SECTION 44

LOCATING A BURIED BOMB (II)

4401. The Bomb locator instrument requires a specially trained operator. The principles on which it works and the technique of using it are described in detail in Supplement No 1* to ME Volume XII, Bomb Disposal, 1956 (WO Cod No 8939). These are summarized below.

4402. Briefly, the method depends on the fact that a ferromagnetic body such as a bomb has the property of causing local distortion in the earth's magnetic field, creating area where the field strength is respectively greater (+) and lesser (-) than that of the normal undistorted field, as shown in Figure 44-1.

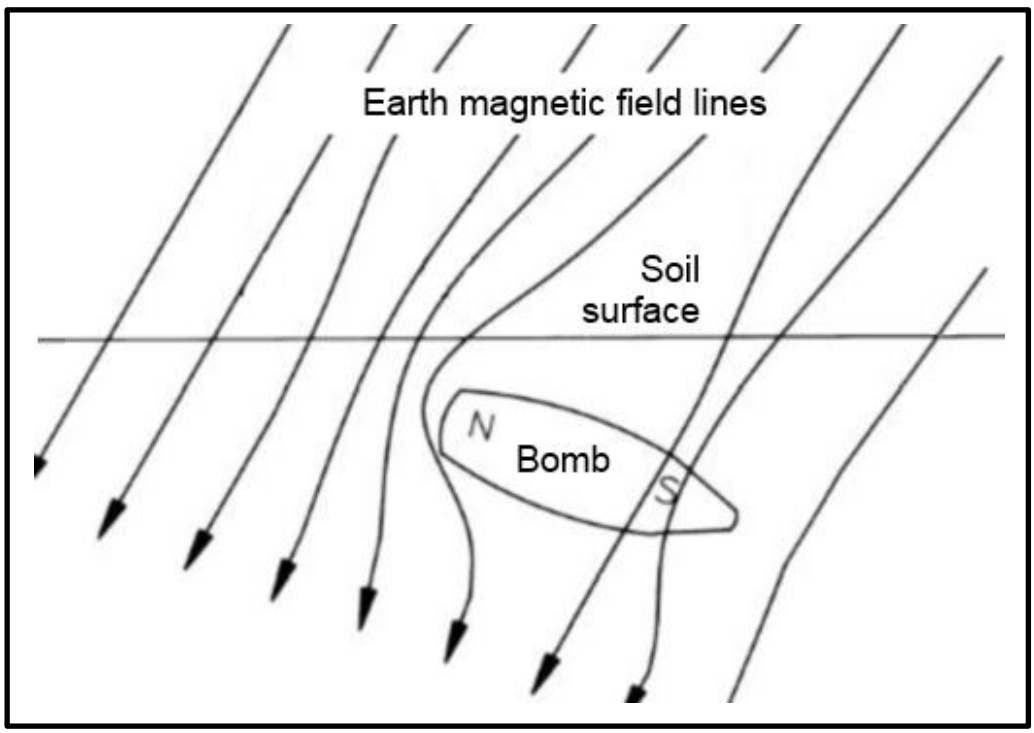

Fig 44-1: Earth Magnetic Field Distorted by a Bomb

* To be published.

4403. The bomb locator is a portable differential magnetometer which measures the difference in the magnetic field strength affecting two sensitive elements set three feet apart in the detector unit. The instruments are first balanced in an undistorted field so that a micro-ammeter records a central zero reading. The detector unit is then placed vertically in a series of positions around the suspected location of the bomb (non-magnetic lined boreholes being made for the purpose) and the micro ammeter reading recorded, a deflection to one side of zero indicating that the upper element, and to the other side that the lower element, is in the stronger field. Results are interpreted graphically and by a process of trial and error the suspected area is narrowed down until the actual position the bomb is ascertained. The equipment can also be used from the surface of the ground or the floor of an excavation to determine the position of shallow bombs.

