Modifying the AR7 Receiver

PART ONE

BY G. M. BOWEN,* VK5XU

GENERAL DESCRIPTION

A communication receiver, based on the H.R.O. design, this receiver covers from 138 Kc. to 25 Mc. with a break at 410 Kc. to keep clear of the 455 Kc. i.f. channel. Five sets of coils contained in removable coil boxes cover this range. Tuning range ratio for A, B, C and D coil boxes is approximately 3 : 1 whilst E range covers from 12.5 to 25 Mc.

The receiver has eight valves, this including a double triode (6C8G), one half operating as a v.t.v.m. for the "S" meter, and the other for the b.f.o. circuit. The set I believe was originally designed around high gain pentodes but the shortage of overseas supplies made it necessary to use 6U7Gs, as r.f. and i.f. amplifiers, a 6J8G as converter, and a 6G8G coupled to a 6V6G for the audio stages.

A very good crystal filter in a balanced tuned type of phasing network enables signals as close as 200 c.p.s. to be attenuated below nuisance strength when the filter is correctly aligned. (Quite a few sets being sold at present have had the crystal removed from the small mounting box!)

The input to the first r.f. stage can be used with a balanced transmission line or alternatively one side can be bridged to earth and a single wire attached. The latter arrangement gives the best results for all band coverage for short wave listening.

Two r.f. stages give a large attenuation of second channel interference which can be a decided nuisance on the 14 Mc. band with the high powered broadcast stations on the 15 Mc. band.

No fancy circuitry is found; all sections follow well tried and trouble-free designs. The noise limiter is what it says and is not a noise suppressor of the lamb type and it reduces noise and signal to a common level. This is done by reducing the screen voltage on the 6G8G—first audio—to a point where saturation occurs on positive peaks and cut-off on negative peaks.

The power supply enables the set to be operated from the a.c. mains or from a 12 volt accumulator. It is separated from the receiver as is also the speaker. A pair of 6X5GT valves with plates paralleled ensures a very high degree of regulation, under mains fluctuation.

A study of the circuit will show that a.v.c. is applied to the first audio valve (6G8G) and this is done to achieve a certain amount of muting when there is no signal together with a much more uniform output of the audio signal. The 6V6G is coupled to an output transformer mounted on the chassis and this has output windings for the permag. speaker and the phones.

Quite a few receivers coming onto the Disposals market are performing very poorly and a common fault seems to lie in the misalignment of the crystal filter stage. When this is by-passed (leaving only the 1st i.f. and 2nd i.f. stages) the sensitivity of the receiver improves remarkably. However, it should be possible to have the filter correctly aligned, but it needs the use of a wobbulator and a c.r.o. to really do the job properly. Even then it takes up to four hours!

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● With this article we introduce a series relating to the popular AR7 Receiver. This part of the series gives a general description of the equipment and details of "lining it up."

To those particularly anxious to improve the AR7, the series is especially recommended. You will be taken, stage by stage, through the entire receiver, being shown what steps should be taken to make the receiver comply with present day requirements.

To those who feel that modifications to commercially built equipment are not justified, this, the first article, should appeal. We warrant you will, eventually, make all the modifications to be described!

The controls are the usual ones found on this type of receiver and they are well labled on an etched stainless steel escutcheon overlaid onto a steel panel. The dial mechanism should be checked to see that it has no play, before attempting any calibrating; the worm gear is spring loaded and although it may be worn, when it is cleaned up, greased with vaseline and the tension on the springs increased, the play should disappear.

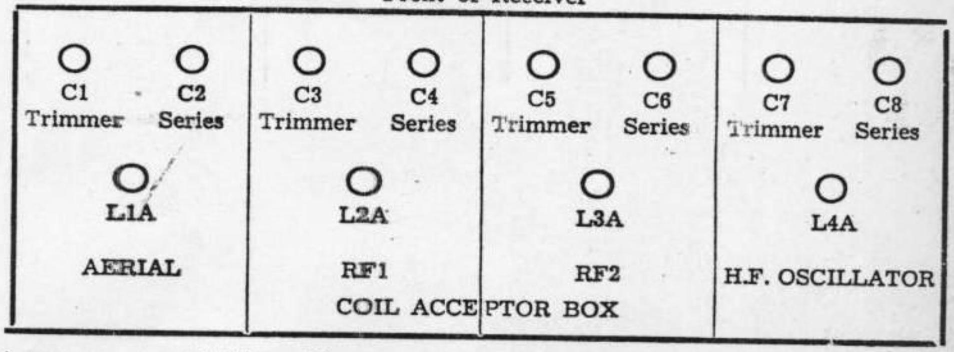
The heaters of the valves are operated from a 12 volt winding on the transformer or are switched to the 12 volt d.c. input when operating from battery supply. Hence the series parallel connections to the sockets as follows: The two r.f. valves; the converter and the 1st audio (6G8G); the two i.f. valves; the 6V6G and the 6C8G, with a 42 ohm resistor across the heater of the 6C8G to allow 0.45 amp. to the 6V6G heater.

