Nature and scale of the problem

1. DIVERSITY OF THE DEVICES

DEFINITIONS

According to the International Conventions:
«Shall be considered as a 'mine', booby trap or suchlike device, any apparatus placed on or under or in proximity to any surface and designed or adapted to explode or blow up by **the simple presence**, proximity or contact of an individual» (or of a vehicle);

Or, according to military handbooks:
«A mine (antipersonnel or antitank) is a pyrotechnic device designed to be triggered by an **unintentional action** on the part of the enemy so as to put personnel (or vehicles) out of combat-action.»

Finally, a third definition defines mines in terms of their parts:

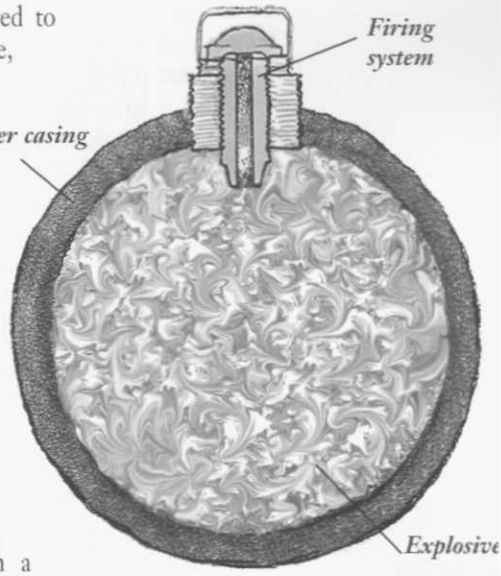
«A **case**, equipped with an **activator**, containing **explosives** or other matter, intended either to destroy or damage vehicles (...), or else to wound, kill or otherwise incapacitate personnel.»

Like most pyrotechnic devices, a mine is thus composed of three basic parts:

An outer casing: the case holding the charge and protecting it from the immediate environment. In some particular examples, the explosive (e.g., moulded plastic) may be left uncovered. Originally, mine cases were always metal. Nowadays, metals are involved in the composition of only one third of industrially produced mine-cases, being more generally replaced by plastics, bakelite or rubber. Particularly in Soviet mines and their derivatives, wooden, or even concrete, casings are to be found. This possibility of resorting to very basic materials explains the spread of «home-made» manufacture.
The body may contain objects (splinters or balls, or nails and shrapnel) which intensify the destructive capacity of the explosion by means of **projection of fragments**.

A firing system, which may include:

— a **firing device**, charged to react to «the presence, proximity or contact» of the target;
— a **detonator**, being a small amount of highly reactive explosive, set off by the ignition flame and triggering the explosion of the main charge;
— a **booster or relay**, intended, in the case of certain explosives, to reinforce the detonator explosion with a third explosive, or «relay».
Such sets of explosive thus constitute what are known as «pyrotechnic chains» or «explosive trains».

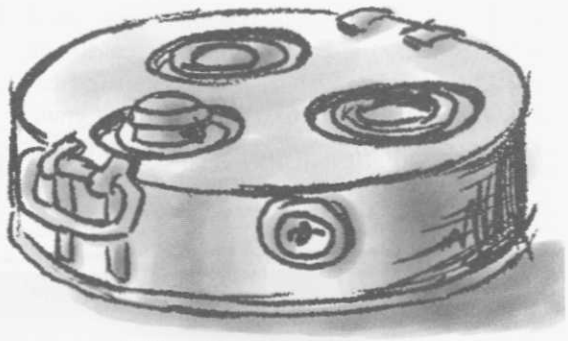


An explosive which «puts personnel (or vehicles) out of combat-action», either by blast-effect or by projected elements.

CLASSIFICATION OF THE DEVICES USED

Devices can be classified, and the concomitant threat defined, in terms of the nature and operating principles of the activator system and main charge employed. Ignition analysis enables the target of the device to be determined, and analysis of the explosive charge defines the danger to which this target is exposed. Thus the various models of mine can be divided, in terms of their intended target and of their destructive force, into

TS 50 (Italy)



Teller Mine 29 (D 1929)

«**antipersonnel mines**» (AP) and «**antitank mines**» (AT).
Among other types of mine, «**anti-landing**» **land-mines** may be singled out for mention: these are intended to destroy or damage landing-craft when they land on the foreshore (that depth of shore-line which is under water at high tide and exposed at low tide), and are obviously very powerful. This kind of land-mine is not to be confused with the water-mines which threaten landing-craft while these are actually afloat.
To mines as such there must also be added various more or less sophisticated pyrotechnic devices and, in particular, a large amount of unexploded munitions, such as shells, bombs and grenades, etc., which may represent or conceal what are called «booby-traps».
A **booby-trap** may be defined as «an explosive or non-explosive device or any other object so placed as to inflict casualties on personnel when an apparently inoffensive object is moved or an action which would usually be without danger is performed. It may be made using the whole or part of a recuperated explosive device (grenade, mine, shell or various explosives combined with shrapnel and nails).»

