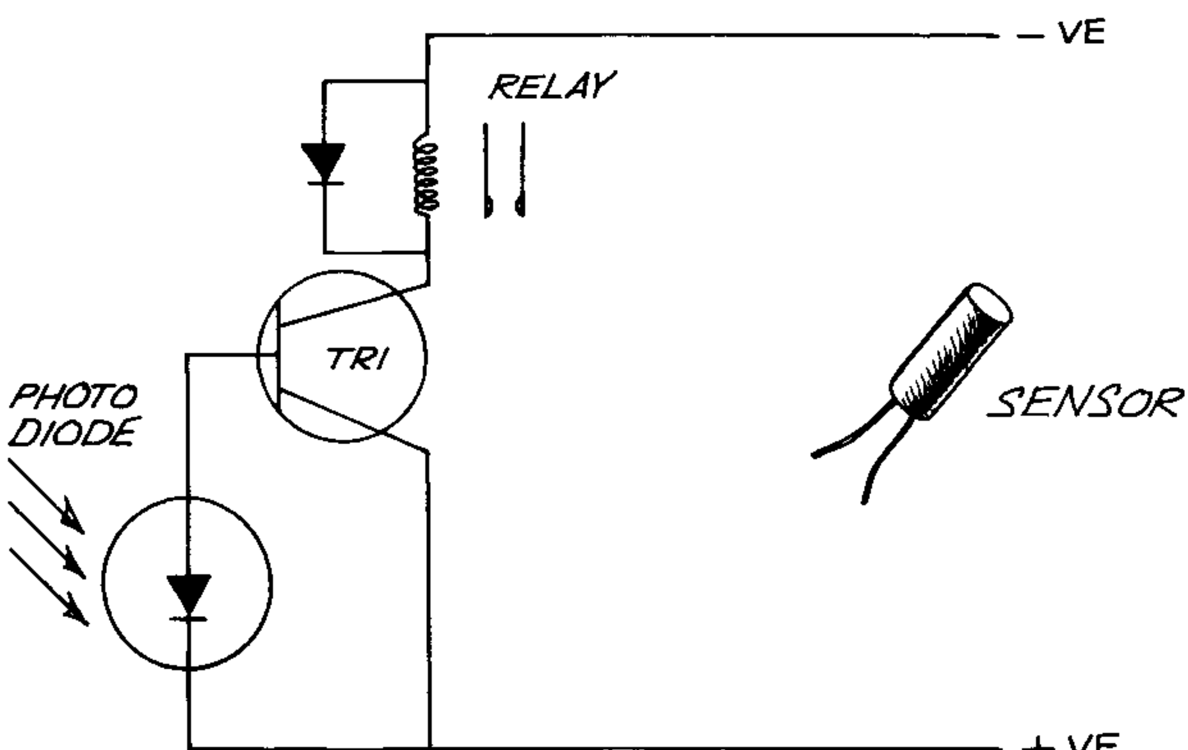

FIG. 82 INFRA-RED SENSITIVE SWITCH

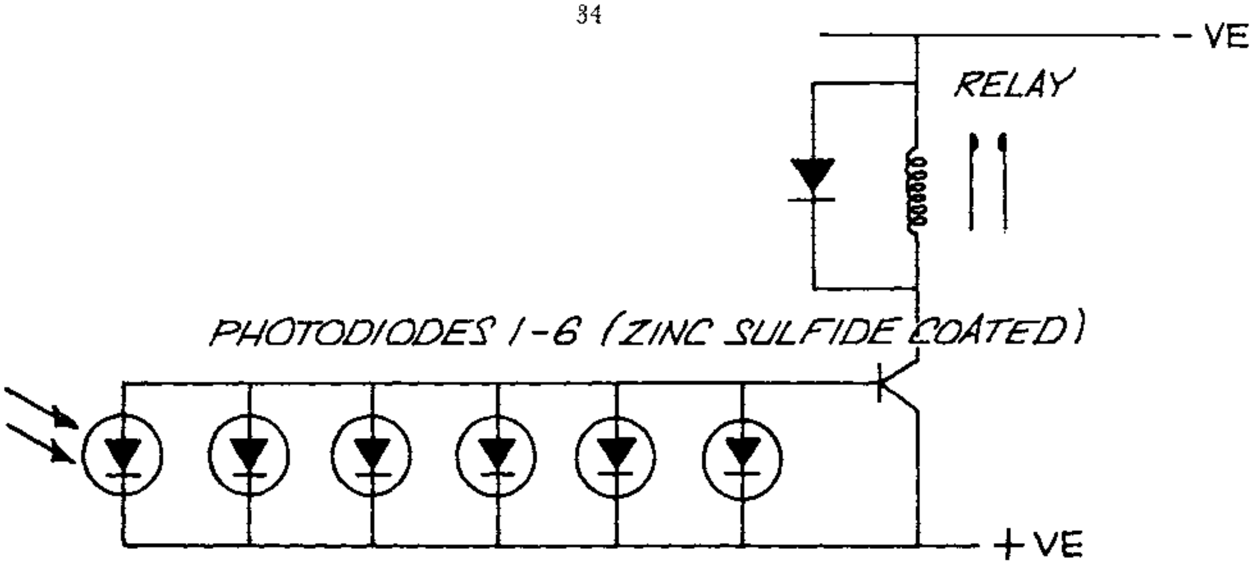

FIG. 83 X-RAY SENSITIVE SWITCH

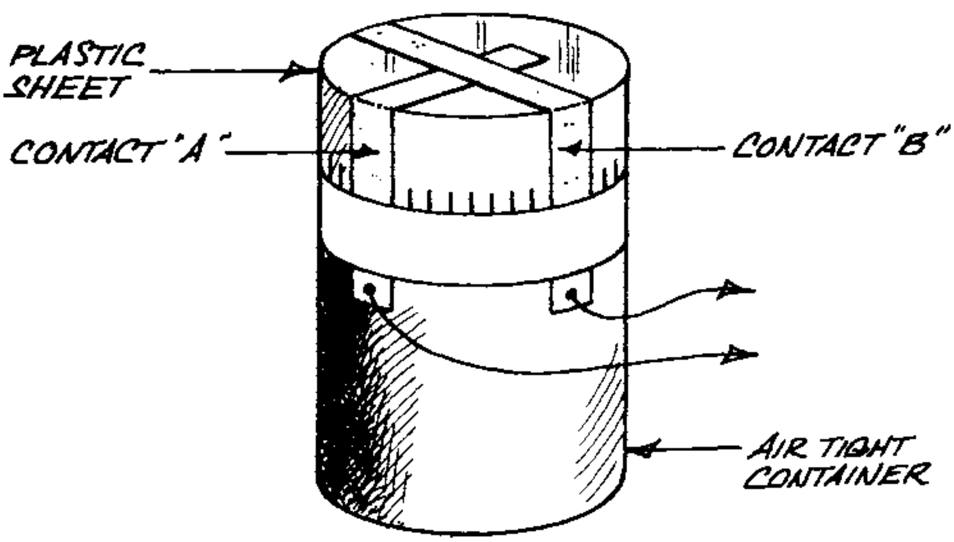

FIG. 84 BAROMETRIC CAN SWITCH

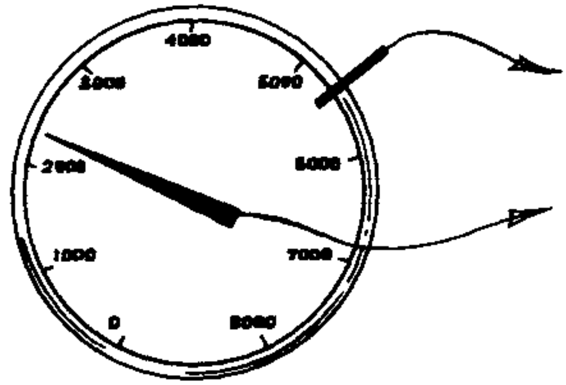

FIG. 85 ALTIMETER SWITCH

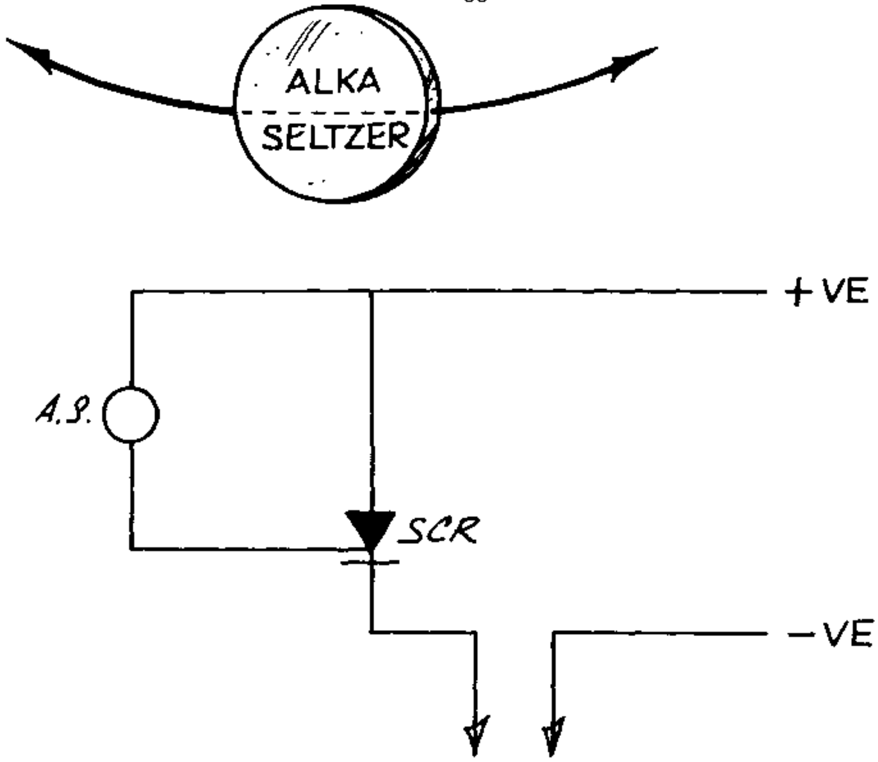

FIG. 86 ALKA SELTZER TABLET SWITCH

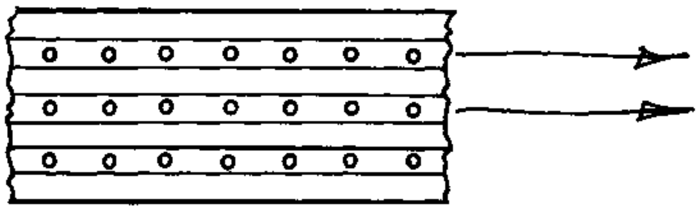

FIG. 87 CONTACT PLATE HUMIDITY SWITCH

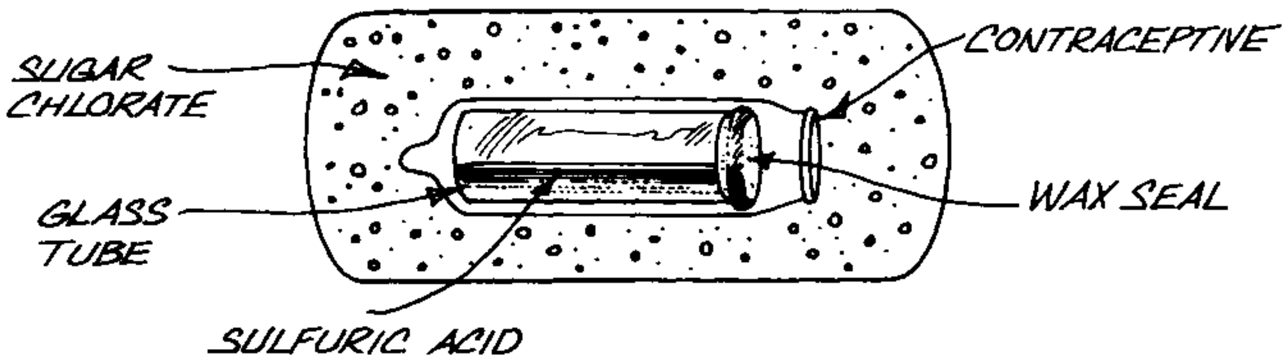

FIG. 89 TUBE/CONTRACEPTIVE CHEM. SWITCH

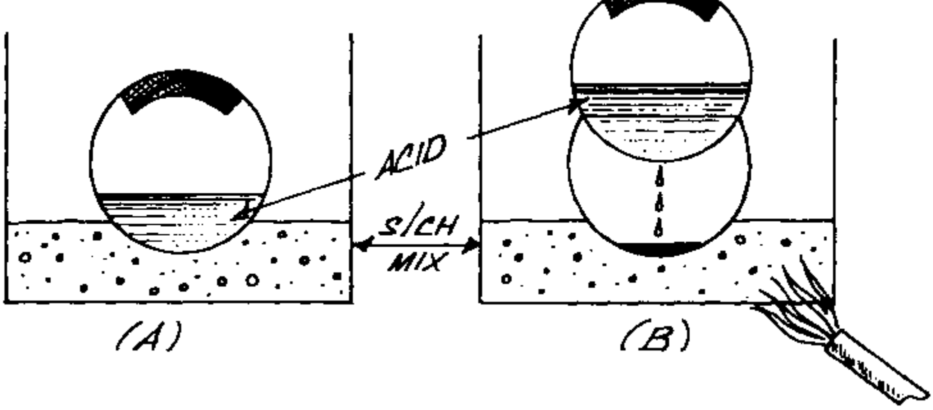

