

THE



METAL DETECTOR

OPERATION

AND

MAINTENANCE

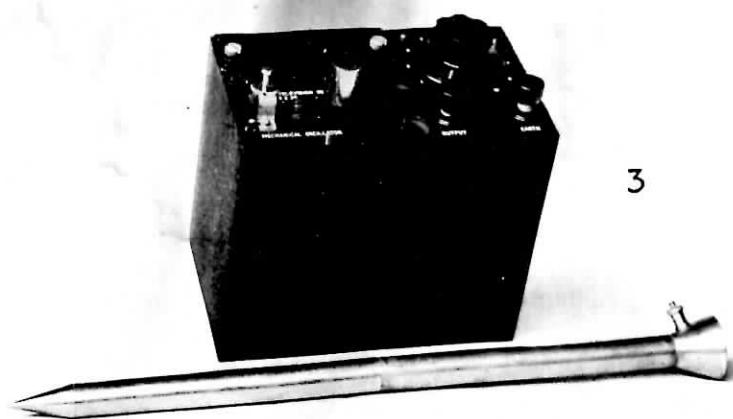
THE 'CINTEL' METAL DETECTOR

*T*HE 'CINTEL' Metal Detector has been designed for the purpose of locating concealed metal objects. Using the apparatus in its simplest form, objects buried to a depth of approximately 3 feet, depending upon their size, may be detected, while an auxiliary apparatus, the oscillator, enables objects at considerable depths to be located provided that an electrical connection of the object is accessible at some point.

The apparatus comprises a Search Head containing a pair of coils which are connected to the input and output of an Amplifier. When the Search Head is brought near a metal object, the Amplifier oscillates, and a note is heard in the telephones. The position and shape of hidden metal objects may thus be found.

The apparatus supplied comprises the following three major units as illustrated :—





1. Search Head,
2. Amplifier, with telephones,
3. Oscillator, with earth rod and connecting lead (optional),

together with various accessories. The whole apparatus is contained in a stout wooden transport case.

BRIEF DESCRIPTION OF MAJOR UNITS.

Search Head.

This is a water-tight case containing the two search coils. These coils are carefully adjusted in position and the Search Head must not be roughly handled or the coils may be moved and the operation of the Detector upset.

Amplifier.

This is a 3-stage battery-operated amplifier to the input and output of which the search coils are connected. The telephones also are connected to the output of the amplifier. It is provided with two controls, a three-position switch labelled "Off", "Service" and "Metal" and a continuously adjustable control labelled "Sensitivity".

Oscillator.

This is a simple induction coil with tapped secondary. It is used for the location of deeply buried pipes and cables. The tapping switch is provided so that the best output can be obtained.

Range and Accuracy.

Using the apparatus as a metal detector objects buried at depths not exceeding 3 feet (for a 6-inch pipe) can be readily traced. For pipes at greater depths the apparatus is employed as a pipe tracer (using the oscillator) and in this condition signals can be heard at distances ranging from 200-300 feet from the pipe if the surroundings are quiet. Pipes can be traced for distances of at least 300-400 yards but this distance is normally greatly exceeded. An accuracy of location ± 1 -inch per foot of depth is usually obtained.

OPERATING INSTRUCTIONS AS METAL DETECTOR.

- (1) Remove search head from transport case and assemble handle to spigot on top of head.
- (2) Remove amplifier and telephones from case, connect the latter to the plug on top of amplifier.
- (3) Put on the headphones and set amplifier switch to "metal".
- (4) Take hold of search head and hold as far away as possible from all metallic objects, turn amplifier sensitivity control clockwise until a note is heard in the headphones, then adjust the control anticlockwise until this note just ceases. The apparatus is now in its most sensitive condition for detecting even small pieces of metal. If, however, the metal to be detected is thought to be large, i.e. manhole covers, etc., the sensitivity control should be turned back slightly, otherwise as the

search head is passed over the ground oscillation will occur owing to the presence of other metallic or magnetic bodies in its vicinity.

- (5) On commencing to search, move the search head horizontally over the probable location of the object to be located until a note is heard in the headphones. Note during this operation it is important to see that the search head does not come near the amplifier box slung from the operator's shoulder otherwise oscillation will be heard.

OPERATING INSTRUCTIONS AS PIPE OR CABLE TRACER.

When the object to be located is a pipe or cable, either at a depth greater than three feet or of which the position is masked by adjacent metal (other pipes, etc.), the oscillator is used.

- (1) Assemble detector as for metal with switch on amplifier over to "service". The detector with the switch in this position will not act as a metal detector in any way and can now only be used in conjunction with the oscillator.
- (2) Locate a point of connection for the oscillator at some point on pipe or cable to be traced and connect point, using the clip provided, by a short piece of wire (5 to 6 feet) to terminal marked 'Output' on the oscillator, then connect earth wire to terminal marked "Earth".
- (3) The earth wire should be run out as far as is possible, a distance of 80 to 100 feet is satisfactory, and should lie at approximately right angles to the pipe to be traced. The earth rod at the end of the wire must be driven well down in the soil. A good "earth" is most important and all joints and connections must be clean and good conductors.

