Modifying the Army W.S. 19 for Amateur Bands Operation

By D. P. J. MEAD (G3IDM)*

THE advent on the surplus market, in brand new condition, of quantities of the No. 19 Set (an Army transmitter-receiver used mostly in tanks and Army transports) is a somewhat mixed blessing. There is no doubt that a lot of them have been bought by people who have not the slightest qualifications to use them, which has made it extremely easy for the potential pirate to get on the air with the minimum of trouble. However, the fact remains that the 19 Set is a most attractive " buy " at the current price, in which connection there should be no need to remind readers that a transmitting licence is necessary before going on the air!

The power input to the p.a. is normally 15 watts on m.c.w. and phone and 30 watts on c.w.

The number of modifications that can be carried out vary from the barest essentials to get " on the air " to more elaborate structural alterations. The first essential is to strip out the " B " set and the " I.C." amplifier. This is quite simple. All of the gear to the left of the above-chassis screen and the below-chassis relays (looking at the front panel) can be taken out and put in the junk box, as it is quite useless for amateur use as it stands. The leads to the plugs can be clipped off close to the pins except for those connected to pins 1 and 4 on the 12-way plug, and pins 3, 4 and 6 on the 6-way plug. On the 12-way plug, pin 1 is the microphone lead and pin 4 is the lead for the headphones, while on the 6-way plug, pin 3 is the l.t. positive (12 volts), pin 4 is the 500 volt h.t. positive line and pin 6 is the 275 volt h.t. positive line.

Unless one is lucky enough to have the necessary flexible sockets to match the original plugs, it is better to remove the two existing ones and fit a Belling Lee 5-pin plug to the top hole and transfer all the connections to that, blanking the lower hole off, if external power supplies are to be used. It is better, however, to make the set self-contained by building a power pack in the case.

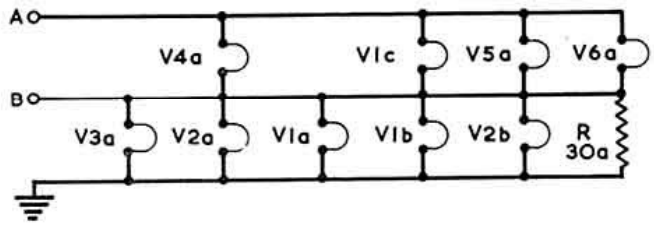

Fig. 1. Circuit diagram of the heater connections. Originally A was the 12 volt supply point but by earthing A and supplying 6 volts to point B modification for 6 volt operation becomes easy.

Power Supplies

The power requirements are 275 volts at about 80 mA, 500 volts at 70 mA (for c.w.) and either 12 volts at 2 amps. or 6·3 volts at 4 amps. While these voltages can be supplied from external sources, the removal of the " B " set and " I.C. Amplifier " leave a space that begs to be used for an internal power pack.

The heaters should first receive attention. The valves are wired up as shown in Fig. 1. By taking the 12 volt lead to chassis and supplying 6·3 volts to the centre " rail " the conversion to 6·3 volts is easily effected. A readily accessible point for this modification is the 807 valveholder: the heater pin that carries 12·6 volts should be earthed and the 6·3 volt line connected to the other.

The necessary h.t. voltages can be obtained in various ways. Fig. 2 shows the conventional circuit using full wave rectification. It will be noticed that no smoothing choke is used in the 500 volt supply, as it has been found from experience that no ripple is noticeable on the carrier using only an 8 μF reservoir smoothing condenser, *even when only half wave rectification is used.* Metal rectifiers could, of course, be used if desired and would save generating excessive heat—a serious consideration in the confined space of the cabinet.