FIG. 89 TABLE-TENNIS BALL CHEM SWITCH

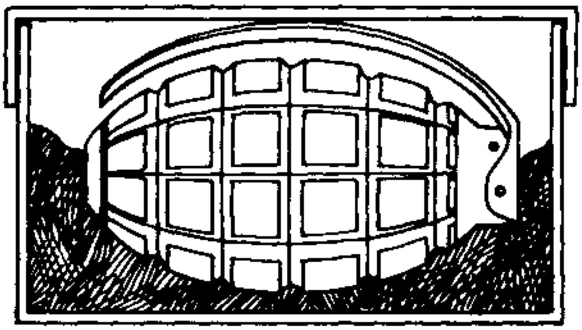

FIG. 90 HAND-GRENADE DEVICE

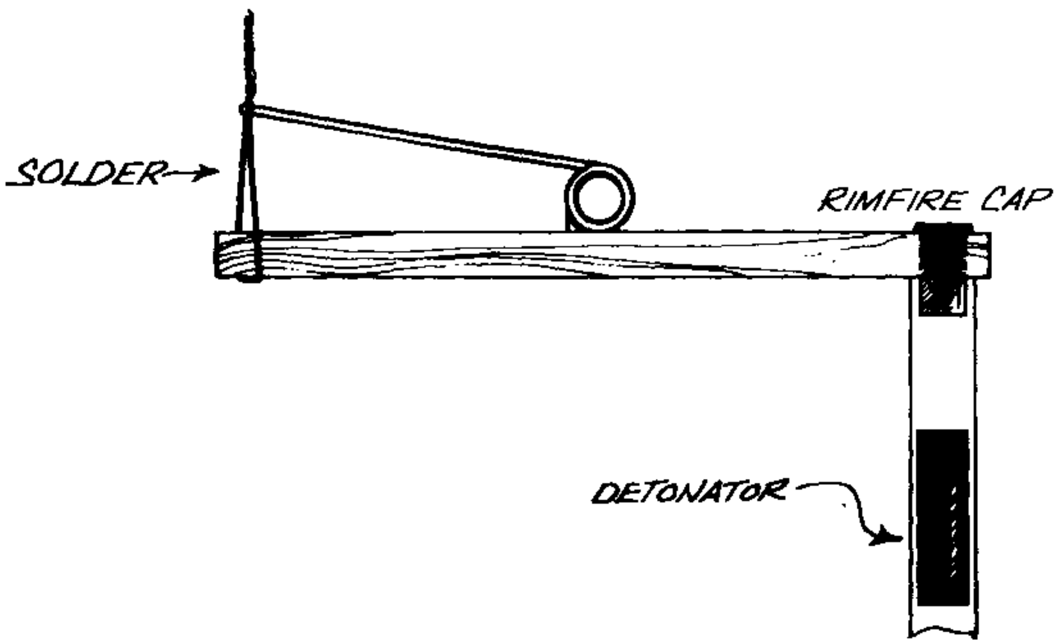

FIG. 91 MOUSETRAP GUN

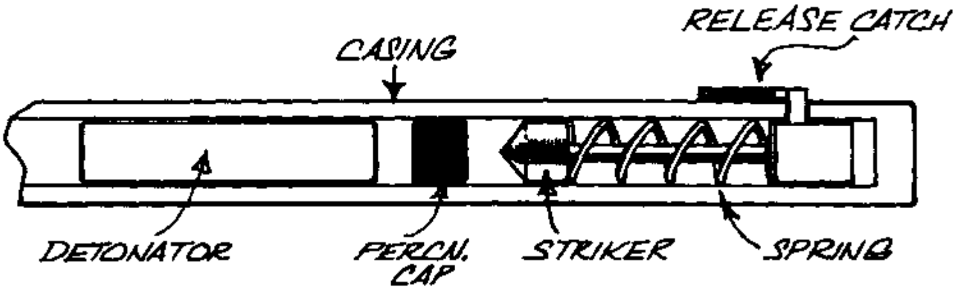

FIG. 92 SERVICE-TYPE RELEASE SWITCH

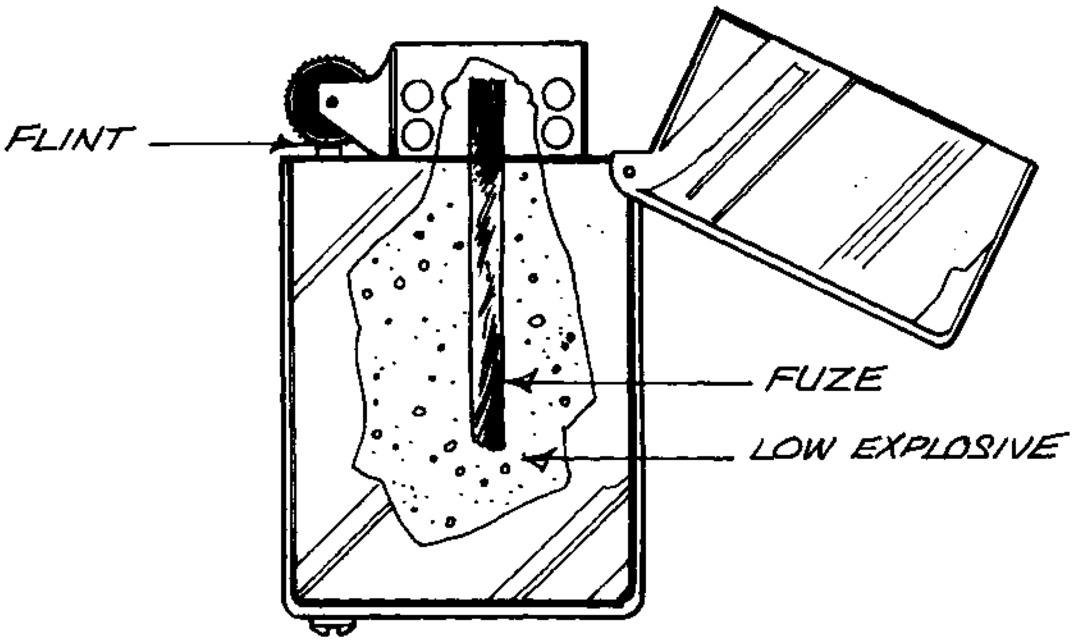

FIG. 93 CIGARETTE LIGHTER DEVICE

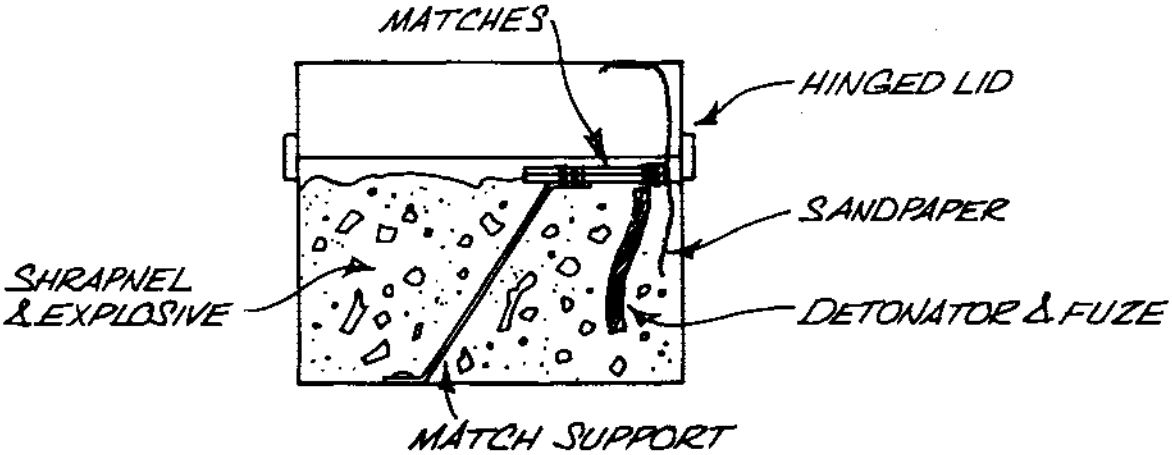

FIG. 94 SANDPAPER FLAP DEVICE

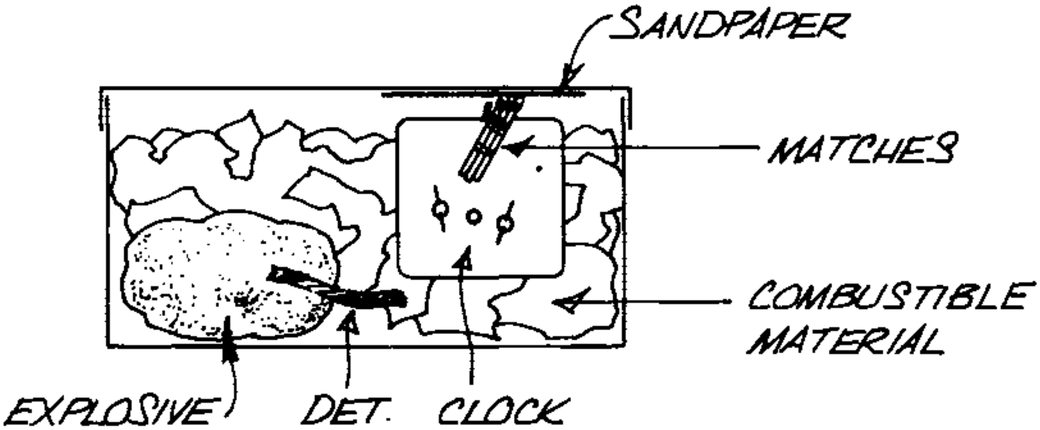

FIG. 95 CLOCK FRICTION SWITCH

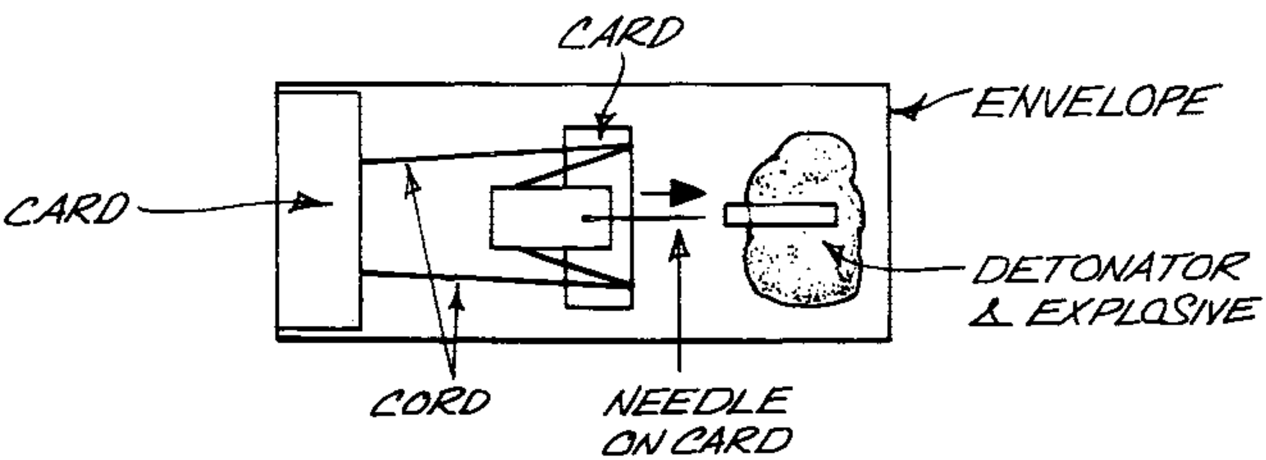

FIG. 96 NEEDLE IN DETONATOR

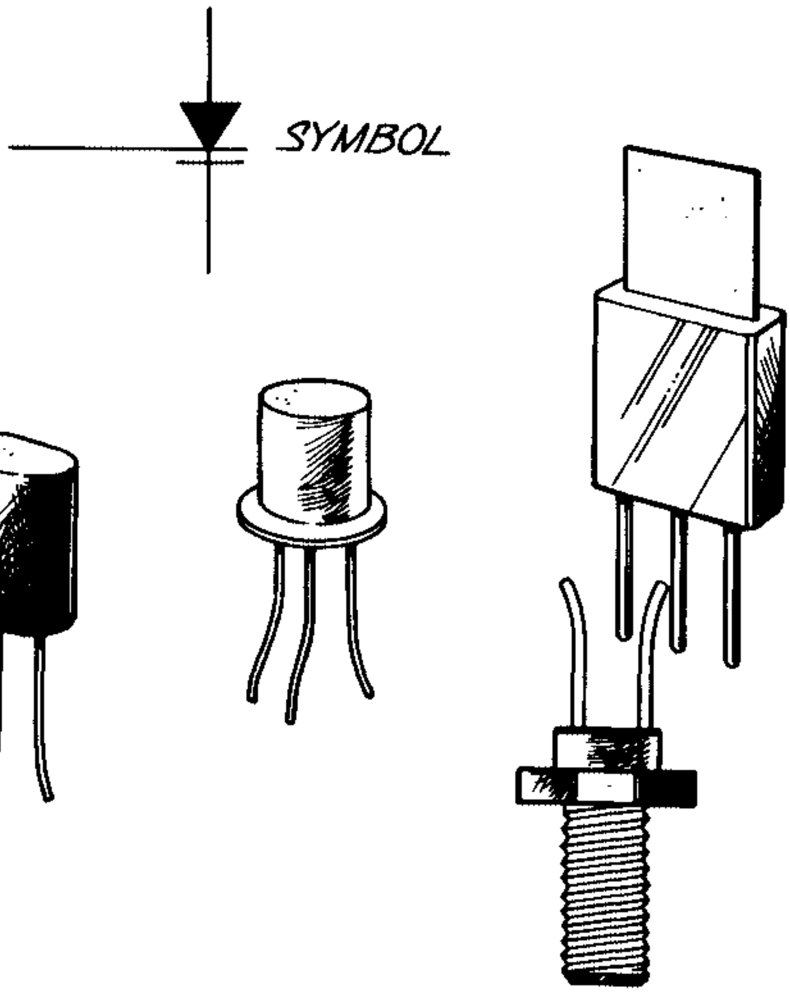

FIG. 97 THYRISTOR (SCR)