4404. The range at which a bomb can be located depends on the extent of the disturbance created in the magnetic field which in turn depends, primarily on the mass of the bomb. The locator is, of course, sensitive to any magnetic, distinguish without difficulty, from the readings obtained, between the influences of a large but remote source such as a steel bridge or those due to small pieces of metal close to the locator, and those due to a bomb-shaped object. The maximum ranges at which bombs can be located may be taken approximately as follows:

weight of bomb	Horizontal distance (borehole location)	Depth below surface (surface location)
(lb)	(ft)	(ft)
(a)	(b)	(c)
100	3	7
500	5	12
1,000	7	15
2,000	9	18

4405 **Application** There are three ways in which the bomb locator can be used, i.e. surface location, borehole location and a combination of the two designated sub-surface location.

a. **Surface Location**. This method is used when the previous reconnaissance has indicated that the UXB is not deeply buried and probably lies within the range given in column (c) of the table above. The suspected area is marked out into three-foot squares with tracing tapes and readings taken at points of intersection (Figure 44-2). These are interpreted and recorded on a scaled site plan. All points of equal value and the same sign are joined up and form the resulting pattern of the position and depth of the bomb is ascertained. Results should normally be confirmed by probing or by borehole location. The advantages of surface location are simplicity, comparative speed and the lack of need for special apparatus other than the locator. Surface location is impracticable, however, if the bomb is deeply buried, if there are other iron or steel objects of appreciable size in the vicinity or if the ground cannot be traversed easily by detector unit.

b. **Borehole Location**. This is the normal method as UXBs are usually out of range of surface location.

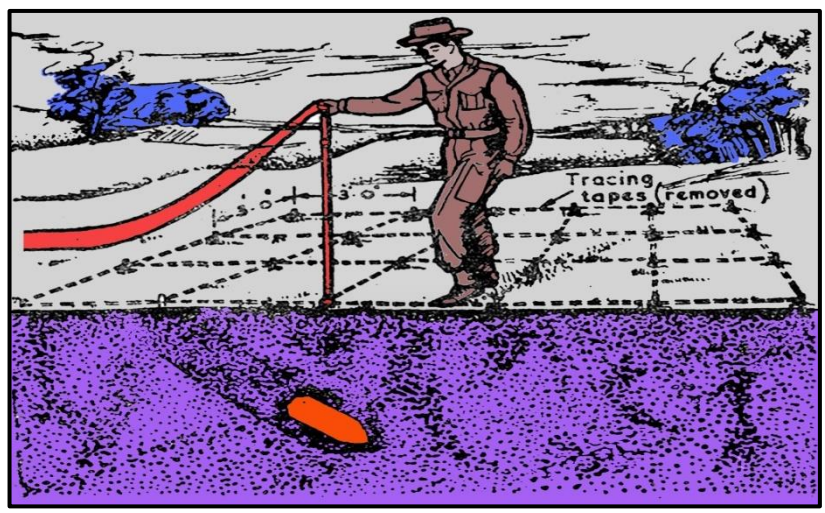

Fig 44-2: Surface Location

A number of series of boreholes lined with non-magnetic pipe are driven to a pattern of equilateral triangles, the length of the sides of which depend inter alia on the estimated size of the bomb and the amount of interference in the area. The depth of the holes is governed by the size of the bomb, the height from which it was dropped and the nature of the sub-soil, but must be such that the hole passes right through the area of disturbed magnetic field. In the united kingdom the

average depth of boreholes for location German bombs varied from 20 ft for a 100 pound bomb to 40 ft for a 2,000- pound bomb. The methods of sinking holes are considered in paragraph 6 below. The detector unit is lowered down each borehole of a series in turn, readings being taken at one foot intervals from a common datum level. The interpreted results of the first series of readings indicate the positions for the next series of boreholes and the process is repeated until the bomb is definitely contained within one triangle of boreholes. Figure 63 shows a typical site plan. The explanation of Gamma Readings and other detail is contained in supplement No 1* to ME Volume XII, Bomb Disposal, 1956 (WO Code No 8939). The advantages of borehole location are firstly that, given patience and perseverance, a UXB (with a case of ferromagnetic material) will, if it incident can be discredited with certainty, secondly, the method will indicate the existence of a camouflet by location primary fragments buried in the walls of the chamber of compression .Thirdly, in the case of case of deeply buried bombs it is more economical in time, labour and material than any form of exploratory excavation. The major disadvantage is the time taken in sinking the boreholes, this being anything from four to eight hours per hole.

