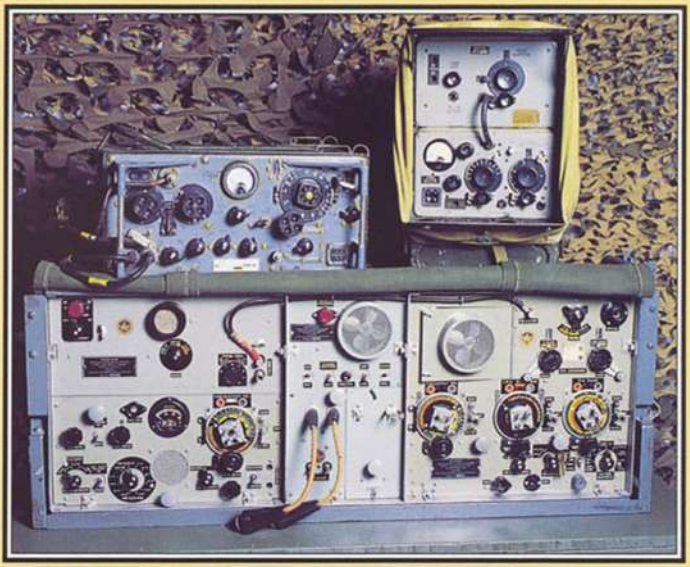
A technical history of
Radio Communication Equipment
in the British Army

WIRELESS *for the* WARRIOR

by Louis Meulstee

VOLUME 2

STANDARD SETS OF WORLD WAR II



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Contents

Introduction

It has already been explained in the previous Volume 1 'Wireless Sets No. 1 to 88', that the 'Wireless for the Warrior' series is not intended to be read as a novel or a war history story. The books are merely written to serve as reference for anyone interested in the technical history and development of British Army radio equipment. Operational history and experiences in the field of a particular set or system are given only occasionally.

Again in this Volume a relative large space is taken by descriptions and illustrations of fitting the sets into a variety of vehicles. This has been done explicitly as it shows the sets in actual use and also gives illustrations of the many station ancillaries. A special appendix (No. 11) is devoted to the Bedford QLR, the standard Command and Wireless vehicle during the war.

Though the emphasis of this volume is primarily directed to standard sets manufactured and used in large quantities during World War II, it also includes information on equipment on which development had started during the war and which was produced after 1945. Additionally a description is given of sets which were initially given a 'Wireless Set' designation but never reached the development stage, and those on which insufficient data was available when Volume 1 was being prepared.

Strongly urged by the publisher, who for obvious reasons requested to keep the number of pages of this volume to a manageable limit, it was at times very difficult to choose from the vast amount of technical references, notably those on the No. 19 Set. Historical data of wartime equipment, however, appeared to be rather meagre, compared to the pre-war and post-war era. This is believed to be caused by the fact that before the war most of the equipment underwent a long procedure through all War Office channels until production began by the industry.

As many of the standard wartime sets were primarily developed by the industry, although of course under supervision by SRDE and War Office, much of the production and development records appeared to have been destroyed over the years.

In Appendices 7 and 8 in this Volume, a summary is provided of the data on commercial equipment and miscellaneous radio equipment procured from other countries, principally used as a stop-gap measure. Although usually used in small quantities, these lists reveal how desperate the supply situation of communication equipment was in those days and virtually anything available and useful for the purpose was pressed into service.

In the 'historical development' paragraph of a number of sections reference is sometimes made to 'A', 'B' and 'C' models. Concise definitions of these terms were given in the Ministry of Supply 'Procedure for the Design and Production of Telecommunication Equipment', Part 1. Briefly they were:

'A' model: the laboratory 'breadboard' model
'B' model: the User Trial model
'C' model: the Pilot Production model

In July 1960 new abbreviations were introduced to identify radio equipment:

Radio Relay RR
Transmitter, radio T
Receiver, radio R
Transmitter-receiver, radio TR
Station, radio SR

In 'Wireless for the Warrior' the sets of the Larkspur range of equipment are denoted with these abbreviations.