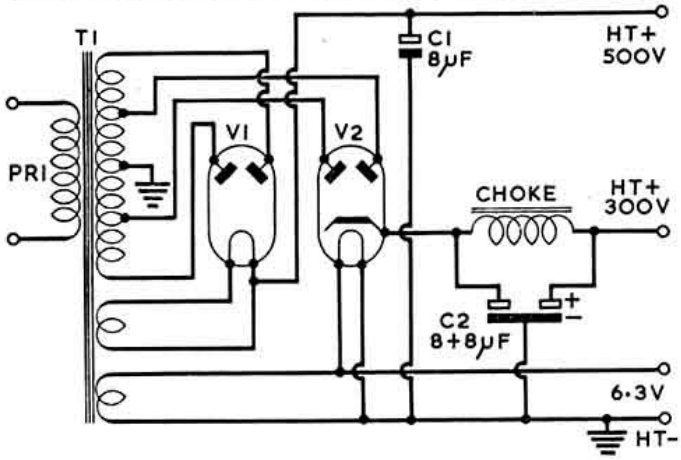

Fig. 2. Conventional type of power supply for operating the 19 Set from the mains. T1 should provide 500-300-0-300-500 volts at 100 mA, 6·3 volts at 4 amps. and 5 volts at 2 amps.

Fig. 3 gives an alternative circuit, using bridge rectification and a normal mains transformer. Here, metal rectifiers are used in half the bridge, and could be substituted for the valve rectifier shown. A further possibility is shown in Fig. 4 where half wave rectification is used.

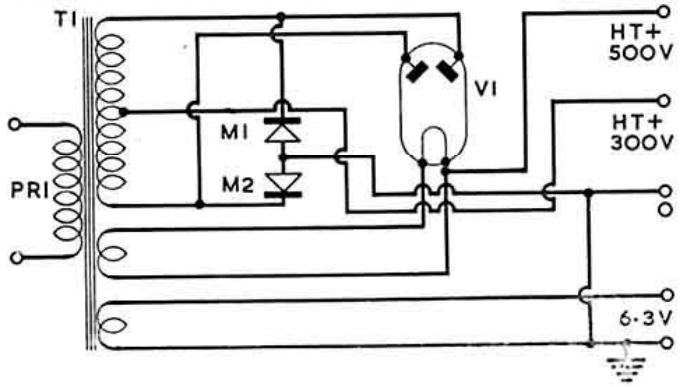

Fig. 3. Bridge type power supply. The smoothing circuit has been omitted for clarity. M1, M2, 300 volt 100 mA metal rectifiers. T1, 300-0-300 volts, 5 volts at 2 amps. and 6·3 volts at 4 amps.; V1, 5U4G. Metal rectifiers could also be used in place of the 5U4G.

All these circuits have been tried and proved, and while the circuit of Fig. 2 is now in use at G3IDM as being the most satisfactory, any one of those shown could be used with equal success. Attention should be paid to the power capabilities of the transformer when used under conditions other than that for which it is designed. For instance, in Fig. 4 only one quarter of the rated d.c. power can be supplied by half wave, instead of full wave, rectification. If lower input power is required, a single h.t. voltage of 300-350 volts can be used, when about 8-9 watts phone is to be expected, and a correspondingly higher power input on c.w. The left-hand switch of the two at the bottom centre can be used as a mains on/off.

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Relays

The relays are designed for 12 volt operation, but it has been found that they will work on 6 volts providing a 6 volt rectifier of a fairly low resistance is used with an adequate reservoir condenser of about 100 μF. Alternatively the relays can be removed and the solenoids rewound with as many turns of 36 s.w.g. enamelled wire as can be accommodated on the former. Series operation from the 275 volt h.t. line through a 2200 ohm resistor should then be possible. Although one of the relays only is used to control the "A" set, it is advantageous to modify and leave them both *in situ* as the unused one can be pressed into service in later modifications. Two spare sets of contacts, one normally closed and one normally open, can be wired to a Belling Lee five-pin socket in the hole in the upper left-hand corner to provide control for external circuits if required.