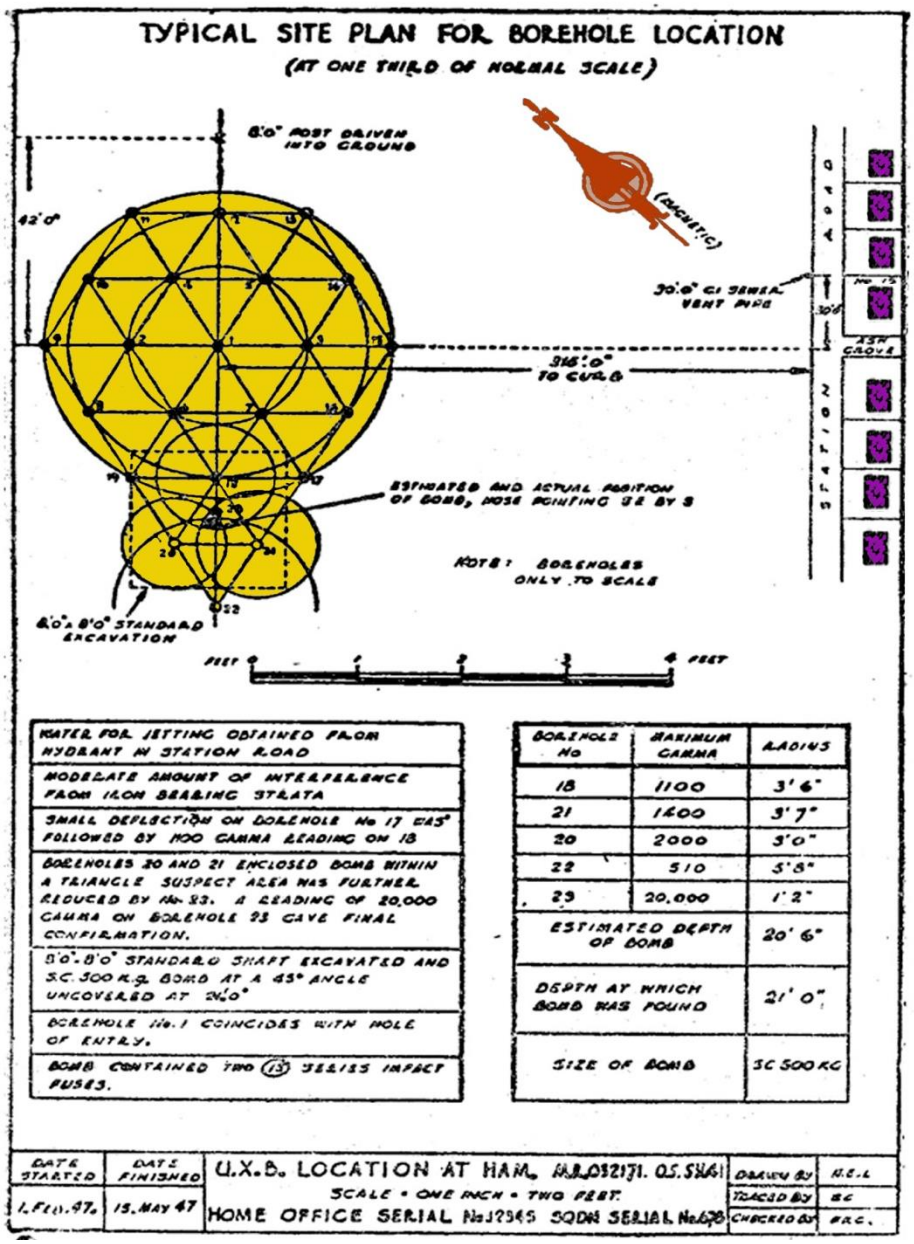

Fig 44-3: Site Plan for Electrical Bomb Location

c. **Sub-surface Location**. This method is used when for some reason boreholes cannot be sunk to the full depth required for borehole location. A number of pipes, auger-holes and so on are sunk to the chequer pattern as used for surface location and the detector unit lowered to the same horizontal level in each, readings then being taken as for surface location (See Figure 44-4).