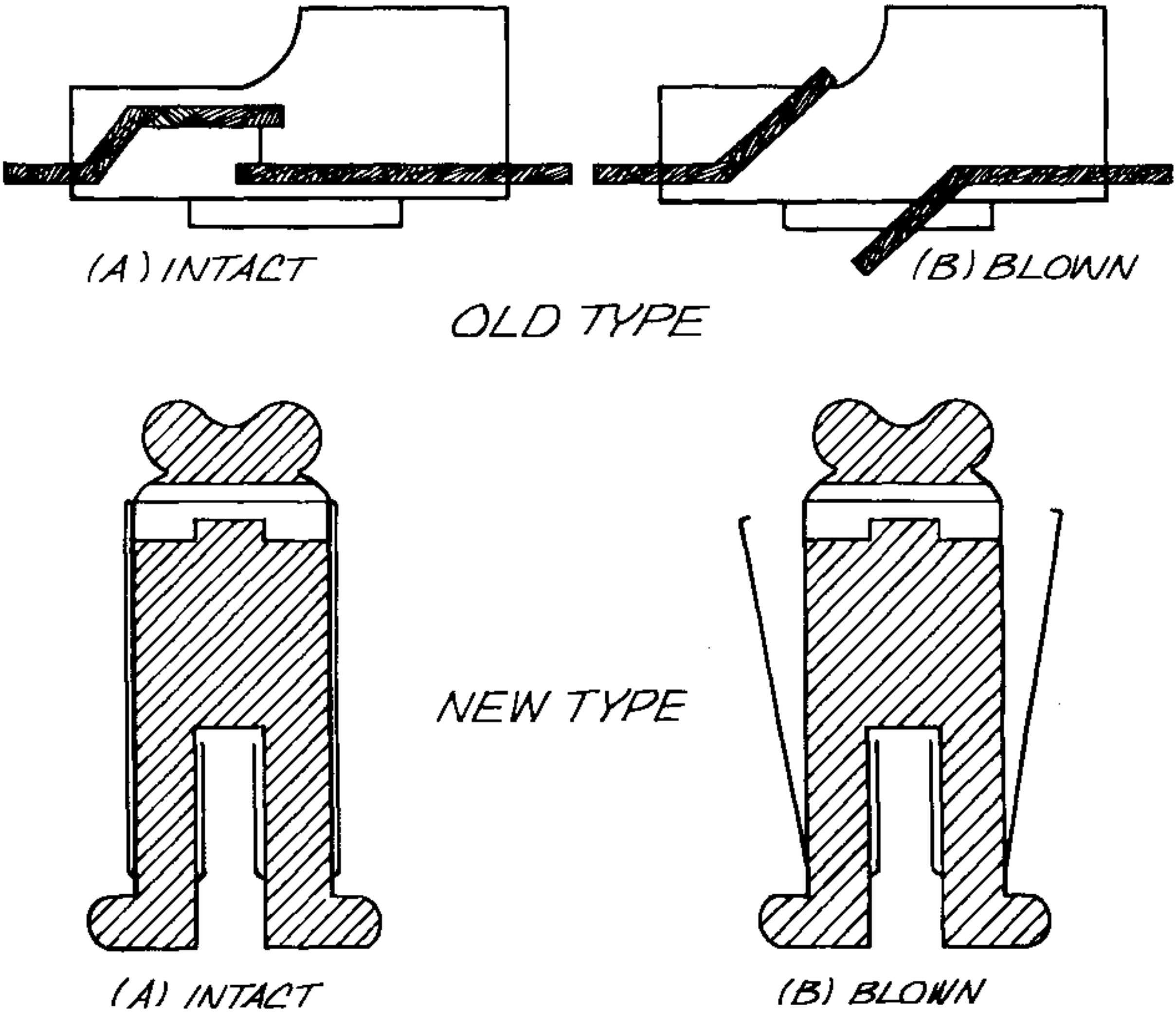

FIG. 98 POST OFFICE FUSES

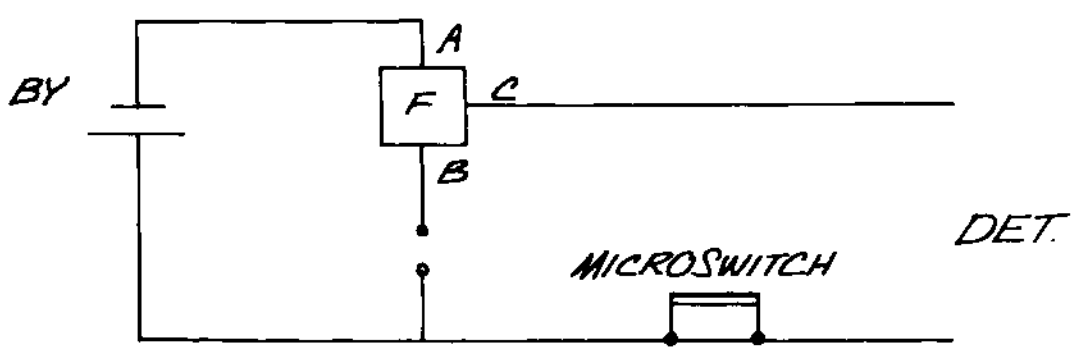

FIG. 99 POST OFFICE FUSE ARMING

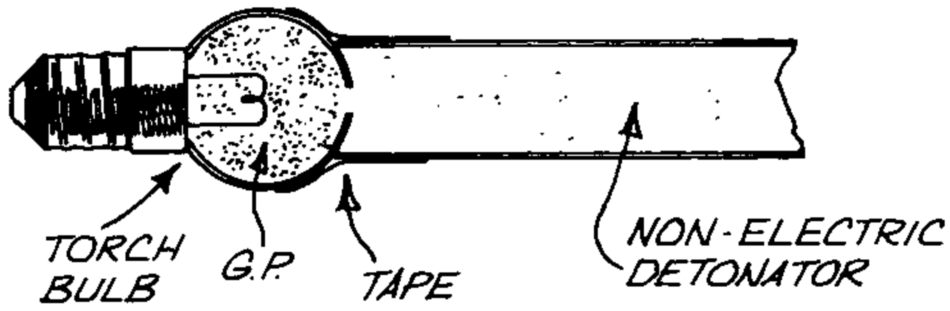

FIG. 100 FLN ELECTRIC DETONATOR

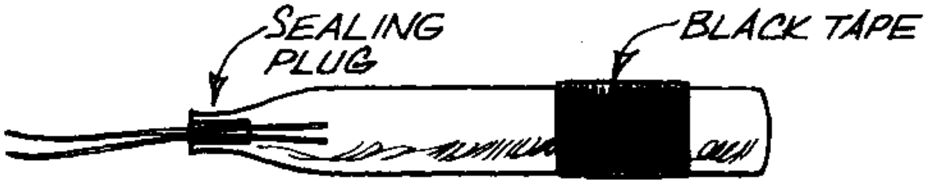

FIG. 101 IGNITOR S.F. ELECTRIC

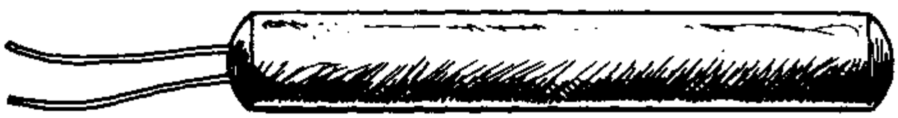

FIG. 102 POWDER FUSE 5 GR

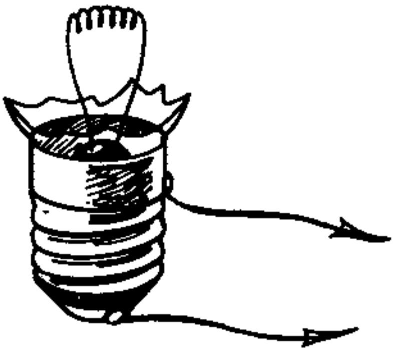

FIG. 103 BROKEN BULB IGNITER

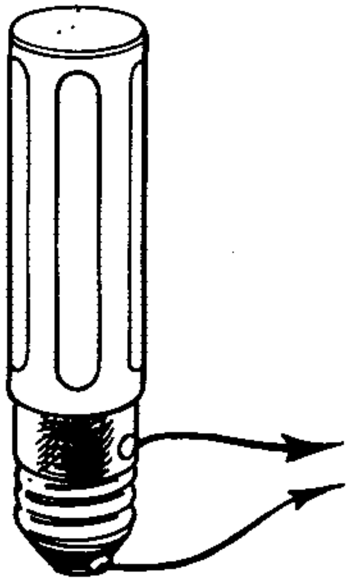

FIG. 104 GAS LIGHTER ELEMENT

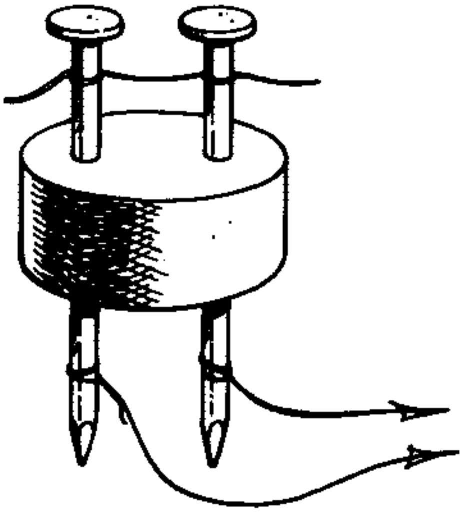

FIG. 105 HOT WIRE IGNITER

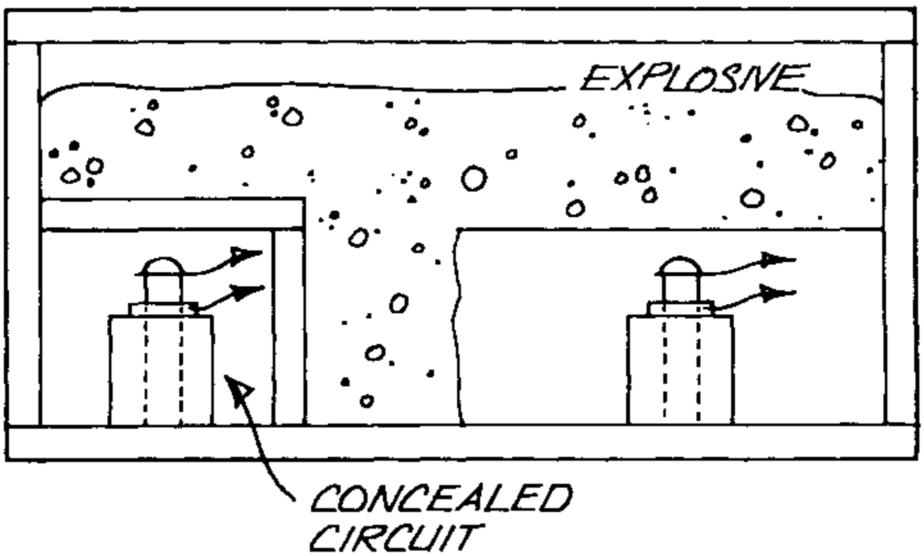

FIG. 106 DOUBLE H/LIFT SWITCH

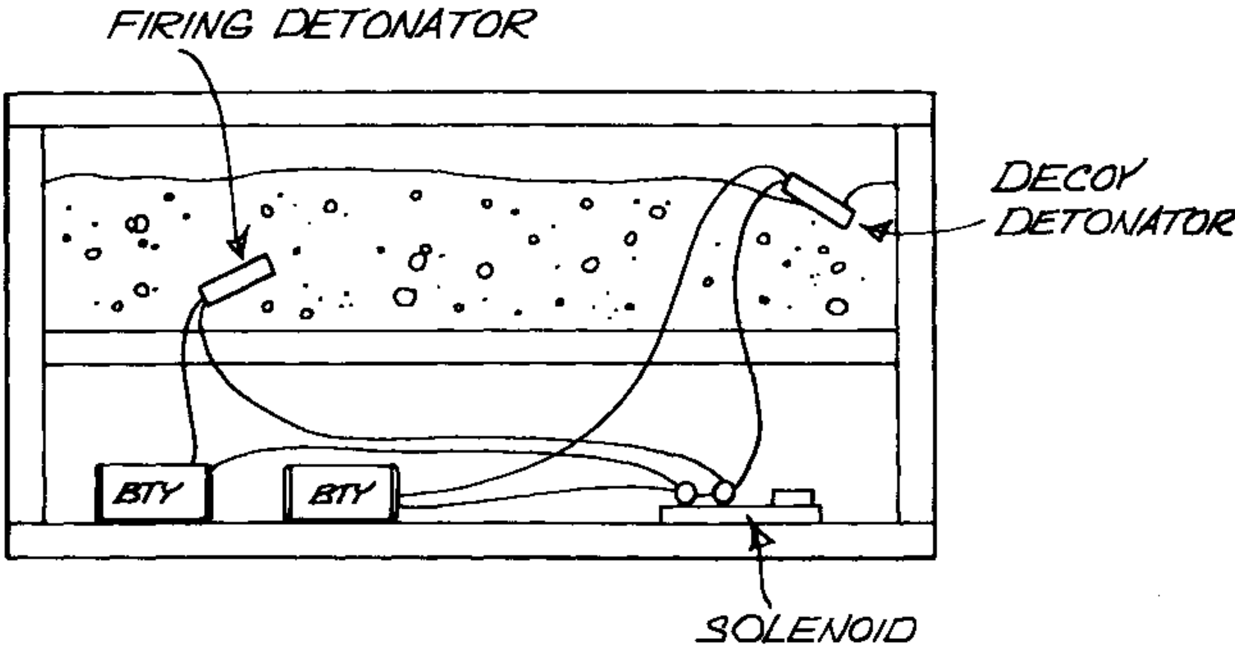

FIG 107 DOORBELL CIRCUIT DEVICE

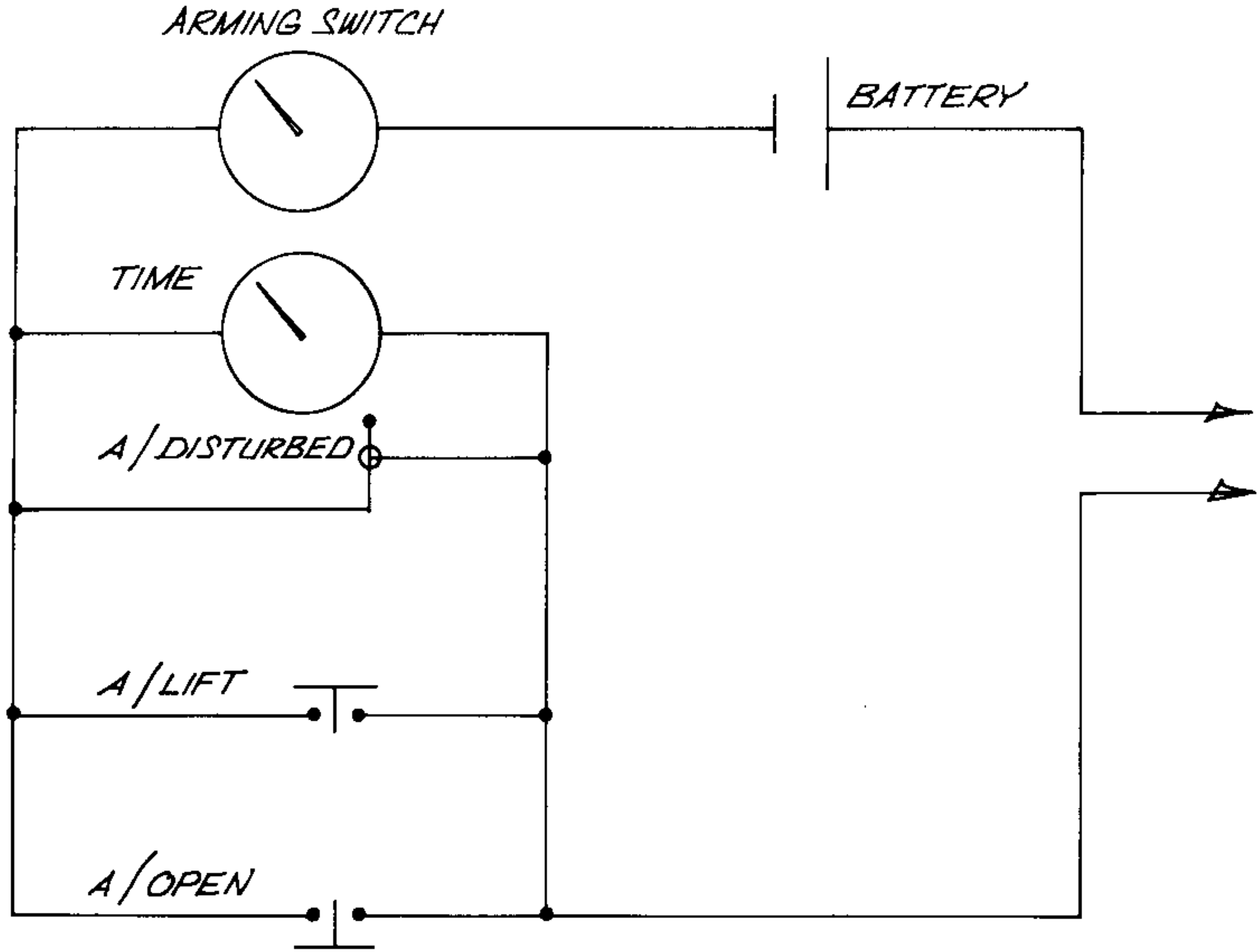

FIG. 108 COMPLEX TIME / ANTI-HANDLING DEVICE

PART 'A'

DATE/ TIME/ GROUP	BOMB REP OPERATORS PRESENT	SERIAL NO.

A. LOCATION

B. TIME

C. SITE

D. INCIDENT CMDR

E. PRIORITY

F. REMARKS

PART 'B'

G. IED/ FIND/ HOAX/ FALSE ALARM

H. HE/ LE/ INCDY/ TOXIC

I. TIME/ ANTI-HANDLING/ COMMAND

J. ELECTRICAL/ MECHANICAL/ CHEMICALS

K. TARGET

L. RESULT OF EOD ACTION

M. REMARKS

2. ACCESS AND RENDER SAFE PROCEDURES APPLYING IN AN EOD (IOD) INCIDENT

DEFINITIONS AND TERMINOLOGY

1. **EOD Procedure.** These particular courses and modes of action for access to, recovery, rendering safe and final disposal of explosive ordnance or any material associated with an EOD incident.

2. **Access Procedure.** These actions taken to locate exactly and to gain access to UXO. (The term UXO is taken to include IED.)

3. **Render Safe Procedure.** The application of special EOD methods and tools to provide for the interruption of function or separation of essential components to prevent an unacceptable detonation.

4. **Final Disposal Procedure.** The final disposal of EO which may include demolition or burning in place, removal to a disposal area, handing to police authority, or other appropriate means.

5. **Improvised Explosive Device (IED).** Those devices placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic or incendiary chemicals designed to destroy, disfigure, distract or harass. They may incorporate military stores but are normally devised from non-military components.