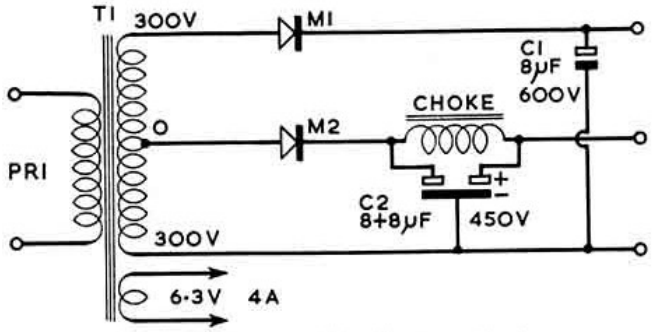

Fig. 4. Half-wave rectification power pack.

The double pole switch to the right of the bottom centre of the panel can be used as a " send/receive " switch as this already has the 275 volt h.t. connected to it. All that is necessary is to earth one side of the relays, which are wired in series, and connect the other side through the 2200 ohm resistor to the switch.

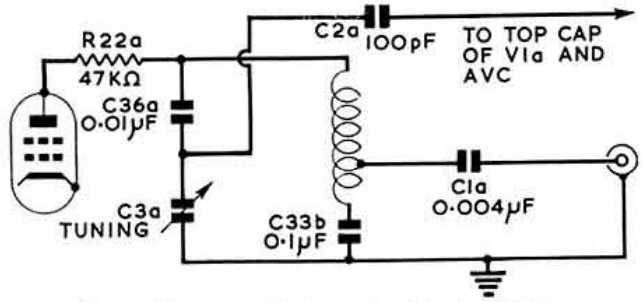

Fig. 5. The unmodified p.a. circuit in the 19 Set.

P.A. Modifications

The first essential modification to the circuit itself concerns the power amplifier, an 807. In the original arrangement (Fig. 5) part of the r.f. output was rectified and fed back through the output line to the panel meter. Unless all the attachments are available this is inconvenient, but the output can alternatively be fed through a 20,000 ohm resistor to a rectifier circuit and then to the appropriate tag on the meter switch (Fig. 6).

The p.a. tank circuit itself can be modified in various ways. First C36A, C1A and L2B should be stripped out, and C1A replaced on the tagboard mounted on the p.a. tank tuning condenser (Fig. 6). The tank coil should then be disconnected but temporarily left *in situ*. The first of several possible alterations is to use a pi section tank circuit. This can be done by connecting the coil (the tapped point should be ignored) between C1A and the aerial plug, the other side of C1A going to the anode of the 807, while the anode is fed with h.t. through a r.f. choke from the live end of C33B. A fixed condenser of 0·001 μF capacity is soldered between aerial and earth. Providing that a low impedance aerial or aerial tuning unit is used this should prove satisfactory. It may be found that the p.a. coil needs to be of greater inductance and a coil of about 40 turns of 24 s.w.g. enamelled wire, close wound, 1 in. in diameter, may be substituted for the existing p.a. coil. Reference should be made to G2HW's article on pi-couplers in the April 1952 issue of the R.S.G.B. BULLETIN. This system (Fig. 6) is in use with every success at several stations known to the writer.

Secondly, a normal link coupling can be used in place of the tapped coil; a winding of about four turns will give an ouput impedance of 80 ohms. If a dummy load with an r.f. ammeter in circuit is fitted to the aerial socket, the

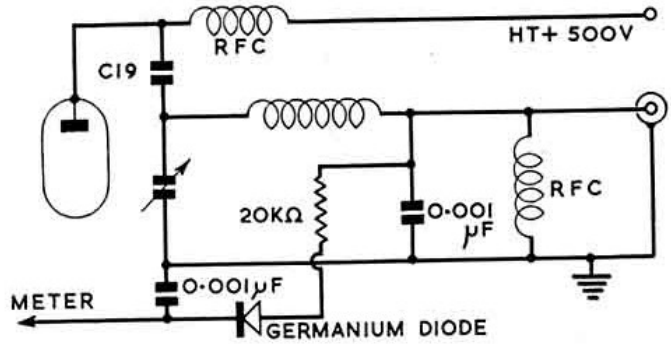

Fig. 6. Circuit of the aerial voltage meter arrangement and pi section p.a. If the link coupling of Fig. 7 is used, the 20 K ohms resistor should go to the aerial terminal in the same way.