- (4) Turn oscillator switch to marking "1" if working in wet soil and "4" for dry soil, but for general conditions "2" or "3" will be found most suitable.
- (5) If after switching on, the oscillator hammer will not vibrate, give a gentle flick with finger to start.
- (6) Having followed the instructions above, commence to trace pipe by moving to a position near the probable run of the pipe. With search head held in a horizontal position the signal from the oscillator should be picked up and the note heard in the headphones. Now carry out a side to side movement of the search head and move in the direction of decreasing signal until a minimum signal is heard in the headphones. The pipe will then lie approximately under the search head.
- (7) Once the position of the pipe is found it may usually be followed with ease by walking along the probable line of the run and following a path which keeps the signal strength in the headphones at a minimum. The search head should be rocked slightly to ensure that the minimum is always obtained with the head horizontal.
- (8) To obtain the approximate depth of the pipe hold the search head at an angle of 45° to the horizontal and move sideways from a position over the pipe until a minimum is obtained. The distance so moved from immediately over the pipe is equal to the approximate depth of the pipe.

DETAILED DESCRIPTION OF APPARATUS.

Search Head.

The search head comprises a water-tight casing of moulded material provided with a handle which is removable for packing

in the transport case. The head contains two coils accurately positioned so as to have substantially zero mutual inductance and a zero adjusting coil which is set by the makers before the head is finally assembled. The search head is permanently connected to the amplifier by a suitable length of cable.

Amplifier.

The amplifier is contained in a weather-tight diecast aluminium alloy box provided with a shoulder strap. The amplifier switch and selectivity control are arranged conveniently at the top of the case which need only be opened when it is necessary to replace the battery. The case is opened by removing the four screws connecting the two castings.

Circuit.

One search coil is connected to the input of the amplifier through a transformer, while the other coil is connected in the anode circuit of the output valve. The amplifier comprises three resistance-capacity coupled stages. It includes an adjustable feed-back circuit from the output to the input. This adjustment is the control labelled "Sensitivity". There is also a compensating coil with a preset adjustment, which is provided to enable a final balance of the search coils to be made. The amplifier is switched on by the 3-position switch. In the "Metal" position this switch renders the amplifier operative with the search coils connected to the input and output so that, as already described, the circuit oscillates when a metallic object comes within the field of the coils. When the switch is set to the "Service" position, the search coil in the output circuit is short-circuited so that the apparatus operates as a straightforward amplifier.

Compensating Coil.

The compensating coil referred to above has a dust core which may be adjusted by the insulated screwdriver provided, access being obtained through a hole, normally closed by a screw plug, in the amplifier case. It is initially adjusted to provide maximum sensitivity on any type of metallic object but may be employed to discriminate between magnetic—as opposed to non-magnetic—objects. To render the apparatus more sensitive to magnetic than to non-magnetic material, the coil is adjusted so that the note heard in the telephones is higher than that for normal operation while adjustment to a lower note renders the apparatus more sensitive to non-magnetic material.

Adjustment of Compensating Coil.

* To set the compensating coil to the optimum for normal operations proceed as follows :—

- (1) Place the search head in such a position that it is not affected by the proximity of any metal object, and switch the instrument to "Metal".
- (2) Turn the sensitivity control fully anticlockwise, and should there be a note in the headphones, adjust the "Fine adjustment" coil by means of the special insulated screw driver supplied until the noise ceases.
- (3) Turn the sensitivity control slowly clockwise until a note is heard. A slight re-adjustment with the screw driver should result in the disappearance of the note. Progressively increasing the sensitivity control, and readjusting the "Fine adjustment" coil should enable a setting to be obtained where no noise is obtainable in the phones unless a **very slight** adjustment is made with the screw driver in either direction.

The instrument is now in its most sensitive condition.

Batteries.

The amplifier is operated from a combined H.T. and L.T. dry battery which provides 69 volts H.T. and 1.5 volts L.T. This battery will give approximately 100 hours working life.

Oscillator.

The oscillator is a simple induction coil energised through a vibrating reed attracted by the core of the coil. The secondary winding, from which the output is taken, is tapped to provide the optimum output for varying conditions of earth resistance. The actual output given varies from 1—200 mA. The coil is operated from three 1.5 volt dry cells which should give approximately 100 hours working time. The oscillator is provided with connecting leads and an earth rod.

SERVICING INSTRUCTIONS.

Amplifier.

The only servicing operations on this instrument which should normally be attempted by the user are the replacement of run-down batteries and defective valves. Any defect other than the above necessitates the return of the instrument, carriage paid, to the makers for repair. Other defects should not, however, arise if the instrument is handled with reasonable care.

Battery.

A battery which has exhausted its useful life will cause the performance of the instrument to fall off gradually until oscillation will no longer take place even with the search head adjacent to a metal object and the sensitivity control fully

advanced, in which state the instrument is obviously unusable. Before this condition is reached, the decline in battery condition should have been noticed from the falling-off in sensitivity of the instrument.