EXPLOSIVES

The explosives employed to make the main charge are **secondary explosives**. This kind of relatively stable explosive affords greater safety during transport, storage and deployment. Such explosives do not usually react to a flame, a red-hot wire or to a shock. Secondary explosives are made to explode by fusing (explosion of a charge on contact: i.e., a detonator) or by influence (explosion of a neighbouring charge: i.e., sympathetic explosion). Primary explosives, too reactive for normal military use, are normally employed in the composition of detonators or fuzes.

• The most commonly employed secondary explosive is T.N.T. (**Trinitrotoluene or Tolite**) and its derivatives, which are used as the main charge in most of the mines which are active at the present time. Among other explosive substances used in the manufacture of mines, «Composition B», R.D.X. and Tetryl are more commonly found in Western (N.A.T.O.) devices. Picric acid derivatives and PTN are also used, but more rarely.

• The main charge of the most common antipersonnel mines (blast-mines) is nowadays of between 40 and 250 g, although in fact the quantity of explosive contained in a land-mine can vary from just a few grams (3.7 g, for scatterable antipersonnel mines) up to tens of kilos (30 kg, or indeed even 140 kg, in the case of heavy anti-landing mines).

More-or-less all the explosives used in the production of mines are nitro-compounds.

(See appendix 1, page 67, «The Explosives»).

In a few relatively rare cases, explosives may be replaced by «other matter»: e.g.,

• illuminating powders to light up the battle-field in case of intrusion; or,
• (more rarely) combat gas.
• There also exist exercise mines, where the charge is replaced by a smoke- or noise-producing or marker device; other mines for use in training personnel in mechanical mine-laying and finally inert mines, replicas or real mines having no military charge, for use in training for manual and mechanical laying.

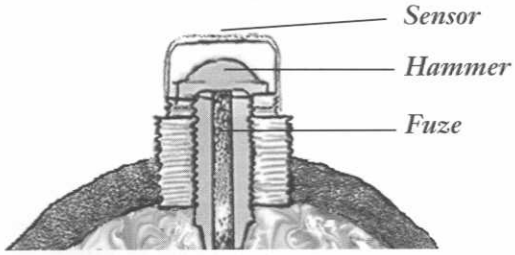
FIRING DEVICES

Whatever the nature of the charge, the firing device is what characterises this type of device and makes it a «mine». The «unintentional action» which sets off the explosion of a land-mine is usually the encounter of the device by the target (individual or vehicle). The firing device itself is composed of the following:

• **A sensor:**
— pressure plate,
— trip-wire,
— pull-activator, or electronic or infra-red command;

• **A fire-ignition system:**
— mechanical (hammer + fuze),
— chemical (striker + inflammable paste), or
— electrical (battery, condenser + inflammator);

• plus, in certain cases:
-A safety system, often installed for arming and, generally, for disarming the mine. It is usually operable from outside. A mine is said to be:
— «**fused**» when the firing system is fitted and the safety device is in place;
— «**armed**» when the firing system is fitted and the safety device is withdrawn.
• A **self-destruct or self-neutralizing system**, sometimes installed in the mine so as, at the end of a certain



time, going from a few hours to a few months, to result in either:
— self destruction by explosion of the main charge, or
— self neutralization by inhibition of the firing device, captor or fire-ignition system.

For obvious safety reasons, self-destruction is hardly possible for mines having wide-scale effect (with powerful charge or with long-range fragmentation) or for large antitank mines, and in these cases self-neutralization is the only option. Self-destruction does, however, have the advantage of being visible in its effect- producing a crater- whereas there is usually nothing to indicate that a mine has become inoffensive.
Self-destruct and self-neutralizing systems are under international negotiation. Their wider use comes up against the barrier of their high cost (which is not easy to reconcile with the generally low-cost nature of mines as such) and of a certain scepticism as to their reliability.

The main types of firing devices:
The devices which transform an «unintentional action» into an explosion (firing the charge), are generally classified into several main types which have a direct bearing on the nature of the danger represented. **(See appendix 2, page 69, «The Main Types of Firing Devices»).**

- **Pressure-activated systems.**
- **«Trip-wire» systems.**
- **Electronic firing devices.**
- **Remote control activators.**