As was already explained in the previous Volume, the quality of some of the illustrations and circuit diagrams is not up to modern standards. However, this is the best possible from the available sources.

cooled when necessary by means of blowers fitted on collapsible platforms on the outside of the trailer walls.

The collapsible Mirror Assembly No. 10, Mk.2 is secured to the roof of the trailer, the two flexible waveguides also being carried in clamps along one side of the roof. The original aerial system with its parabolic reflectors, separately adjustable, was replaced by a single unit with the two mirrors mounted in a rigid framework.

One generating set is carried in the towing vehicle and a second on a special trailer. The power supplies for the generating set or from the AC mains are connected to plugs fitted on Panel Distribution No. 32 which is built at the rear of the trailer. Incoming telephone lines are connected to two 10-way terminal strips (Boxes Terminal Block No. 1) fitted in a metal box also fitted at the rear end of the No. 10 Set trailer.

A Wireless Set No. 31 is carried to contact the distant station for mirror alignment and to provide an independent source of intercommunication for engineering purposes.

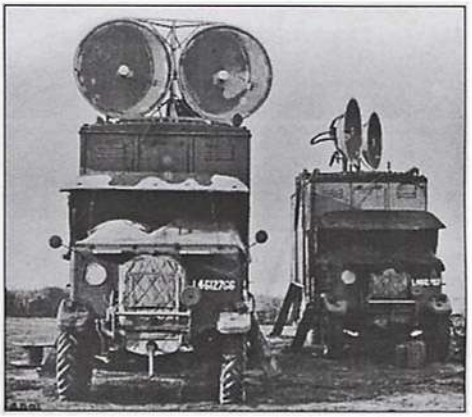
Historical Development

In October 1941 a requirement was formulated for two projects known as 'Beam Set High Power' and 'Beam Set Low Power'. These sets were to use wavelengths of about 7cm so that parabolic mirrors could be used to confine the radiation to narrow beams to give a high security. Modulation was to be of the pulse length variety and only one channel was to be provided. Duplex working was possible by using two different wavelengths.

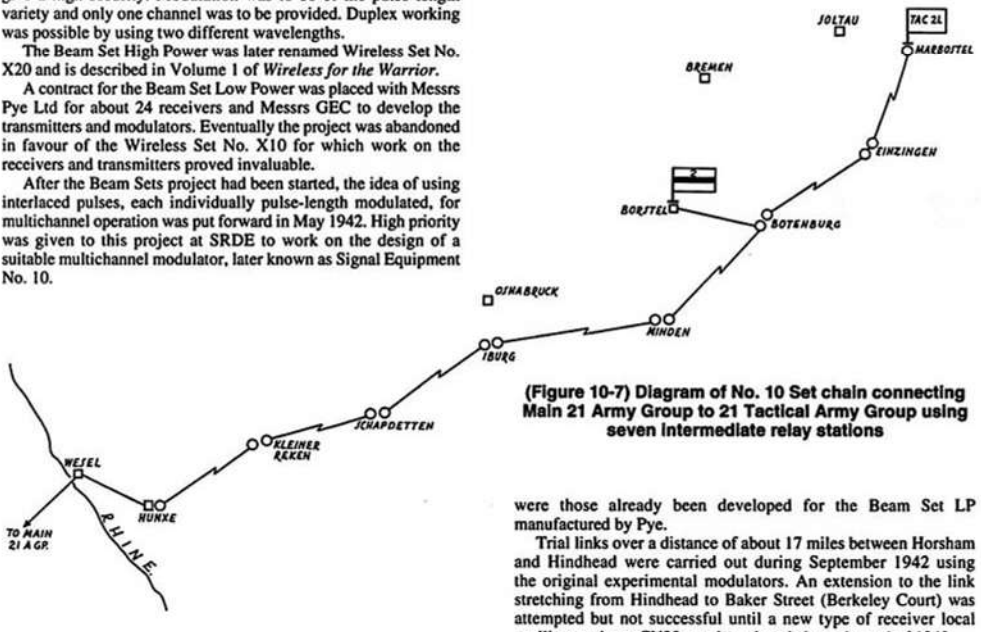
The Beam Set High Power was later renamed Wireless Set No. X20 and is described in Volume 1 of *Wireless for the Warrior*.