In some cases, the internal resistance of the battery rises with increasing age to a degree sufficient to produce audible feedback, which gives rise to a low "growl" in the telephones. This "growl" will at first be of low volume and may be confused with the pick-up from adjacent A.C. apparatus, as the sound is similar, but the volume will increase as the battery ages and the sound will, of course, be present when the instrument is operated far from all possible sources of interference.

In either case, the battery should be replaced by a new one at the first opportunity. The instrument should operate satisfactorily with battery voltages of not less than 40—45 volts H.T. and 1.0 volt L.T.

The H.T. battery voltage may be measured by removing the battery plug and connecting a suitable voltmeter—such as an Avometer—to the appropriate battery sockets. The L.T. voltage, however, should be measured with the battery connected to the instrument and the valves switched on. This may be done by connecting a suitable voltmeter to the amplifier tags to which the red and black leads are connected.

Valves.

Rough handling of the instrument may cause premature failure of the valves by starting fractures in the valve pinch which may spread through the glass, causing the loss of the vacuum in the envelope. This defect is usually detectable by the whitening of the silver "getter" deposited on the envelope.

If the instrument has failed in service and a defective valve is suspected, the following procedure should be adopted to determine which valve has failed.

- (1) Open the amplifier case and remove the amplifier panel, as described on last page.
- (2) Switch the instrument to "Metal" and put on the telephones.
- (3) Tap the output valve (V₃) at telephone end of panel with the finger or with a pencil, when a noise should be heard in the telephones. If this noise is heard, continue with operation (4), if a noise is not heard proceed with operation (6).
- (4) Tap the middle valve (V₂), when a louder noise should be heard. If this noise is heard, proceed to operation (5); if a noise is not heard, continue with operation (6).
- (5) Tap the first valve (V₁) at switch end of panel; if a noise is produced by this operation, all the valves are operating and the fault is elsewhere in the circuit. The set should be returned to the makers for servicing.
- (6) Interchange V₂ and V₃ and again tap the valve in the V₃ position. If a noise is now heard, the valve now in V₂ position is defective and should be replaced by a new valve; if no noise, see operation (8).
- (7) Interchange V₁ and V₂ and again tap the valve in V₂ position; if a noise is now heard the valve now in V₁ position is defective and should be replaced by a new valve; if no noise, see operation (9).

- (8) If the instrument is still silent when a suspected valve has been replaced the fault is elsewhere in the circuit. One possible cause is a disconnection in the telephone leads, which should be checked by making a resistance measurement (the telephones have a resistance of 1,000 ohms). Another possibility is that both valves are defective, which may be checked by interchanging V₁ and V₃ and again testing. If neither of these expedients will produce a noise, the instrument should be returned to the makers for servicing.
- (9) If the instrument is still silent when V₁ and V₂ have been interchanged, either there is a fault in the circuit or both valves are defective. As the output circuit is known to be correct, either valve should produce a noise when placed in V₃ position. If they operate satisfactorily in this position but no noise is produced on tapping the valve in V₂ position, the instrument should be returned for servicing.

NOTE: If a new valve is placed in the V₁ position, it may occasionally be found that the instrument becomes very noisy, loud sounds being produced in the telephones whenever the amplifier is touched. This defect is caused by the valve V₁ being one of the small percentage of highly microphonic specimens known to be produced. The difficulty can usually be overcome by replacing the V₁ valve with that from one of the other positions.

Oscillator.

Almost any defect in the oscillator will result in the failure of the armature to vibrate and is therefore easily detectable.

The possible causes of such failures are as follows:—

- (a) Run down battery.
- (b) Bad connections to battery.
- (c) Dirty armature contacts.
- (d) Armature contacts out of adjustment.

The remedy in each case is obvious.

If the armature or its fittings are damaged or if it vibrates correctly but no signal can be heard even with the search head close to the oscillator lead, showing that some interior defect has developed, the instrument must be returned for servicing.

Access.

Access to the interior of the amplifier for the purpose of testing or replacing battery or valves is obtained by undoing the four captive screws at the corners of the amplifier cover, when the battery may be removed. This operation gives access to the battery.

To remove the valves, the battery panel must be removed from the case by withdrawing the four screws at its corners.

Replaceable Components.

Valves—IT4 or Mullard DF 91.

Amplifier Battery—Ever-Ready B114.

Oscillator Battery—Standard 1.5 volt. Dry Cells.

GUARANTEE.

WE GUARANTEE to repair or replace free of charge any part which can be proved to have failed through faulty material, construction or workmanship within 6 months (valves 3 months) from the date of Invoice, provided the part is returned carriage paid to our Works; but we will not be responsible for any consequential damage arising out of the failure of such part.

CINEMA - TELEVISION LTD
WORSLEY BRIDGE ROAD
LOWER SYDENHAM, LONDON, S.E.26

HITHER GREEN 4600