   (1-5 are taken from NATO STANAG 2143)

6. **Safe, Waiting Period** (more commonly known as "Soak Time"). A length of time which is applied by the EOD operator during which he will NOT make a personal approach to the IED and during which the IED if it is a time device may normally be expected to function. These soak times may be adjusted periodically to counter changes in terrorist techniques and tactics.

7. **Neutralised.** When the function of the IED has been interrupted, e.g. the electrical circuit is broken in such a way that the IED could no longer function as designed.

8. **Rendered Safe.** When the essential components of the IED have been separated and are not joined in any way, e.g. when the main charge, detonator, power source(s), switching mechanism are segregated from each other.

9. **Controlled Explosion.** A term covering the numerous occasions when an EOD operator uses an explosive technique in neutralising an IED during a render safe procedure. The explosion may cover the use of a standard item of disruptive equipment or the use of a demoliton charge to destroy the device, or device detonator's sympathy.

ACCESS AND RENDER SAFE PROCEDURES IN EOD (IED) INCIDENTS

INTRODUCTION

1. Access and render safe procedures are the most important procedures in an EOD (IED) incident during which the EOD operator is at maximum personal risk and where mistakes in planning could prove fatal.

2. Each IED incident is unique because the situation may be affected by even minor changes in terrorist tactics, actual device, target, and its surroundings. It is therefore impossible to insist on the application of inflexible rules in dealing with an incident. It is possible only to develop a technique which will identify immediate threats to safety, and then enable the EOD operator to make a thorough appreciation, and plan and execute his render safe procedure.

3. The guidelines discussed in this precis have been formulated as the result of hard-learnt lessons in the Northern Ireland Terrorist campaign, and whereas some of the detailed considerations may only be applicable to that campaign, the same basic principles should be applied to any IED situation anywhere in the world.