A contract for the Beam Set Low Power was placed with Messrs Pye Ltd for about 24 receivers and Messrs GEC to develop the transmitters and modulators. Eventually the project was abandoned in favour of the Wireless Set No. X10 for which work on the receivers and transmitters proved invaluable.

After the Beam Sets project had been started, the idea of using interlaced pulses, each individually pulse-length modulated, for multichannel operation was put forward in May 1942. High priority was given to this project at SRDE to work on the design of a suitable multichannel modulator, later known as Signal Equipment No. 10.



(Figure 10-6) Extemporised vehicles carrying early version of Wireless Sets No. 10



(Figure 10-7) Diagram of No. 10 Set chain connecting Main 21 Army Group to 21 Tactical Army Group using seven intermediate relay stations

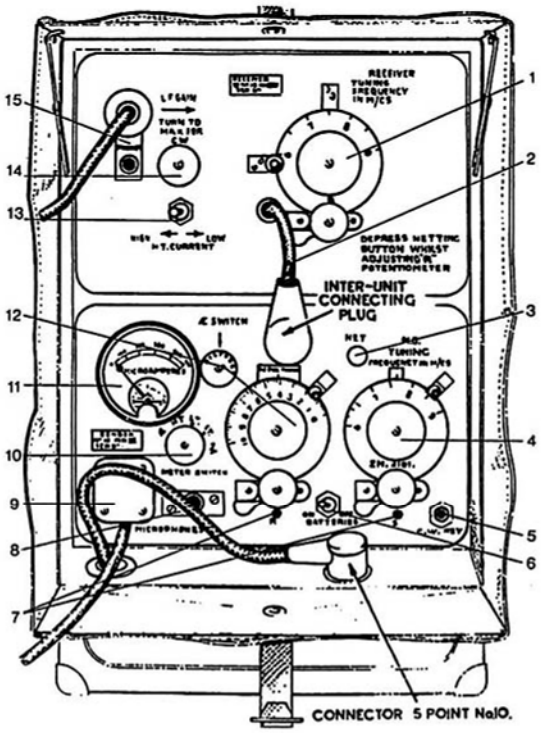
A demonstration of the system over a short radio link was given at SRDE in Warnham Court on July 1942. During the demonstration eight independent telephone circuits were transmitted over a provisional link with simple crystal detector type receivers.

The demonstration was very impressive and on the spot it was decided to place an order for 600 sets. Messrs GEC were to contract the transmitters, Messrs Pye the receivers and Messrs TMC the modulators. Further development was already in progress at SRDE, and in June 1942 it was decided to produce a number of equipments for extended trials. An order of 24 modulators and transmitters of the GEC design was placed on Messrs McMurdo. The receivers were those already been developed for the Beam Set LP manufactured by Pye.

Trial links over a distance of about 17 miles between Horsham and Hindhead were carried out during September 1942 using the original experimental modulators. An extension to the link stretching from Hindhead to Baker Street (Berkeley Court) was attempted but not successful until a new type of receiver local oscillator using a CV90 was introduced about the end of 1942.

At that time the equipment was being laid out for production by the various contractors, the first production models were available in early 1944. The Army had been able to prepare for their delivery prior to D-Day by making use of the various trial models.