number of turns of the link winding can be adjusted for the maximum r.f. output. This is the method of coupling used at G3IDM. It is advisable to modify the circuit of the p.a. to parallel feed (as for the pi section modification) to remove h.t. from the coil and to minimize the possibility of accidents. It is also advisable to use an aerial tuning unit of some sort to add further selectivity to the transmitted signal, because, owing to the method of obtaining the transmitter drive frequency, there is a tendency to transmit signals at 465 kc/s intervals either side of the wanted frequency. Any normal system can be used—pi section, tapped tuned circuit, link coupled, or Z match, etc. (Fig. 7).

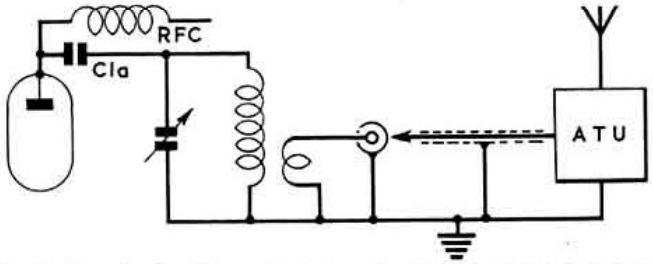

Fig. 7. Circuit of a link coupled p.a. for use with an external aeria tuning unit to suit individual requirements.

The p.a. circuit can be used in its original form quite successfully, but most amateurs will no doubt wish to modify it to one of the more accepted arrangements suggested here.

Loudspeaker

A loudspeaker of 2½ to 3 in. diameter can easily be fitted. Although the output of the receiver is intended for moving coil phones of about 45-50 ohms impedance, it is quite adequate for a small loudspeaker.

The handle on the left of the panel and the bakelite watch case (the latter, incidentally, makes a good hand microphone case!) are removed and the handle refitted at the edge of the panel to correspond with the one on the right. A hole of

sufficient size for the speaker is then cut in the panel just below and to the left of the meter. This aperture can be a series of small holes drilled by a hand drill, or cut out with a " Nibblette " tool. If the edges of the hole are irregular, as they probably will be, they can be hidden by an escutcheon of some sort. At G3IDM a small cream plastic air vent cover of the type found in kitchen cabinets is used.

It is essential that the speaker be removed from the circuit on " send " and the second relay can be used for this purpose. The speaker can be wired in series with two contacts that make on " receive " and break on " send." A resistor of such a value that it does not impair the depth of modulation can be soldered across the contacts, and will still permit the output modulation quality to be readily monitored in the phones.

Headphones

A short circuiting phone jack plug can be fitted in place of the original quench control and wired so that the insertion of the phone jack disconnects the loudspeaker.

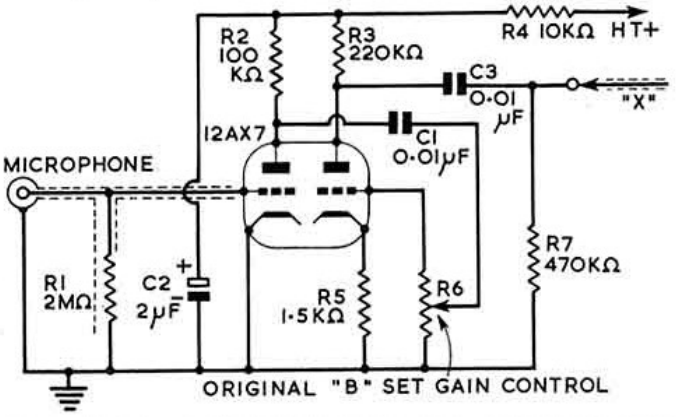

Fig. 8. Speech amplifier for use with a crystal microphone. " X " is the re-routed screened lead to the 6B8G modulator valve.