4. Many of the considerations and actions are mandatory in the Northern Ireland campaign and much of the material included in this precis is extracted from CATO Northern Ireland SOP'S and A & ERs Vol. 3 Pam. 21 Pt. 5.

EOD PHILOSOPHY

5. Life is irreplaceable. When planning the render safe procedure (RSP) there is one over-riding consideration to be made.

"EXCEPT WHEN FACED WITH A CATEGORY 'A' INCIDENT THE SAFETY OF THE OPERATOR IS THE FIRST CONSIDERATION AND IN ALL CATEGORIES OF INCIDENT THE AIM WILL BE NEUTRALISATION BY REMOTE MEANS."

(A & ERs Vol. 3 Pam. 21 Pt. 5 Sec. 1 Para. 2 refers.)

CATEGORISATION OF EOD INCIDENTS

6. There are 4 categories of EOD incidents as follows (N. Ireland):

a. **Category A**: Those EOD incidents that constitute a grave and immediate threat to military or civilian operations that are essential to the war or defence effort. Such incidents are to be given priority over all other incidents and disposal operations are to be started immediately regardless of personal risk. (In NI Category A tasks are authorised by brigade commanders only.)

b. **Category B**: Those incidents which constitute an indirect threat to military or civilian operations essential to the war or defence effort. Before beginning EOD operations a safe waiting period will normally be observed to reduce the hazard to EOD personnel.

c. **Category C**: Those incidents which constitute a little threat to military or civilian personnel or operations essential to the war or defence effort. These incidents will normally be dealt with by EOD personnel after Category A and B incidents as the situation permits and with minimum hazard to personnel.

d. **Category D**: Those incidents that constitute no threat at present.

7. It is only in periods of intense IED activity that categories of incidents may be given. It is invariably left to the EOD operator to accurately assess the situation on his arrival at the scene of the IED and then to accurately categorise. In the absence of any indications in the tasking message, the EOD operator is to assume that the task is Category D.

8. It can be seen that only in Category A incidents is the EOD operator to endanger himself, i.e. in all other categories of incidents, the safety of the operator is paramount. *It is to be noted that even in a Category A situation a REMOTE attack must be made* if it is possible. What it really boils down to is that a safe waiting period is NOT to be applied in a Category A situation if a remote attack is possible.

9. **Examples of Possible Category A Tasks:**

   a. An IED is placed in or near a hospital in circumstances which make it impossible to evacuate or protect the patients.

   b. A second IED is discovered at the scene of an explosion where people are known to be trapped in the rubble. Rescue operations must continue (or even start) to free them.

   Thus it can be seen that intrinsically there must be a possible loss of life unless the IED can be rendered safe. This is to be the underlying philosophy in categorising incidents.

10. CILSA himself after visiting RAOC EOD teams in Northern Ireland subsequently stated that the number of Category A targets in Northern Ireland was so small as to be unquantifiable.

MAKING AN APPRECIATION

11. The crux of dealing with an IED incident lies in the ability of the EOD operator to make an accurate and logical assessment of the situation. This requires the EOD operator to:

    a. Extract all information from all sources at the scene and discard the irrelevant information. To do this the EOD operator must develop a good questioning technique.

    b. Make a realistic assessment of the result of the IED functioning.

    c. Ask VALID questions of himself which should lead to a render safe procedure which is:

       (1) Hopefully remote.

       (2) The safest possible having reduced personal risk to the absolute and acceptable minimum.

AIDE-MEMOIRE

12. To assist the EOD operator when he is planning his actions an aide-memoire card has been produced which in general terms covers all the points which must be considered by the operator. This card is to be carried by all EOD operators and the contents are reproduced below.

Remember the basics:

PIT STOP PLAN FELIX

TASKING

P Place/location of IED?
I Intelligence. What is known about IED?
T Time bomb was laid/discovered/reported?

EVALUATION

S Safety of public, security forces, area and self.
T Time laid. Cross check and confirm timings.
O Observe and question observers.
P Priority. Only take risk if Category A.

P Protection. Shield, armoured suit, ear defenders, etc.
L Location. Establish exact location – questions? CCTV?
A Accessibility. Which remote equipment can be used?
N New or soak?

ACTION

F Fail safe. If in doubt or Category A – refer up.
E Execute plan safely.
L Look again. Assess effects of action taken.
If in doubt, go back to STOP.
I Inform tasking HQ job completed.
X Xpedite feedback.

SEQUENCE OF EVENTS AND CONSIDERATION IN AN EOD (IED) INCIDENT)

1. **Tasking**

a. There must be only one tasking authority (BSAP), other agencies must not be permitted to pass tasking messages to EOD personnel. In Northern Ireland the tasking authority is the operations room of the brigade which the EOD section is supporting. EOD teams should accept tasking only from their approved authority. Adherence to this procedure results in the most safe and efficient direction of EOD effort.

b. It is important when receiving tasking messages that sufficient information is obtained to assist in assessing additional factors, e.g. whether any special equipment may be required. Always call second EOD operator.

2. **Route Planning**

It may be necessary to plan the route to the scene to avoid high risk areas, or possible obstructions (e.g. traffic congestion in cities), if necessary obtaining the necessary clearance from the appropriate operations room. In a hostile area, there may also be other terrorist activity which must be avoided.

3. **Briefing**

All members of the team must be briefed by giving general information as to where and what the suspect IED is. Any special instructions should be given at this point.

MP Stand-by
Army OPs Room Advised

4. **Check Equipment**

It is essential that the EOD team equipment is maintained and checked as thoroughly as possible. All equipment and expendable items should be checked for presence and serviceability at the start of a period of duty. It is recommended that a loading and check plan be prepared so that if necessary, the appropriate item can be located in total darkness. Certain equipment is of a high security grading and may need to be offloaded on return to base.

Certain other equipments are very attractive, e.g. camera, binoculars, cassette tape recorders, etc.. and must be offloaded on return to base to prevent theft. ***It is necessary to maintain detailed procedures to ensure equipment is always fully operational (e.g. charge/recharge batteries, etc.).***

5. **Movement**

Before leaving base establish radio communications (usually with the tasking authority) and proceed along the preplanned route paying due regard to normal traffic regulations unless the nature of the task warrants use of the blue light and horn. The EOD team may comprise a number of vehicles and it must be the responsibility of commander of the lead vehicle to ensure that all vehicles stay together.

6. **Arrival at Scene**

On arriving at the scene, report this fact to the tasking authority and then report in person to the incident commander (IC), who may be anyone from a police constable to a lieutenant colonel. The EOD operator is tasked as adviser to the incident commander and it is advised that the EOD operator does not assume the role of the incident commander, otherwise he will find himself assuming responsibilities for details which are not of his concern. The EOD operator must remember that his concern is the bomb, the safety of life and property and restoring the situation to normal with the security forces (this term embraces both civil police and military forces) acting on his advice.

7. The incident commander will tell the EOD operator all that he knows about the situation and also detailing his actions to date to evacuate and cordon (in Northern Ireland a standard radius for cordoning and clearance is 100 METRES FOR THE NORMAL BOX TYPE OF IED AND 200 METRES FOR A CAR BOMB OR LARGE IED). The distance of the cordon may of course be reduced in an urban situation due to buildings acting as screens to reduce the effect of the bomb if it were to function. The EOD operator may need to advise the incident commander but it would be pointless to reduce a cordon which is already established.

8. **EOD Control Point**

a. After making the initial contaact an EOD control point must be established. The EOD control point is a location from which the EOD team can operate and still be afforded adequate cover from the danger of the suspect bomb and possible other terrorist action, i.e. sniper fire. This location will invariably be within the cordon. *The R V at a scene is not always the most suitable place to locate the control point.*

b. When locating the EOD control point it must be borne in mind that if the bomb were to function, windows in direct line of sight can normally be expected to be blown inwards whereas windows not in direct line of sight, e.g. around a corner, can normally be expected to be sucked outwards; in such a case if the EOD control point was located around the corner of a multi-story building then it could be showered with shards of glass and even slates and tiles.

c. If possible the incident commander should be located with the EOD control point, but this is not always possible and therefore there must be some means of communicating directly with him, e.g. use of the EOD communications equipment could put him in direct contact with the EOD operator at all times.

d. Witnesses available for questioning by the EOD operator would normally be located in a safe location convenient for the EOD control point. Only personnel actually involved in the RSP (except incident commander) should remain in the control point.

e. In an operational theatre where the terrorists' target may be members of the security forces or specifically the EOD team, the EOD control point should be sited after consideration of avoiding the obvious site, or locations previously used.

9. **Evacuation**

There must be no conflict of advice over the question of evacuation of premises once a bomb is discovered. It is recommended that where safe alternative exits exist in a building, the exit leading near to the device should be blocked and evacuation should only be by the alternative exits. Evacuation should never be resorted to if the only exit passes the bomb. In certain types of building and depending on the explosive content of the bomb, people inside the building could be safe two or more floors above the bomb. Another alternative is to request fire service assistance to evacuate people from upper storeys on the side of the building furthest away from the bomb.

The decision to evacuate a building on the discovery of a suspect bomb must be for management and not for the EOD operator. It must be borne in mind that if management decide not to evacuate the building then the EOD operator cannot take any positive action to dispose of the bomb, as his action may cause the bomb to go off and so put the people in the building at unacceptable risk. Invariably if management fail to heed the EOD operator advice then certain 'pressures' may be brought to bear to to achieve the desired result.

10. **Questioning Technique**

After the briefing by the incident commander and after ensuring that the necessary clearing and cordoning has been initiated, all witnesses who know anything at all about the circumstances by which the suspected bomb came to be emplaced, are to be questioned. Annex A to this precis gives information on questioning technique.

11. **Observe**

After finding out all that it is possible to find out from witnesses the EOD operator will ideally like to see the bomb and the surrounding area. He must consider doing this remotely. A personal approach is not to be made only to have a look, as this unnecessarily puts the EOD operator at high risk. It may be possible to *use binoculars from several vantage points* at a safe distance from the device or alternatively, wheelbarrow equipment with closed circuit TV equipment (CCTV) may be used.

If the latter was the choice then it would be considered bad tactics to use wheelbarrow and CCTV without suitable render safe equipment being fitted. (It has been experienced in Northern Ireland that occasionally after a remote wheelbarrow recce, the bomb functioned as the vehicle was being brought back to the EOD control point and seriously damaged the wheelbarrow.)

12. **Electronic Counter Measures (ECM)**

ECM (if applicable) would be ordered at this stage. It must be remembered that no action which could cause the bomb to function can be taken until it has been confirmed by the incident commander that the cordon is established and working effectively and that all evacuation action has been taken.

13. **Making the Appreciation**

The elements of making the appreciation include:

a. Assessing the maximum possible possible explosive content.

b. Assessing the probable effect on the target (if a building, e.g. will the result cause a fire, would other buildings be affected, etc.)

c. Deciding what assistance could be given by other agencies, e.g. advice of TMO/STMO, fire brigade, gas, water, electricity boards.

d. Confirming the category of incident and any restrictions on time or other factors which could affect the RSP.

e. Establishing approach and exit routes (for both remote and manual attacks).

f. Planning a render safe procedure (RSP). The time element should not normally have any effect on an RSP (i.e., avoid pressure to carry out the RSP quickly).

14. Ref. Para. 13a—This assessment would be made as a result of observation and from information supplied by witnesses.

15. Ref. Para. 13b—TMO/ATs do not receive training in making this assessment. The ability to make such an assessment would develop as a result of experience, but it may be possible to seek the advice of expert structural engineers.

16. Ref. Para. 13c—If a fire is a likely result the fire service must be warned. They may decide not to turn out but hold themselves in readiness at their base in case of other calls.

The EOD operator must satisfy himself that such arrangements are adequate. If the fire service attends at the scene, it must be arranged with the incident commander that they do not pass through the cordon without the EOD operator authority, i.e. they are given a route and RV point.

17. Ref. Para. 13d It has been made quite clear to all operators in Northern Ireland that the provisions of CATO NI SPOs are to be strictly observed in relation to the use of remote methods of attack and the *mandatory* application of the current minimum soak time. The need for stressing this has arisen because some operators deliberately prefer to wait a mandatory soak time and then make a manual approach in preference to attempting remote methods.