The first operational requirement was a link between Ventnor, Isle of Wight and Cherbourg, 22 days after D-Day and only three days after the fall of Cherbourg. This link was not used for about one month due to the lack of lines to the Cherbourg telephone repeater station (about seven miles away). Thereafter, No. 10 Sets followed the advance, on arrival of 21 Army Group and Main 2nd Army in Brussels, it was decided to establish a link to Eindhoven in Holland. This was done with two relay stations and a terminal



1. Receiver tuning control
2. Interconnection cable
3. Netting button
4. Transmitter MO tuning
5. CW key jack
6. Battery on/off switch
7. LT adjustment
8. Respirator microphone
9. Microphone plug
10. Test meter switch
11. Test meter
12. Aerial tuning controls
13. Battery economy switch
14. Volume control
15. Phones jacks

(Figure 18-16) Controls of Wireless Set No. 18 Mk.III

Meter Switch Position	Correct Meter Reading	Indication of	Remedy if unsatisfactory meter reading
H. T.	As shown on the correction label.	State of H.T. battery voltage.	Replace battery.
Plug in microphone.—L.T.S. pressel switch pressed.	As shown on the correction label.	Sender L.T. voltage.	Carefully adjust screw S. Failing that, replace battery.
L.T.R. pressel switch released.	do.	Receiver L.T. voltage.	Carefully adjust screw R. Failing that, replace battery.
mA. (Pressel switch released).	170 to 300 μA.	Condition of receiver valves.	If the removal of a valve causes no reduction in the meter reading, that valve is defective and must be replaced.
mA. (Pressel released). Net button pressed. Sender and Receiver must not be at same frequency for this test.	Increase of 30 μA., or more.	Condition of M.O. valve in Sender.	Replace M.O. valve.
mA. (Pressel switch pressed).	340 to 400 μA.	Condition of P.A. valve in sender.	Replace P.A. valve.
mA. Net button pressed. Net sender to receiver.	Dip of needle.	A.V.C. satisfactory.	Check Receiver valves.

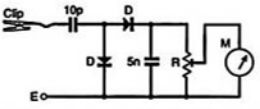
NOTE.—That in the case of Wireless Set No. 18, Mks. I and II, there is only one L.T. position for the METER SWITCH. This gives an indication of the L.T. battery voltage, and this should not be below the full red line on the meter scale. If however, the reading is above the dotted line, then the filament switch at the back of the sender must be put to its H position.

Table 2 – Standard test figures for No. 18 Set

TEST TOOLS

RF Probe

The RF probe is primary used as a tool for alignment of neutralisation, but is also very useful when tuning the transmitter to a long wire aerial. It can easily made from a few bits and pieces – all components are mounted on a small piece of Veroboard. Almost any type of diode may be used, with preference for a germanium type, e.g. OA90. When a multimeter is used, the potentiometer can be omitted. Using a separate meter (any small meter with 0.2–1mA fsd) as shown in the drawing, the potentiometer should be set to give a suitable deflection.



Circuit of diode probe. D – OA90 e.g. (2 off); R – 50kΩ pot; M – 200μA – 1mA full scale; Clip – miniature croc clip; E – connection to chassis

Dummy Aerial

For alignment of the No. 18 Set transmitter, a dummy aerial comprising a 33pF capacitor and 15Ω 1-watt resistor is necessary. Resistors A and B form a voltage divider to provide a signal to a sensitive instrument, e.g. digital frequency counter, at Tp1. An alternative, though not really accurate, is the RF output indicator. It has the advantage that the brightness of the lamp gives a rough indication of the RF output power.

Circuit of dummy aerial (left). Resistor A – 10kΩ; B – about 100Ω (B selected to give a good reading when using a digital frequency meter). Circuit of RF output indicator (right). C – 30pF; LP – 6V 100mA lamp

Start with the adjustment of the LT of both receiver and transmitter to a 2-volt reading on a accurate multimeter.

• Connect the meter to the filament terminals of one of the valve bases in the receiver. Adjust the variable filament resistor fitted on the front panel of the transmitter unit: R21A (marked R) to a reading of 2 volts whilst pressing the NET button.