Speech Amplifier

The quality of the phone transmission can be greatly improved by the use of a crystal microphone and a speech amplifier. A suitable circuit is shown in Fig. 8. The unit can be built on a small bracket and placed under the chassis in a convenient position near the original " B " gain control which is now the " Modulation Depth Control."

The original microphone transformer, mounted on the rear of the screen between the four gang tuning condenser and the 6B8G modulator/output valve, is removed and the screened lead to it pulled back under the chassis, enough slack being allowed to enable it to be connected to the output from the speech amplifier. The " B " set aerial Pye socket can be used for the microphone. Screened wire should be used to connect the socket to the grid of the speech amplifier valve. It should be noted that the Pye socket is insulated from the panel so either the screening should be bonded to the outside of the plug or the insulating bush should be removed. The latter is probably the best course. This modification, with a crystal microphone will provide more than adequate modulation depth and will greatly improve the quality.

If it is desired to use a moving coil microphone, a transistor amplifier could be used to save power and space, the circuit shown in Fig. 9 giving a gain of up to 300 times.

Selectivity

The first i.f. transformer is over coupled, so an increase in the distance between the coils will improve the selectivity. First remove the screen that runs along the back behind the i.f. transformers and the two screws at the back of the transformer itself. Next remove the two nuts securing the transformer can to the chassis. The can should now be free and can be drawn off of the coils. These coils are fixed in slots, and by loosening the screws that hold the formers to the paxolin strip, the coils can be separated to the full extent of the slots and the screws retightened. The screening can should now be replaced and the i.f. transformer realigned.

Range Alterations

By soldering a 150 pF close tolerance silver mica condenser across each section of the four gang condenser Top Band and 80m can be covered quite conveniently. The two ranges now become approximately 1·8 to 3 Mc/s and 3 to 5 Mc/s. This also enables a frequency check at 2·5 and 5 Mc/s to be made from the transmitted standard at MSF. The p.a. coil will have to be suitably altered to cover the new frequency ranges. In this case a pi section tank circuit is probably the most useful. By using a fixed condenser of 0·001 μF capacity as an output loading capacitance, both bands should quite easily be covered.

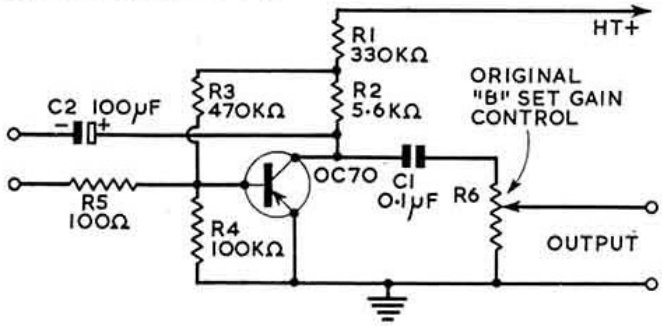

Fig. 9. Transistor speech amplifier for use with a moving coil microphone. In this case, the " B " set aerial socket, if used for the microphone, should be left insulated from the panel and care taken not to short-circuit the input to earth. The input impedance is 200 ohms and the output impedance less than 10 K ohms.

Bandspread

By far the most useful and yet satisfying modification is the introduction of bandspread. The first operation is to remove all the moving vanes from the four gang variable condenser except for one in each section. This should be done very carefully. Use a thin hacksaw blade (one of those sold for the miniature Eclipse spring back saw is ideal) to cut through the metal strap that connects the vanes together at the tip, and then grip the separated vane firmly with a pair of long nosed pliers and, with a steady pull (not a jerk) peel the vane off the spindle. Do not attempt to take off more than one vane at a time or the other vanes may be bent. Owing to the close spacing it is not easy to rectify a short between moving and fixed vanes.