The basic rules are:

a. "Disposal operations are to be started immediately regardless of personal risk" is to be applied only when the lives of other people are at risk, i.e. a Category A situation.

b. For other than Category A tasks a manual approach is to be resorted to only if a remote approach is not possible and only after the current minimum soak time has elapsed. All information relating to the device must be obtained before such an approach.

c. Even after a remote attack but when the extent of disruption of the device cannot be viewed, the mandatory minimum soak time is to be applied before a personal approach is to be made.

d. Whenever remote attacks are *not* possible EOP operator should, whenever time permits, seek advice from CATO or SATO before making approaches which involve personal risk.

18. Ref. Para. 13e—As stated, this must be done for both remote and manual attacks but is particularly important for manual attacks, so that due regard has been given to the possibility of secondary hazards such as tripwires, pressure mats, hidden devices, etc.

19. **Planning a Render Safe Procedure**

a. **Remote**

The first question that the EOD operator must ask himself is "Can I deal with it remotely?" and then explore every avenue of remote method of attack. This entails listing every weapon in the remote attack armoury and asking of each,

"If I use it . . . .

"What is the best that can happen?
"What is the most likely thing that can happen?
"What is the worst that can happen?"

If the worst that can happen carries an unacceptable risk, then that particular method must be discounted and another chosen to reduce that risk. Only when *every* remote method has been considered (and improvisations thought about too) can the final choice be made. It is obvious that the particular method which gives the best chance of neutralising the device and presents only acceptable risks is the method to be applied. The decision should not be accepted without going through the whole thought process again double checking. If the decision at the end is the same as the first then proceed with the detailed planning.

NOTE: A *remote* attack may be made *immediately* that confirmation is received that the area is clear, i.e. safe waiting periods are not to be applied.

b. **Manual**

(1) Only when all avenues of remote attack have been explored then (and only then) should a manual approach be considered. It is advisable that, if time permits, the facts of a remote attack being impossible, be referred up the technical chain of command before the EOD operator puts himself at risk.

(2) If a manual approach is confirmed, the first thought must be "Is it possible to make only one personal approach and move the device to a location where a remote attack can be made?" A hook and line should be used for this task.

(3) If the decision is to perform a completely manual RSP, i.e. (2) above is not possible, then to choose the most appropriate and safest method the same questions are to be answered for each of the techniques, i.e. "If I use it . . . . What will be the best/most likely/worst thing that can happen?" Only by applying this method of selection can the final selection be made. If the worst that can happen carries any unacceptable risk then another method must be chosen to reduce that risk.

(4) A good way of helping to decide the safest possible RSP is to count against each method how many personal approaches would be required (allowing) for any likely secondary approaches if the result of the primary approach proves unsuccessful, e.g. first placing of hook and line pulls off). The method which entails the least number of approaches is obviously the safest.

(5) Another consideration is to reduce the amount of time spent in danger from the device. This time in danger could well start from the moment the EOD operator steps out of cover which may be at the EOD control point. Every possibility of reducing such time should be thought about.

(6) It may be an acceptable technique to make only one personal approach to lay a demolition charge as close as possible but without actually touching and dispose of the device as though it were a blind or a stray. This is an acceptable technique particularly for devices in rural area, i.e. a command wire detonated device at the side of a country road. In Northern Ireland even this one personal appraoch may be avoided by using 'stand off' destructive weapons.

20. **Safe Waiting Period (Soak Time)** (See also Para. 16)

a. Except in Category A incidents a safe waiting period may need to be applied before a personal approach is made. In Northern Ireland it is mandatory to apply a minimum soak time before making the first personal approach. This Northern Ireland soak time is based on the result of an intensive study of known terrorist timing switches. The study revealed that the most dangerous times after laying are:

(1) Between 25 and 35 minutes,

(2) Between 1 hour 50 minutes and 2 hours 10 minutes.

(3) Between 5 1/2 and 6 1/2 hours.

Soak times of up to 13 hours may be justified in certain situations. (See also Appendix 1 to Annex A.)

b. **Secondary Soak Time**

The EOD operator must make allowances in his RSP for secondary soak times after each positive action. These times may be shorter than primary soak times. The reason for this soak time is to allow secondary arming switches to act, e.g. the secondary collapsing ciruit in a holdall device operated by a microswitch located in the base of the holdall which would have decayed between 3 1/2 and 7 minutes after the holdall was picked up or moved. The secondary soak time may be as long as the primary soak time, depending on prevailing terrorist techniques (10 minutes minimum).

c. All soak times should be varied to prevent the terrorist noticing a standard pattern of work and associating it with any particular EOD operator. This would give the terrorist an initiative to lay a particular type of device to take advantage of this standard pattern.

d. The EOD operator must resist pressures that may be put on him by superior ranking officers of the security forces to disobey any mandatory soak times in order to effect a quick clearance. Any such pressures must be firmly and politely (but diplomatically) resisted, explaining that orders do not permit a personal approach until the soak time has elapsed.

21. **Protection**

Due consideration must be paid to the precaution which could be taken that would give protection to the EOD operator. Considerations such as:

a. Would the wearing of the EOD body armour give protection? For example, some homemade explosives are especially crush and abrasive sensitive. After disruption techniques have been used the main explosive charge may be spread around the immediate area; the next approach on foot could be hazardous and use of the EOD suit may give protection. Another technique in this situation is to hose the area down with water as the approach is made.

b. If the EOD team vehicle is an armoured vehicle, this could be used to make part of the initial approach or could even be positioned as some midway point and so reduce the length of time that the EOD operator is exposed to danger.

c. Ear defenders must always be worn.

d. Small portable shield.

No protective measure can confer absolute invincibility on the EOD operator who must therefore guard against being lulled into a false sense of security.

22. **Discussion and Briefing**

a. *After deciding* upon the final RSP to be used, the complete plan should be discussed with the No. 2 in the EOD team who may be another EOD operator or an experienced member of his team. The old adage "two heads are better than one" is particularly applicable in an EOD (IED) incident. The No. 2 may pick up some point that the No. 1 may have missed. After this discussion the EOD team members are to be briefed on the proposed RSP and what their actions should be in support.

b. **Briefing**

A final briefing should be held at which the incident commander, fire services, public utilities representatives are present, and are fully briefed on what their actions are to be at each stage and what the possible outcome of the RSP actions could be.

It is not necessary to explain the RSP in detail, it would be sufficient to say, e.g. you will be using equipment which will give a controlled explosion which may or may not cause a high order detonation. The EOD operator may wish to institute a signal system, e.g. one long blast on a whistle is the "all clear" signal and that security forces, etc. should keep under cover until that signal.

23. **Implementing the Render Safe Procedure**

a. **When at the Device for the First Time**

(1) The EOD operator should ask himself if the proposed RSP is still feasible. It may happen that new factors have become apparent. If the plan is not now feasible the EOD operator must retire and replan.

(2) If the EOD operator ever feels that he is spending too long at the device, it is most probably true and indicates some weakness in the plan or in the implimentation of the plan. Once again, he should retire and replan.

(3) The EOD operator should always keep asking himself if any action is likely to move or disturb the device. If this is possible then he must retire and replan.

(4) Is the equipment being placed to give the best results?

(5) Is any action being dictated by the fact that only certain pieces of equipment have been brought forward? If this is the case the EOD operator must retire at once, replan and obtain the necessary equipment.

The foregoing points indicate that the EOD operator must never commit himself to slavishly following his plan, but should remain flexible and keep his own safety uppermost in his mind. The thought processes that were applied in making the original RSP mean that a contingency plan has already been thought out, should it be necessary to abandon the initial plan. (Maximum exposure 15-30 seconds.)

b. **After Each Subsequent Positive Action** (whether remote or manual)

The EOD operator must consider:

(1) Can the effects of the attack be seen? This may be achieved by deploying other members of the team at safe flank observation points to report on what they see. The EOD communication equipment is most suitable for this purpose.

(2) If the previous approach was a personal one, can a remote approach now be made?

(3) When will the next personal approach be possible? I.e. apply a secondary soak time before making it.

(4) Is the next step in the planned RSP still practicable? If not, replan before approaching.

(5) Never at any stage cut into the device without being absolutely sure that everything inside the device has been seen. A useful technique to achieve this is by using a hook and line to empty the container of the device.

(6) *Always take the most appropriate tools (i.e. hook and line) forward on the next planned approach. Do not make the approach empty-handed, as this would constitute an approach into danger which would not produce any positive action, i.e. do not approach only to observe.*

(7) When will it be safe to collect the remains for forensic evidence? Make effort to leave maximum amount of evidence.

24. **After Clearance**

a. When the RSP is finished and forensic evidence has been taken, the "all clear" can be given. The EOD operator should thank the incident commander and representatives of other public utilities for their assistance, report *brief* details of clearance to the tasking authority before leaving the scene.

b. As soon as possible after the task prepare reports and other documentation relating to the task.

ANNEX

QUESTIONING TECHNIQUE

1. **Introduction**

It is always in the EOD operator's own interests to form a good questioning when dealing with persons/ witnesses at the scene of a suspect IED. Many questions may need to be asked to establish all relevant information. In essence the answers to the following questions must be obtained:

a. Where is it?

b. What is it?

c. When was it placed?

d. Why was it placed?

2. **"Where Is It?"**

a. It is not unknown for security forces to be deployed too close to the IED, and for this reason this must be the first question asked so that appropriate action to move back is taken (but see also Para. 3a).

b. The location of the device may already be firmly established before arrival at the scene (via the tasking message), but in certain circumstances a more detailed description of the precise location of the IED may be required to enable the EOD operator to use his remote equipment in the best way, e.g. are doorways wide enough, are there any steps up or down? Even if a manual approach is resorted to, the precise location is required so that time spent in danger from the IED is reduced to a minimum and is not spent in searching. A useful way to ensure that the location is precisely known is to have a diagram drawn and have it confirmed in detail during your independent questioning of witnesses.

c. One question under this heading is to find out if anyone has been up to/come away from the IED and so establish cleared paths for the EOD operator to use (particularly in rural areas). Allied to this after a positive response is "Was anything unusual noticed on the path taken, e.g. wires, boxes, disturbed ground, etc."

d. It may also be necessary to find out whether the suspect IED is placed on or near to any material which is toxic, flammable, or chemical, e.g. fuel oils, dry cleaning fluids, fertilizer, etc. The presence of this kind of material may add to the effect of the bomb were it to function, and could therefore enlarge the danger area.

3. **"What Is It?"**

a. Any proposed evacuation/clearance action as a result of asking "Where is it?" must of necessity be arrived at by also considering the size of the suspect device and imagining that it is crammed full of plastic explosive, and then having the appropriate action taken.

b. Certain information relating to the container of the suspect IED will invariably be known to the EOD operator, but this limited knowledge should only be regarded as the frame on which to build additional information. Witnesses to the placing of the bomb may be able to give an account of what was seen and heard. However, it must be borne in mind that this information cannot always be relied upon, as there as been at least one instance where the story was a complete fabrication.

4. **"When Was It Placed?"**

a. The EOD operator may wish to base his waiting time (also known as "soak" time) on this information. If the accurate or true time of placement cannot be established, the EOD operator *must* start his waiting time from:

(1) The time that the security forces arrive on the scene and can guarantee that no one has tampered with the IED; or

(2) The EOD operator's time of arrival at the scene.

5. **"Why Was It Placed?"**

a. The answers to this question may give some indication of the source from which the device came and therefore possibly the degree of sophistication or type of switch.

b. It may only be necessary to find out the race/creed of the owner of the building.

c. In any case, make certain exactly what the target is *(it could even be the EOD operator)*. This in itself may point towards the likely operation of the IED.

6. **"Whether Anything Was Seen or Heard?"**

a. Witnesses' accounts of what the terrorist said or was seen to do can often give the EOD operator some assistance in deducing what type of switching arrangement is incorporated in the bomb.