• Connect the meter to the filament terminals of V3A (RF power-amplifier). Adjust R21B (marked S), whilst pressing the microphone pressel, to a reading of 2 volts.

• The value indicated on the set test meter (position LT R and LT S of the test meter switch) should be approximately 200μA and equivalent to the value written on the calibration tablet on the set case. If the calibration is found to be incorrect, either a correct calibration should be written on the tablet or a note should be attached to the set indicating the correct value. Setting the LT at more than 2 volts is useless as it does not increase the efficiency and rapidly shortens the life of the valve.

• Check the indication of the test meter in the HT position which should be approximately 300μA. (Indication on meter : 1/2 = HT voltage)

• The calibration of the set test meter in the mA position, full scale (500μA) should be 25mA. Connect a multimeter in series with the HT and compare indications on both meters (multiply indication on multimeter by 20). If not correct, check the value of R12a in the transmitter unit.

• Replace the base plates on both transmitter and receiver units.

TRANSMITTER ALIGNMENT

Preliminary

• Connect the dummy aerial to the aerial contact plate and chassis.

• Connect the Microphone, Hand No. 4A or the four-point plug of the Key and Plug Assembly No. 8. (Don't insert the CW jack plug yet)

• Leave the receiver connected to the transmitter. The LT of the MO valve in NETTING mode is taken from the receiver filament circuit and will be too high if the receiver is not connected.

Drive adjustment

• Tune the MO dial to 9MHz.

• Set the AERIAL TUNING to 0.

• Set the TEST METER switch to mA.

• Check the MO anode current by pressing the NET button. The increased reading on the set test meter should be at least 30μA. If not correct, change the MO valve V2b.

• Switch to transmit by pressing the microphone pressel or by turning the CW key switch to the SEND position.

• Adjust the DRIVE ADJUSTMENT trimmer C15F (accessible through the transmitter chassis bottom cover plate) to a reading of 380μA.

Neutralising

The primary object is to overcome the pulling of the Master Oscillator by the RF power amplifier by compensating the internal capacity of the RF power-amplifier valve. This is simply done by removing the LT of the RF power amplifier on transmit (or just pressing the NET button) and aligning the neutralising trimmer to minimum RF output.

• Switch to RECEIVE.

• Connect the RF test probe to the aerial contact plate (leave the dummy aerial as connected).

• Depress the NET button and tune the AERIAL TUNING and Æ SWITCH for maximum deflection on the meter connected to the RF test probe.

• Adjust the NEUT ADJUSTMENT trimmer C15E (accessible through the chassis bottom cover plate) for minimum deflection on the RF test probe.

• Re-tune the AERIAL TUNING and Æ SWITCH for maximum deflection.

• Readjust the NEUT ADJUSTMENT trimmer for minimum deflection.

• Remove the RF probe.

• Check the drive adjustment. If necessary readjust the DRIVE ADJUSTMENT trimmer C15F to a reading of 380μA on the set test meter in mA position.

• If any adjustments are made check the NEUT ADJUSTMENT trimmer for minimum deflection.

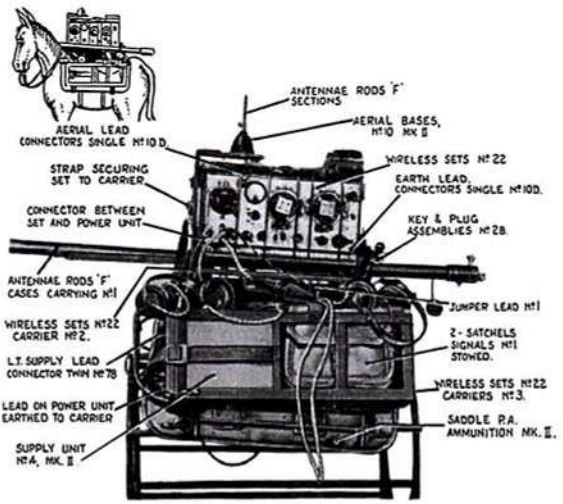
Netting Compensation

• Switch to transmit and tune the MO dial to zero-beat on a calibrated receiver tuned to 9MHz.