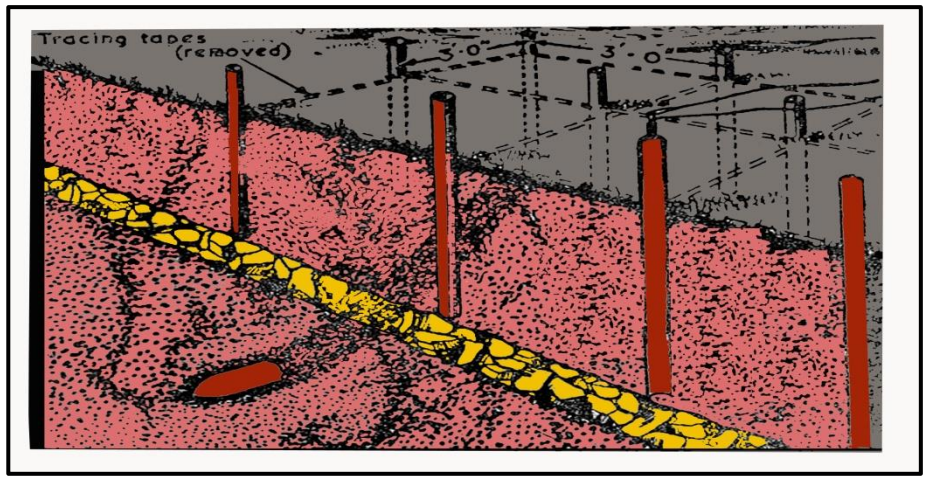

Fig 44-4: Sub Surface Location

4406. **Sinking Boreholes**. The methods which are used are water jetting , well-boring rigs, and augers, power or hand.

a. Water jetting is described in detail in supplement No 1* to ME Volume xiii, Bomb Disposal, 1956 (WO Code No.8939). Briefly the process involves "Jetting" the sub-soil from immediately below the borehole lining and forcing the lining down the excavation thus made. Water is required at the rate of 500 gallons per minute at a pressure of about 150 pounds per square inch and under good conditions a hole 50 ft deep takes about 4 hours. The time will be considerably increased if the subsoil contains stones. The particular advantage of this method is that it is comparatively free from vibration which might activate a sensitive fuze. The disadvantages are the requirement of a large quantity of water and the fact that the water makes the subsequent sinking of the shaft for gaining access more difficult.

b. Well-boring rigs can only be used if vibration and possible danger of actually hitting the bomb can be accepted. This is, however, the only method suitable for hard and stony ground. In easy subsoil, progress may be as fast as 50 ft in 100 minute but rocky obstruction may well raise the time to 10 hours or more. A small water supply of about 100 gallons an hour is required while the drill is working.

c. Auger holes cannot usually be sunk sufficiently far for borehole location, while hand operated augers make very slow progress. However, where no water supply is available for jetting or well-boring this process may have to be used, link probably with the sub-surface method of location. Auger holes must be lined as soon as made.

4407. **Lining for Boreholes**. The pipes, couplings and so on used must be non-magnetic. For jetting, duralumin and asbestos are suitable material, the former being preferable. For use with the well – boring rig, cease hardened X-Monel steel pipes are the most satisfactory.

4408. **Locating a Bomb Outside a Shaft**. It is possible that exceptional underground interference or faulty adjustment of the detector unit may lead to inaccurate "pin-pointing" of the bomb, with the result that the access shaft when dug passes by the bomb. Figure 44-5 illustrates two ways of locating such a bomb with the detector. The normal method is to lower the detector unit down the side of the shaft taking reading as in borehole location, but if a locator designed for working in a horizontal plane is available, pipe may driven outwards from the side of the shaft.

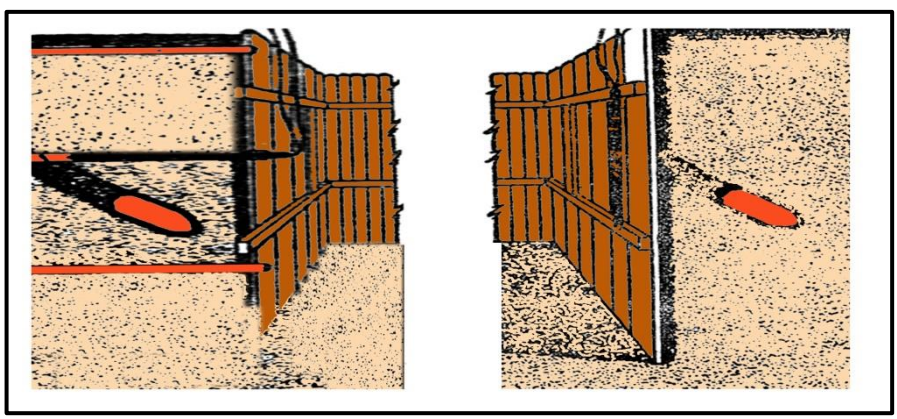

Fig 44-5: Tow Ways of Locating from a Shaft.

4409. **Safety Precaution**. Should the bomb be struck by the pipe while jetting or drilling, the normal procedure will be to abandon work until the maximum delay period of any likely long delay fuze has expired.

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