When this operation has been completed and it has been ascertained that there is no short circuit, a 50 pF silver mica close tolerance condenser should be soldered across each of the four trimmers beneath the chassis on the 2 to 4·5 Mc/s range. After readjustment of trimmers to align the circuits, it should be found that the 3·5 Mc/s band occupies about three-quarters of the dial.

Forty Metres

The 7 Mc/s band will occupy about half an inch which, while an improvement on the previous one-tenth of an inch, still leaves something to be desired. Experimenting with new windings on the h.f. range, whilst quite satisfactory on the receiver side, has not been a success on transmit owing to the impossibility of maintaining sufficient drive. It is thought perhaps that condensers in series with the tuning capacitance on the h.f. range only might meet the case, but the writer has not had an opportunity to do the necessary alterations.

(Continued on page 393)

G3MNM (GTD740)	Top Band—6G6 c.o., 12A6 p.a. modulated by 12AT7 and 6V6 (8 watts input). 144 Mc/s—four EF91s (2·5 watts), p.a. modulated by 12AU7 and 12AX7. 420 Mc/s—two 6J6 in self-excited p.a. modulated by 6AG5 and 6AQ5. Aerials—6 ft. loaded whip for Top Band, dipole for 144 Mc/s and 5 element bi-directional beam for 420 Mc/s.
G3MQT (BWR195)	Transmitter—12A6 c.o., 1625 p.a., modulated by 12AX7, ½ 12AU7 and two 6AQ5s in class AB1 (covers 1·8, 3·5 and 7 Mc/s); aerial—4 ft. base-loaded whip.
G3MWG (OVE907)	Minimitter converter into modified Command receiver at 1·5 Mc/s.
G3WW (RFG555)	Transmitter—EL91, 6C4 b.a.-doubler, 5763 p.a. for 1·8 and 3·5 Mc/s with voice controlled send-receive switching; receiver—Command type; aerials—centre-loaded whips.
G3XC (TPP198)	Transmitter (1·8 Mc/s)—12AT7 c.o., 5763 p.a. modulated by 12BA6, 12BA6 and 12BH7.
G4IB (WKJ968)	Transmitter (144 Mc/s)—1·2 watts input to 12AT7 p.a.; receiver—6BQ7A cascode, 12AT7 mixer-oscillator followed by 10·7 Mc/s i.f. and 465 kc/s second i.f.
G5PP (RWK967)	Transmitter—Z77 e.c.o., Z77 b.a. 6L6 p.a. modulated by 12AX7 into 6L6; receiver—modified Command set for 1·8 Mc/s; aerial—whip with matching box at base.
G6NW (261MMG)	Transmitter—12AT7 Tesla v.f.o. and cathode follower, EF91 b.a. and two 5763s in parallel in p.a. modulated by EF91, 12AT7 and p.p. 6V6s (covers 1·8, 3·5 and 7 Mc/s); aerial—continuously loaded whip.
G6SN (GVW708)	Transmitter (144 Mc/s)—12AT7, Z77 to QV04/7 p.a. (12 watts input); receiver—cascode comprising 6AK5, EC91, 12AT7, two 12SG7, 6SQ7 and 6C5.
G8ML (SDD720)	Transmitter—6SJ7 oscillator, 6SJ7 b.a. and 5763 p.a., modulated by Z77, 6C4 and 12AX7.
G8TL (OJN717)	Transmitter—6CH6 v.f.o., 5763 b.a.-doubler, 5B/254M p.a. for 1·8 to 28 Mc/s; receiver—6BJ6, 20D4, 6BJ6, 12AT6 and 6BW6 with converter (6BJ6 and 6U8) for higher frequency bands.

Corrections and additions to this list will be welcome and should be addressed to *Mobile Column*, R.S.G.B. BULLETIN, New Ruskin House, Little Russell Street, London, W.C.1.