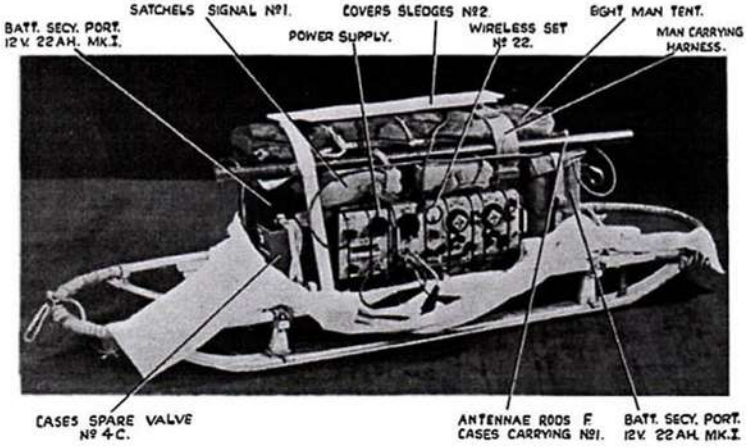
An alternative is the use of a calibrated wavemeter, e.g. an Army Class D No.1, an SCR-211, or a reading of 9MHz on a digital frequency counter connected to Tp1 on the Dummy Aerial.

Animal Pack Station

The use of pack animals for carrying wireless equipment goes back to the early days of radio. Although after World War I in Europe, animal transport give way to mechanical transport, for mountain warfare and particularly in India animal-pack transport remained in general use, up to and including the second World War. A complete Wireless Set No. 22 may be fitted on a pack animal, the complete station including Charging Set 300-watt, batteries and spares including petrol and oil may be carried by three animals. The animal carrying the No. 22 Set is fitted with standard saddlery (Saddle PA Ammunition Mk.II), the equipment mounted in special carriers allowing the carriers to be secured as top and side loads and providing hooks for side loads. The equipment may be operated whilst on the move. In that case the aerial is a 12ft rod fixed on Aerial Base No. 10 which is fitted on the carrier of the top load. The carriers may be removed from the animal and set up as a ground station.



(Figure 22-45) Wireless Set No. 22 as an animal pack station. The nearside of the animal is shown; in the offside carrier one battery and the spare valve case are carried



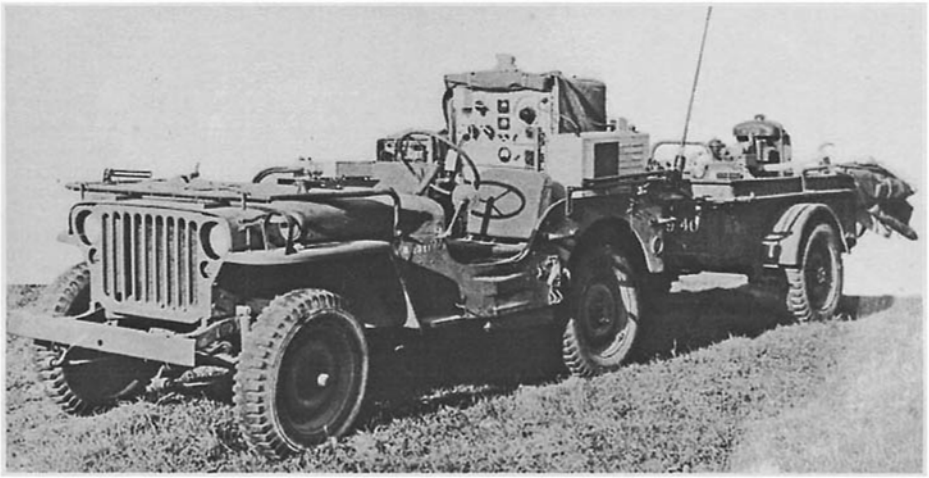
(Figure 22-46) Wireless Set No. 22 as sledge station with Covers Sledge No. 2 removed