Tiltrod mine

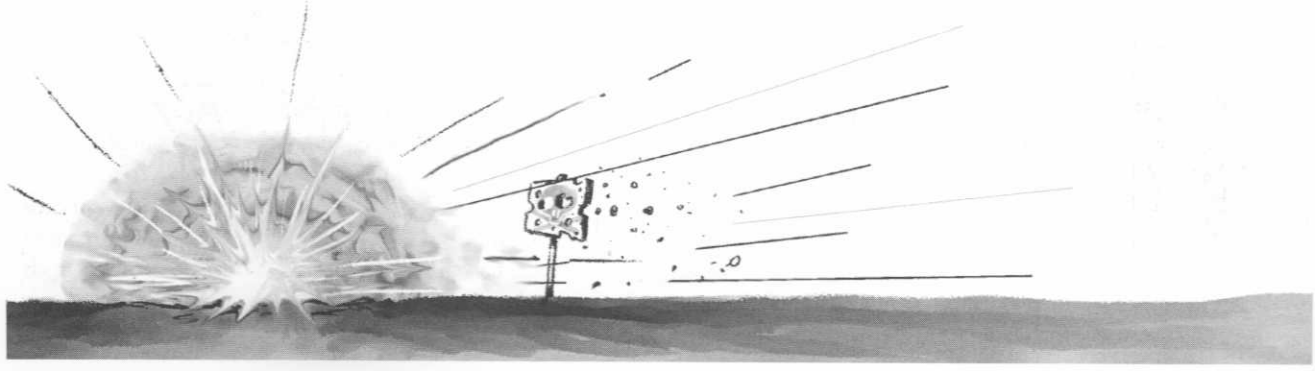
ANTIPERSONNEL MINES

The characteristics of the known models of antipersonnel mine mean that, whatever their country of origin, they are relatively small devices, of a few centimetres, relatively light (between 1 and 2 kg), and containing an explosive charge of up to 300 g. Antipersonnel mines make up **75% of all mines laid**.

According to the complexity of their casing, antipersonnel mines may be divided into 2 categories:

- **blast effect** (with or without a light, often non-metallic, casing); and
- **fragmentation effect** (with a heavy, often composite, and normally metallic, casing).

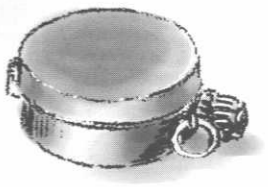
Blast effect



Fragmentation effect

BLAST EFFECT ANTIPERSONNEL MINES

These antipersonnel mines strike their target with the actual blast of their explosion, which may also project certain elements from the ground; i.e., the casing of such devices is relatively light, whether metallic or not, and therefore does not contain any objects such as splinters or balls intended to enhance the injury-effect of the explosion. Indeed, there are even certain such mines made of «moulded explosive»: i.e., without any casing at all. This sort of mine generally contains an explosive charge of around 50 grams; they are either placed on the ground or else buried a few (about ten or so) centimetres under it, and they have a lethal range which does not exceed 1 or 2 metres. Blast-effect mines are far and away the most numerous kind, being as they are:



PMN (USSR)

- easy to produce (easily copied from old models),
- easy to acquire (at 2 ECU per mine),
- easy to carry (sometimes less then 100 g),
- easy to hide (diameter less than 10 cm), and
- easy to lay (e.g., for militias or guerrillas).

ANTIPERSONNEL FRAGMENTATION MINES

While «blast» mines strike an individual victim, fragmentation models are designed to decimate whole groups. As their name suggests, they are made to project a large number of lethal splinters. Thus, fragmentation mines are a good deal more dangerous than are blast mines. Fragmentation mines usually send out metal fragments (about 4 to 6 cm in size and with a weight of between 0.5 and 6 g.) at an initial speed which reaches 1,600 m/s (as compared to 950 m/s for a rifle shot), and that over a wide area. The lethal range of directional fragmentation antipersonnel mines can be as great as 100 m, and certain fragments may be projected, in a single direction, as far as 250 m.

Fragmentation antipersonnel mines are more expensive and more complicated to handle (with laying of «trip-wires», etc.). They require an operator who is sufficiently well-trained not to put himself at risk from them, and to be able to direct the effects of the device precisely. For these reasons, this kind of mine is more unusual. Three main categories of antipersonnel fragmentation mine may be distinguished:

PMR 2A (Yugoslavia)

- **«fixed» fragmentation stake-mines**: this kind of mine was thought up during the Second World War, and derived from defensive grenades which were booby-trapped and triggered by means of a wire. The name of this category of mine comes from the stake to which they are generally fixed. Positioned in this way at about thirty or so centimetres above ground, such mines send out their lethal splinters in all directions; Their lethal range, which tends to be of about 40 m, is thus in fact proportional to the strength of their main charge.

Valmara 69 (Italy)

- **«bouncing» fragmentation mines:** this kind of mine, which was developed during the Second World War, contains two explosive charges, the successive explosion of which produces a very considerable destructive capacity. The first of the two charges serves to propel the mine above ground from where it has been buried; the second («fragmentation») charge is then set off by the tension of a «restraining wire», to explode and project its lethal fragments over a range (of 40 m) comparable to that of stake-mines.

M18A Claymore (USA)

- **«directional» mines:** unlike the above two categories of antipersonnel fragmentation mines, which act in all directions at once, «directional» fragmentation mines concentrate their fragments in a pre-determined direction, which has the effect of enhancing their destructiveness and their lethal range (up to 100 m).

NOTE: «Home-Made» Antipersonnel Mines:

Attention should be drawn to the particular case of home-made antipersonnel mines.

An explosive originally intended for some other purpose (e.g., a demolition charge, or an abandoned shell) can relatively easily be converted into a mine. Such cases may be referred to as «circumstantial mine-laying». All that is needed is to fit an activator which can be triggered by a human footstep or by some simple operation.

In the case of a shell, the artillery fuse (the classical activation system) may be replaced by a mine-activator. The explosive charge will be so great that whole buildings may be subject to the blast (the explosive charge of air-to-ground bombs being of the order of hundreds of pounds or indeed of kilograms), and, in certain unlucky cases, the number of victims may be in double figures.