At Appendix 1 to this Annex is an extract from CATA NI SOPs giving the deductions that can be made from reported terrorist actions. Any such deduction must be treated with some scepticism and not regarded as a reason for placing oneself at personal risk by e.g. ignoring soak times.

b. An account that a terrorist left the room and was away for a few minutes could be interpreted as there being a possibility that he has placed another bomb somewhere in the building in addition to the bomb placed where the witnesses were being held. Often in this situation only one bomb warning is given by the terrorists so when the first bomb functions the security forces will be attracted into the building to investigate and be placed at risk by the second unreported bomb. If the bomb goes off while the EOD operator is questioning witnesses, he should complete his questioning technique to try and establish whether another bomb could have been placed in the building. If the possibility exists, then the minimum soak time should be applied before investigating the building.

7. **General**

a. Questions do not always produce the answers required; the EOD operator must ask himself "What do I need to know?" and then ask questions to achieve this knowledge. Each answer must be fully exploited. A useful technique is to ask of the answer received, "So what?" or "What does that mean to me in terms of my aim?"

b. When questioning witnesses it is advisable to allow them free rein to tell their stories rather than asking a range of pointed questions which may cause the witnesses to withhold information because the appropriate question was not asked, e.g.:

EOD operator to witness: "Why didn't you tell me that you'd seen a clock inside the bomb?"
Witness: "You didn't ask me."

Only after the story has been told should the witness be questioned to fill in the gaps.

c. Interview witnesses separately, as people with the best intentions tend to stick together.

d. Above all, be firm and friendly and show no hostility.

TERRORIST TIME DELAY

GENERAL

3-63 The Northern Ireland terrorist has used many methods to produce time delay:

a. Burning Fuze

b. Acid/Diaphragm/Sugar Chlorate

c. Clothes Pegs

d. Parkway Timers

e. Travel Alarms

f. "Jock" Clocks

g. Collapsing Circuit Delays

h. Self Destruct Circuits

The list is not exhaustive and others must be expected. Methods of attack have been well publicised but remote means of identification and diagnosis are not yet available. The task is therefore to reduce risk during the identification phase of an operation.

FACTORS

3-64 a. **Common Timing Mechanism**

Burning fuze are available in lengths ranging between 25-500 feet and having burning rates of between 15 and 42 seconds per foot. Burning fuze can usually be identified by reported laying activities or from visible smoke.

b. **Chemical Fuzes**

All chemical fuzes, so far found which have functioned correctly, have done so between 10 minutes and 2 hours after laying. Some fuzes build up a delicate passive membrane which halts their action, but it is broken easily and action is then instantaneous.

c. **Clothes Peg Delay**

Although possible to produce longer (up to 4 hours) delays, terrorist models have been found calibrated between 15 minutes and 1 hour 48 minutes. Clothes peg delays are influenced by ambient temperature. (The colder the longer delay that is produced.)

d. **Parkway Timer**

This timer can be set for any delay between 5 minutes and 2 hours. All that have been found have been set to give the maximum delay. Other clockwork timers, such as cooker timers, giving 1 hour delays have also been encountered.

e. **Travel Alarms**

These may be set to give varying times up to 12 hours. The only circuit so far positively identified gave a time of either just less than 30 minutes or just less than 6 hours.

f. **Other Clocks of the Alarm Type**

These when used have been adapted so that they can give delays of up to 11 1/2 hours. By incorporating a post office fuze into the circuit, the terrorist knows that delays up to 23 hours are possible.

g. **Mains Powered Clocks**

Mains clocks, e.g. Venner, Smith Clocks can be arranged to give delays of up to 7 days 23 hours. They all require a mains supply to keep running and thus limit the tactical use of the device. Electronic timing sets giving up to 24 hours delay have been found in IED situations.

h. **Collapsing Circuits**

The only collapsing circuits so far found have had time delays of:

(1) 3 1/2 minutes

(2) 7 minutes

(3) 30 minutes

It is, however, relatively easy to vary the time delay of this circuit. The short delays above were to be initiated by moving or tumbling the device.

j. Radio controlled devices have been encountered with 2 hour delay self destruct circuits.

DEDUCTIONS

3-65 a. Most devices which emit smoke may be considered safe if they have not functioned within 20 minutes of the smoke being seen, unless the fuze is used as a decoy.

b. An identifiable chemical device NEEDS a waiting period of not less than 2 1/2 hours.

c. Currently a time delay is unlikely to be clothes peg, but they may be reintroduced. A waiting period of 2 hours would allow all pegs so far discovered to function or fail.

d. No clockwork device has any particularly "safe" time. The most dangerous times after laying based on current experiences are:

(1) Between 25 and 35 minutes.

(2) Between 1 hour 50 minutes and 2 hours.

(3) Between 5 1/2 and 6 1/2 hours.

e. Clocks of longer delay than 12 hours are not often used as they generally require mains supply or additional circuitry (see Para. 3-64 f.) All devices found so far have been set for the hour (12:00).

f. Collapsing circuits have so many variables that few times can be considered safe. Currently delays of over 1 hour have not been found. Short delays may well start after the device has been tumbled, not after laying.

TERRORIST ACTION

3-66 Certain devices require actions to be carried out on laying. These actions may give indication as to type of device.

a. **Crushing or Pressing in of a Rod**

The act of pushing in a rod or of crushing the device may either:

(1) Break an acid ampoule, or

(2) Bring together two contacts to arm a circuit.

b. **Turning**

(1) A turning action carried out on a surface that will be covered, e.g. base of bomb, is possibly indicative of a parkway type of device. If this is preceded by pressing in a rod the parkway is unlikely, but if a rod is inserted, a switch thrown or two wires joined after the twisting action, a parkway timer is highly probable.

(2) Twisting on any other surface, probably of a rod or screw, is likely to be the burning together of two arming contacts.

(3) **Removal of a Rod**

Dependent upon the size of rod this may be either:

(a) Large diameter--an arming rod for a clothes peg.

(b) Small diameter--a rod allowing two arming contacts to come together.

c. **Simple Bridging**

Placing of metallic object between two external contacts, e.g. nail or screw heads – post office fuze arming.

If device is level – anti-tilt.

DEDUCTIONS

3-67 a. A combination of twist and another action makes a parkway timer highly likely.

b. Crushing is almost certainly indicative of acid delay.

c. A large arming hole may well indicate the presence of a clothes peg.

d. Bridging action may indicate anti-handling or collapsing circuit type of device.

RESPONSE TIME

3-68 When devices are laid to act specifically against EOD teams, their timing is geared to response time/recce or to normal waiting time, or to neutralisation time, after pulling.

DEDUCTION

3-69 a. Efforts should be made to avoid a time pattern of work.

b. Waiting time must be varied according to the recognisable factors.

c. A second waiting period is needed after pulling a device.

d. A factor of safety time should be considered regardless of environmental pressure.

CONSTRUCTION

3-70 Bombs have a tendency to be constructed in groups to a standard pattern. Full information on IED design is published to all interested parties. Outward appearance is not always a true indication, since devices may have different contents in standard or standard contents in unusual cases.

DEDUCTION

3-71 Construction may be an indication to bomb type, but is not a reliable factor.

TERRORIST INFORMATION

3-72 Conversation between terrorists and bystanders will sometimes give an indication as to the time available. This information although valuable is seldom accurate and should not be relied on.

Telephone warnings sometimes establish a start time for the terrorist when he has laid a time bomb previously.

DEDUCTIONS

3-73 a. Telephone call times may be meant to mark the start of activity. Response time is therefore a factor.

b. Terrorist information, e.g. "You've got 10 minutes", cannot be relied on to indicate the type of mechanism.

MISFIRE DRILLS

3-74 A & ERs give mandatory waiting periods for misfires, both igniferous and electric: these are 30 minutes and 10 minutes respectively.

SUMMARY

3-75 a. Smoke indicates igniferous fuze with a normal maximum time of about 15 minutes.

b. Chemical fuzes may not function due to the membrane which builds up.

c. All clockwork mechanism will operate within 23 hours unless failure occurs.

d. Collapsing circuits are relatively short, but may start after pulling and tumbling.

e. An examination of the device through binoculars may show the type of arming, and hence indicate a type of circuit.

f. Terrorist laying actions assist in identification and diagnosis.

g. Action time must be related to response time.

CONCLUSIONS

3-76 a. It is essential that patterns of EOD work be varied.

b. All information available at the scene from witnesses and long range recce must be considered before a decision is made.

c. A second period of waiting time may be necessary after a physical action has been carried out on the bomb. This includes attempted explosive opening.

d. STUDY of patterns does not indicate safe period; it does, however, indicate periods of highest risk.

3. THE USE OF DETONATING CORD IN THE OPENING OF IEDs

THE USE OF DETONATING CORD IN THE OPENING OF IEDs

WAYS AND MEANS OF USING DETONATING CORD

1. During the Indonesia Confrontation 1965-66 and the terrorist bombing campaign of 1967 in Hong Kong, great use was made of a short length of Cordtex mounted on a piece of cardboard and initiated electrically as a means of gaining entry through the container of an IED.

2. Whereas it must always be a principle of an EOD procedure to render an IED safe by completely remote means, it is not always possible to do so and a manual render safe procedure must be resorted to. The use of the Cordtex strip is one method of carrying out a very critical operation, i.e. opening the IED while the EOD operator is safe and under cover. This then requires only one approach into danger to lay the Cordtex opening charge.

3. **Bonus**

   In certain situations there is a bonus to opening the device. From experience and trials it has been found that up to 75% of simple circuits in IEDS are disrupted by the Cordtex strip, by either breaking a wire from the battery or breaking one of the detonator leads.

4. With the exception of gunpowder and certain of the more sensitive home-made explosives, there is little chance of the Cordtex initiating the main explosive charge.

5. **Capabilities**

   a. Trials and experience have shown that one strand of Cordtex will gain entry through:

      i. 1/2 inch thick boxwood (13mm).

      ii. 5 ply plywood pieces.

      iii. Sheet metal, e.g. biscuit tin.

      iv. Cardboard, fibre board and leather (of for example a briefcase).

   b. Two strands of Cordtex (or one strand Cordtex 22) will gain entry through:

      i. 3/4 inch thick boxwood (20mm).

      ii. 7 and 9 ply plywood pieces.

      iii. Heavier gauge metal, e.g. a metal ammunition package.

      iv. Reinforced boxwood, e.g. battens on the underside.

   It is advised that more than two strands of Cordtex not be used, as this will greatly increase the chance of initiating the device and must therefore regarded as being more of a demolition charge than an opening charge.

6. **Where the Charge Is to Be Placed**

The following points are for guidance in placing the opening charge:

a. On the most unsupported span of the package which is accessible.

b. Whenever practicable, the Cordtex strip is to be placed with the grain of the wood.

c. If it can be seen that the box is compartmented, as a general rule the smaller compartment will contain the switch and the battery, the larger compartment holding the main charge. In such cases the Cordtex charge should be used against the smaller compartments. A compartment wooden box can be indicated by visible rows of nail or screw-heads.

Suitcase -place on locks/clasps.

7. **How the Charge Is to Be Placed**

a. The card with the Cordtex mounted on it can be placed either with the Cordtex downwards or uppermost, it is not critical.

b. In windy conditions or on a sloping surface it may be useful to use a piece of tape adhesive on the underside of the card—the adhesive side of the tape facing outwards. Do not risk moving the device to place the charge in these conditions.

8. **Procedure**

The safety rules when using explosives and detonators are still applied, viz.:

a. Always keep either the EDC or the key in your possession.

b. Prepare the detonator end of the firing cable into a T form and join the bare ends together.

c. Untwist the EDC end of the firing cable only sufficient to enable the ends to be inserted into the EDC. Do *not* short out.

d. *Ensure that all radios in the vicinity are switched off.*

e. Earth yourself.

f. Remove an electric detonator from the metal box and prepare its end in a T form.

g. Connect the detonator to firing cable and insulate the join with adhesive tape.

h. Tape the detonator to the Cordtex or use Cordtex clip.

i. Move forward from cover holding the Cordtex charge and cable, the No. 2 playing out the cable.

j. Place the charge on the IED.

k. Return to cover avoiding crossing or stepping on the cable. Inform incident commander.

m. Connect the EDC and fire.