Sledge Station

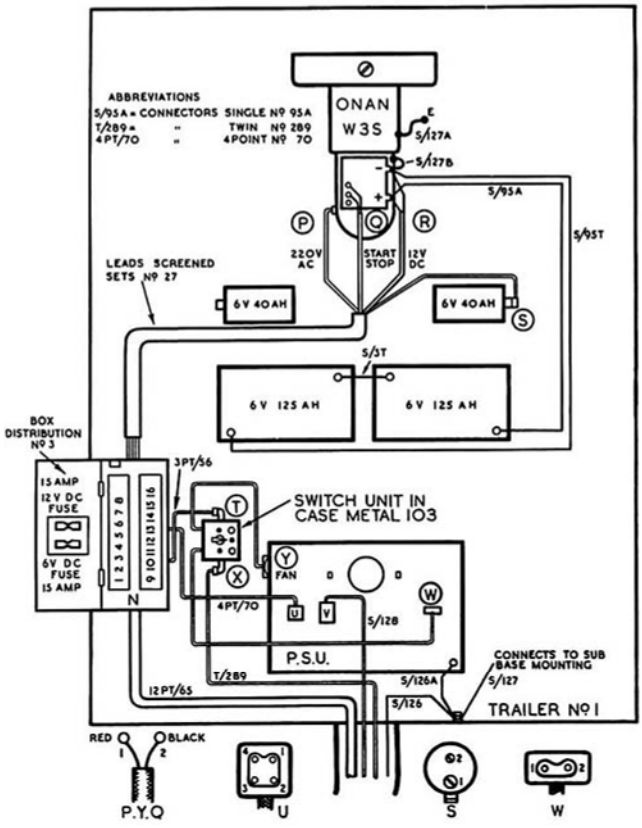
Developed for warfare communications under arctic conditions, a sledge station comprised two Wireless Sets No. 22, batteries and charging equipment. The station was normally carried in two Trucks 15-cwt 4-wheeled Wireless and provided with equipment to enable the sets to be carried on Sledges 1 man Mk.II (Nansen type sledges) and operated and maintained independently of the trucks for a period of 72 hours. Three sledges are required to carry the complete station, two sledges are identically loaded, each carrying a Wireless Set No. 22 and three batteries, the third sledge carries the Charging Set 300-watt and additional batteries. When fitted as described, the sledges are loaded to their maximum capacity. The total weight of each sledge when loaded is about 285 lb.

Operating the sets and battery charging is possible whilst on the move without taking the radios or charging set from the sledges. Jackets Battery Secondary No. 4 are provided for lagging each battery, increasing the operational life of a battery by 100 percent when used at very low temperatures. The Charging Set 300-watt is modified for operation at low temperatures using an auxiliary tank for starting up the set with cold starting fuel C.S.F. 1 and after warming up using the main tank filled with petrol.

The No. 22 Set and ancillaries are fitted on Carriers Set No. 15, Aerial Base No. 10 Mk.II mounted on a platform on this carrier. A rubber tube fitted in the Covers Sledge No. 2 allows the aerial to pass through the cover if operation on the move is required. For stationary working two Bags Aerial Gear No. 2 Mk.II are carried on the Charging Set sledge, each containing a complete 34ft vertical aerial.



(Figure 53-62)
Mobile Wireless Station No. 53/R109AT fitted in Jeep and trailer. Note Reception Set R109AT on the left-hand side and Aerial Coupling Unit No. 8 on the right-hand side of Wireless Set No. 53



(Figure 53-63) Block wiring diagram of trailer part of No. 53 Set mobile station in Jeep