Top Band Most Popular

Unfortunately, the newcomer to mobile cannot tell readily from this list which is the most popular band for mobile operation. However, checks show that about 70 per cent of all mobiles operate on Top Band, and about 25 per cent on 144 Mc/s. A high proportion of those on Top Band can also operate on 3·5 Mc/s. Mobile operation on all the other bands up to 420 Mc/s has been reported; but the proportion is very small. Equipment for Top Band work is comparatively easy to get going but in the past the outsize aerials have appeared to be rather a disadvantage. However, good results are now being obtained by many stations, using whips of reasonable length, and at least one manufacturer has made such aerials available commercially. Aerials for 144 Mc/s present no problem, the halo and half-wave dipole, mounted as high on the car as possible, being the most popular. Results on the DX bands are encouraging and several mobile operators are well on the way to a DXCC/M.

Mobile operation is not limited to transmitting amateurs. A.1404 of Oldbury, Birmingham, for instance, uses a much modified 19 set for Top Band, 3·5 and 7 Mc/s with an RF24 unit ahead for 14, 21 and 28 Mc/s.

Points to be borne in mind in planning mobile gear are the current consumption—the car battery is not a limitless source of amps.—and safety. The very minimum requirements for the latter are that the equipment should be rigidly fixed in the car and arranged in such a way that it does not impede the normal operations of the driver. For the h.t. supply, the advent of reasonably priced power transistors make a transistorized unit the obvious choice.

Insurance

As mobile radio equipment is not generally covered by a motorist's normal comprehensive policy it is suggested that those who operate mobile should check with their insurance companies or brokers to ensure that they are covered in the event of theft, fire or accidental damage to their gear. At least one company is willing to issue a special policy covering the radio equipment in a car at 10/- % per annum for the risks mentioned.

* * *

Contributions to *Mobile Column* are always welcome and should be sent direct to Headquarters.

Mobile Meeting in London

SO much support has been promised for the meeting of mobile enthusiasts to be held at " The Rising Sun," 46 Tottenham Court Road, London, W.1. on February 22 that practically all the available seating has been booked. Those who have not yet replied to the organizer's circular letter and would like to attend should write to Rex Toby (G2CDN/M), 13 Wood Lane, Isleworth, Middlesex, immediately. It is hoped that the meeting will result in the formation of a self-supporting group or club devoted solely to the interests of mobile operators.

Voice of America Amateur Radio Programme

A SPECIAL 15 minute programme of news and propagation forecasts for radio amateurs and shortwave listeners is broadcast at five different times on Sundays by Voice of America transmitters. The programme forms part of the *Sunday Report from America* broadcast and transmission times are announced at frequent intervals.

Reports on the reception of the programme, which will be acknowledged by a special QSL card, should be sent to Amateur Radio, Box 922, Washington 4, D.C.

Nice Work G3MCN

THE November 1958 issue of " *5 and 9*," the News Sheet of the Liverpool and District Amateur Radio Society, reports that Harry James (G3MCN) received the final card for his DX CC certificate a year to the day after he was licensed. Is this a record?

Are You a Tabler?

THE Society's Region 8 Representative, Mr. E. R. Dolman (G2DCG), 20 Canterbury Road, Margate, Kent, who is a keen member of Round Table, would like to hear from other R.S.G.B. members who are Tablers.

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Further Modifications

Two further modifications are worth considering. One is the provision of an r.f. gain control which can be provided by a 10 K ohms wire wound variable resistor introduced between the end of the cathode resistor of V1A (220 ohms) and the chassis. The other is an a.v.c. on/off switch to improve the reception of c.w. signals. The main trouble in the alterations is finding room on the panel for the controls! Possibly a potentiometer and switch combined might be a way out, so that, with full r.f. gain, the a.v.c. is on and when the r.f. control is brought into operation the a.v.c. is automatically switched off.

It is hoped that these notes will enable many more No. 19 Sets to be suitably modified for amateur use.

The writer thanks G3HTP, G3IPB and G3IHF for their helpful suggestions and criticism during the modification of his own 19 set.