9. **Further Render Safe Procedures**

a. After firing the charge and whenever possible safely viewing the results, always apply a secondary safe waiting period of 10 minutes or more as the Cordtex charge may have caused a timing switch in the device to start.

b. During this secondary safe waiting period, retrieve the firing cable and if, as a result of safe observation it is decided to use another opening charge, prepare it.

c. When it is decided to move forward to the device, take either or all of the following:

i. Another opening charge.

ii. Hook and line.

iii. Wire cutters.

d. It is to be a principle of render safe operations at this stage that the opened up device is not dismantled UNTIL YOU CAN SEE EVERYTHING INSIDE. It may be necessary to use hook and line to empty the contents of the IED out of the box, etc., and spread them along the ground. Then and only then can the device be neutralised by either isolating the power source(s), i.e. battery or isolating the detonator(s). Another Cordtex charge may be used to cut wires, e.g. detonator wires in preference to cutting with wire cutters.

10. **Definitions**

a. NEUTRALISATION: When the circuit to the detonator(s) or from the power source(s) is interrupted.

b. RENDER SAFE: When the main parts of the device are segregated and are separated from each other, i.e. when the detonator, main charge, power source and switching arrangements are laid out separately from each other.

11. **Other Uses of Detonating Cord in EOD Procedures**

a. As car door/bonnet/boot opening charges. 3/4 in. strand.

b. Opening doors in a building suspected of being booby trapped.

c. As another means of breaking car windows. Circle of Cordtex.

d. Unwrapping suspect parcels. Cordtex with stand-off. 6–12 in above.

4. USE OF THE SHOTGUN IN THE DISPOSAL OF IEDs

USE OF THE SHOTGUN IN THE DISPOSAL OF IEDs

INTRODUCTION

1. Shotgun has been part of the EOD (IED) operator's armoury for many years, but until recently there has been little detailed study on the use of the weapon. However, it has been shown that an IED can often be rendered safe by firing at it with a shotgun, when the device is disrupted without the explosive, detonator or initiation system functioning.

2. School of Ammunition (RSA) and RARDE have made a detailed study, the results of which are published below.

AIM

3. The aim of this precis is to outline the use of the shotgun in IED disposal.

THE WEAPON

4. Shotguns are simple, reliable and lightweight weapons. They are readily available and compared with some other EOD equipment are comparatively cheap.

5. Any type of shotgun may be used, but 12 bore weapons are normally used. The current issue and ammunition is 12 bore, therefore the data in this precis relates to 12 bore shotgun.

6. The shotgun currently in use with RSA EOD teams is the FN manufacture 12 bore Browning semi-automatic "Riot Shotgun". The weapon will hold 5 rounds which may be assorted types. If 5 rounds are loaded, one of them will be chambered.

METHODS OF EMPLOYMENT

7. Shotgun is used to attack IED in 2 ways:

a. **Short Range**

Short range attack is defined as attack at a range of 0-3 m. Ideally, the shotgun is delivered by means of remote delivery equipment, but it may be manually delivered, and mounted on a purpose made stand or between sandbags. With a remote delivery system an electro mechanical firing system (solenoid) is required. With a manual approach the weapon may be fired either by the method described above or by using a line to pull the trigger. Use of a line may well limit the shotgun with manual emplacement.

b. **Long Range**

Long range attack is defined as attack at a range of 50-150 m. Long range attack is possible using the methods outlined for short range attack, or the EOD operator may fire the weapon in the normal way. It is stressed that the operator must work on the assumption that the IED may function, and therefore not choose a firing point where he would cause a hazard to himself. He must make the best use of cover and ensure that he would be safe in the event of a detonation. 150 m is stated as being the upper limit of long range attack, but a well practised shot may be able to hit a target at greater ranges. However, multi-shot ammunition is presently not effective at ranges greater than 50 m, because of the disperson of the shot.

8. To use shotgun between the ranges given above, the data given must be interpreted in the light of circumstances prevailing at the time.

9. Apart from attacking IED to disrupt them, shotgun may be used for many other tasks. Examples are:

   a. Removal of car windows may be achieved by firing 2 or 3 rounds of solid shot to shatter the glass, then sufficient No. 6 or No. 7 to remove the shattered glass. On operations, TMO/AF have been able to achieve this at ranges up to 150 m.

   b. Remote unlocking of doors may be achieved by shooting off locks.

   c. Jarring and tumbling the IED instead of using hook and line.

LONG RANGE ATTACK

10. **Choice of Ammunition**

For long range attack, a fairly heavy shot is required, or the projectiles will have insufficient energy to penetrate the container of the IED. A suitable ammunition is ICI Alphamax or rifled slug ammunition has better penetrative power at this range, but the slug must strike a critical component of the IED, and there is a probability of the slug initiating the explosive on impact. Comparisons of the loading and penetrative ability of LG and rifled slug are at Table 1 and 2.

11. **Disruptive Effects**

Trials of shotgun ammunition were carried out on a range of small IEDs constructed in wood and cardboard boxes. The IEDs contained explosive, with a detonator embedded in it. The detonator was not connected to the firing circuits. The detonator's place in the firing circuit was taken by a tell-tale fuze head, so that if the explosive detonated it was possible to determine the source of the detonation. A summary of some of the firing results is at Table 3. Having penetrated, rifled slug has no real disruptive effect, unless it strikes a critical part of the IED.

12. **Effect on Explosive**

A series of 1/32 inch metal (H83) containers, each filled with 3/41b coop, all detonated when attacked with shotgun firing various ammunition. A short series of trials on soft cased IED suggests that rifled slug has 40% chance of detonating coop, while only 10% of the IED attacked with LG detonated.

13. **Conclusions on Long Range Attack**

   a. Sensitive anti-disturbance devices are unlikely to be NEUTRALISED with either LG or rifled slug.

b. Alphamix LG has potential for disrupting IED.

c. Rifled slug has good penetration, but little disruptive effect. It may initiate the explosive.

d. Attack of IED in metal containers is liable to lead to detonation, particularly if rifled slug is used.

SHORT RANGE ATTACK

14. Choice of Ammunition

There is a wide range of ammunition suitable for short range attack. Generally No. 1-9 shot are recommended for cardboard or wooden boxes. SG, LG or AAA are suitable for light metal containers and heavy wooden containers. Ammunition loaded with large shot has greater penetrative ability, but the more individual pieces of shot that are fired into an IED at one time, the greater the chance of disrupting the circuitry.

15. Method of Attack

At short range it is possible to aim to critical components with reasonable confidence of hitting them. In some cases it will be possible to see critical components, but this will not usually be so. If no critical components can be seen, the operator must make a reasoned estimate as to where they will be. In the case of an IED which is seen to be in 2 compartments, the smaller compartment should be attacked. Duffel bags and holdalls should be attacked in the upper regions. Aim to have greatest portion of object hit. Aim at circuitry.

16. Disruptive Effect

The type of ammunition used at short range will make a small, clean entry hole. The shot will spread out inside the container, normally destroying batteries and other components and cutting some of the wiring. Often the back of a wooden box will be detached, particularly if more than one round is fired. If the container is a suitcase or similar item, the hinges and locks may be destroyed. Indeed, after firing one or two rounds into the main container, it may be desirable to fire a round at each lock. If the back of the container is removed, or locks and hinges broken, subsequent hook and line work will be easier, and more likely to be effective. Trials show that sensitive anti-handling devices can be disrupted. Results of some firing trials are at Table 4.

17. Effect on Explosive

Explosive is unlikely to be initiated if the ammunition listed above is used, even if it is fired directly at the explosive. To reduce the risk, the operator should avoid firing directly at the explosive. Detonators bearing evidence of having been struck by shot may often be recovered from IED's disruption in this way.

18. Conclusions on Short Range Attack

a. When it is possible to use short range attack, it is more likely to be successful than long range attack, even with sensitive anti-handling devices.

FURTHER WORK

19. RARDE are continuing to research the effects of shotgun on IED. They are concentrating on new ammunition for long range attack. It is hoped that ASA (RSA) will be able to carry out further work on short range attack.

20. **Chain Shot**

It has been mentioned that multi-shot cartridges are not effective at ranges greater than 50 m, because of the disperson of the shot. RARDE attempted to overcome this by various encapsulation techniques, none of which were entirely satisfactory. They eventually discovered an Italian round loaded with 13 lead balls attached to each other by coiled copper wires. The manufacturers claim that the ammunition is accurate, and presumably tightly grouped, at ranges up to 130 m. RARDE copies this ammunition and also made up ammunition to their own design, where 8LG size split shot were crimped onto a wire ring. RARDE do not feel that they know enough about the new ammunition to make any firm recommendations, but they believe that it shows great potential for the disruption of small thin cased IED at ranges up to 50 m. Wax loaded rounds.

CONCLUSIONS

21. Shotgun is a useful tool for disruption of IED. Selection of the correct ammunition gives the operator flexibility and shotgun can be used effectively from comparatively long ranges. However the use of multi-shot ammunition is not effective at ranges greater than 50 m.

22. IED constructed in metal containers are not likely to be disrupted with shotgun.

23. Exploitation of different ammunition may make shotgun an even better weapon in the future.

FURTHER READING A & ERs Vol. 3 Pam. 14 Part 4 and Expl. & Bomb Disposal Guide--Lenz, p. 217-229.

TABLE 1

LOADINGS OF 12 BORE CARTRIDGES

CARTRIDGE	FIG.	TOTAL WT. OF SHOT	NO. OF BALLS	DIAM. OF BALLS	WT. OF BALL
Alphamax LG	1	36.6 gm.	8	10 mm.	4.58 gm.
ICI Rifled Slug	2	26.19 gm.	1 Slug	–	26.19 gm.

TABLE 2

PENETRATION OF SHOTGUN AMMUNITION AT 20 METRES

TARGET	SHOT	RESULT
3/8" Plywood Sheet	LG	Penetration, clean entry hole, splintered exit hole.
	Rifled Slug	Penetration, clean entry hole, clean exit hole.
1/2" Soft Wood	LG	Penetration, clean hole.
	Rifled Slug	Penetration, clean hole.
1/16" Dural Sheet	LG	Penetration, clean hole.
	Rifled Slug	Penetration, clean hole.
1/16" Mild Steel	LG	No penetration, heavily dented.
	Rifled Slug	Penetration, clean hole.
1/8" Mild Steel	LG	No penetration, dented.
	Rifled Slug	No penetration, heavily dented.

TABLE 3

ATTACK ON WOODEN AND CARDBOARD CONTAINERS
RANGE 20 METRES

SERIAL	CONSTRUCTION OF IED	METHOD OF ATTACK	RESULT
1	Fuzehead, very sensitive pendulum. HE Sub, wooden box.	4 Rifled Slugs	Limited damage. Fuzehead functioned. IED would have detonated.
2	As for serial 1, but in cardboard box.	4 Rifled Slugs	As for serial 1.
3	Fuzehead, timer, battery HE Sub, cardboard box, insensitive anti-handling switch.	1 LG	Top of box opened, wires cut, some disruption of contents. Fuzehead intact.
4	As for serial 1.	4 LG	Lid removed and box damaged. Fuzehead functioned IED would have detonated.
5	IED recovered from firing 4.	1 LG	Further damage. Fuzehead still intact.
6	Fuzehead, timer, battery 3/4 lb. coop, Det. L2A1, wooden box, insensitive anti-handling switch.	3 LG	Box lid off, timer smashed, expl. charge disrupted. Fuzehead intact.
7	Similar to serial 6.	1 RFD	Partial expl.
8	Fuzehead, sensitive micro-switches, battery 3/4 lb. coop, Det. L2A1, wooden box.	2 LG Shot	Top/bottom of box disrupted. Wires cut, expl. package moved. Fuzehead intact.

TABLE 4

SHORT RANGE ATTACK ON WOODEN CONTAINERS

SERIAL	CONSTRUCTION OF IED	AMMO	RANGE	AIMING POINT	RESULT: COMPLETE NEUTRALI-SATION	RESULT: FAILURES
1	Castle Robin type 12" x 8" x 8", 1/2" timber	No. 6 Shot	1"	Centrally 2" above base	·4	1
2	Anti-lift micro-switch 10" x 14" x 8", 3/4" timber	No. 6 Shot	1"	Centrally 2" above base	1	
3	Clockwork time device	No. 6 Shot	36"	Centrally 2" above base	1	

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