Delayed a.v.c. is obtained by rectifying the signal obtained from the plate of the 2nd i.f. valve and fed to one diode of the 6G8G. This connection reduces the loading on the secondary of the i.f.t., gives a higher voltage and isolates to a degree the b.f.o. input which is fed via a small trimmer condenser to the second diode. It is thus possible to operate with the b.f.o. and a.v.c. on, if an alteration is made in the switching. (See modification.)

Following usual practice a.v.c. is applied to both r.f. and i.f. stages as well as that mentioned already. The converter has no a.v.c. applied for obvious reasons. A 5,000 ohm potentiometer, in series with a 50,000 ohm bleeder resistor, affords separate manual control for the r.f. and i.f. stages and operates independently of the a.v.c.

The overall sensitivity of the set should be less than 2.5 microvolts input at any frequency for an output of 50 milliwatts measured across a resistance of 100 ohms connected to the "phones" jack.

Front of Receiver



Adjustments to the coil units are made through the holes in the coil acceptor housing and are marked L1 to L4, C1 to C8 (see diagram).

L1—Inductance adjustment on aerial coil.
L2—Inductance adjustment on first r.f. coil.
L3—Inductance adjustment on second r.f. coil.
L4—Inductance adjustment on h.f. oscillator coil.
C1—Aerial trimmer.
C2—Series trimmer (Coil E only).
C3—1st r.f. trimmer.
C4—Series trimmer (Coil E only).
C5—2nd r.f. trimmer (mixer input).
C6—Series trimmer (Coil E only).
C7—H.f. oscillator trimmer.
C8—Padder, series condenser on h.f. oscillator coil for coils A, B, and C. Series trimmer (Coil E only). Coil D uses a fixed padder.

ALIGNMENT PROCEDURE

Extreme accuracy is required in the alignment of the i.f. circuits. Slight misalignment of these i.f.t's. will have a marked effect on the sensitivity and selectivity of the receiver. They are permeability tuned with an iron-dust core and there is quite a deal of movement either side of resonance, which makes aural checking almost useless.

A very stable signal generator or a Bendix BC221 are suitable instruments.

(Continued on Page 6)

Modifying the AR7 Receiver

(Continued from Page 5)

Remove the grid cap from the converter valve and connect the output of the signal generator through a 500 pF. and return the grid to earth through a 100K resistor. Connect the grounded side of the signal generator lead to the receiver chassis. Short out the oscillator gang to stop heterodynes from external signals getting into the i.f. channel and causing spurious readings.

Having checked to see that the crystal is still in the receiver—remove the small cover of the shielded section near the right hand side of the front panel —set the receiver controls as follows:

Crystal switch to IN; selectivity control on zero; phasing condenser to centre scale; a.v.c. switch to a.v.c position; tone control on 10; r.f. gain on 8; noise limiter on 10; audio on 6; b.f.o. condenser to centre. Set the "S" meter adjustment to a suitable value that can be read easily.

Vary the frequency of the signal generator until a maximum reading is obtained in the "S" meter, indicating that the frequency is exactly that of the crystal. Leave the signal generator alone and switch out the crystal filter.

Adjust the iron cores; those above chassis level are grid circuits, below the plate circuits. Make quite sure that all movement is positive and that there are no loose slugs, etc. **Leave L5A, the crystal filter transformer grid circuit, well alone** for the present (this appears beneath the chassis and is the nearest screw to the chassis side). Align the i.f.t's. in the usual order from the converter to the second detector.

To check whether the xtal filter is aligned swing the signal generator plus and minus 5 Kc. of the setting and note whether the reduction in signal strength reading in the "S" meter falls off symmetrically. If it does, then do not meddle with any part of the filter circuit; if it doesn't, then tread warily. Leave it alone for another occasion!

Now to the r.f. amplifiers and h.f. oscillator. If there is any reason to doubt the mechanical construction of the coils and their trimmer condensers (and if you have just got them from Disposals there is every reason), remove the coil shields from the structure and then the coil and condenser assembly carefully. **Do not expect to find all the connections identical.** Note carefully on paper the way that the connections are made and save yourself a headache later.

With coils A, B, C and D the alignment procedure is the usual low frequency inductance and high frequency trimmer adjustment that can be found in any handbook. Coil E has neither padder nor inductance adjustment since the series condenser will perform the necessary band spreading.

In Coil E, the series trimmer C8 is adjusted instead of L4 to obtain the correct oscillator range; C2, C4 and C6 are adjusted at the low frequency end of the range and C1, C3 and C5 at the high frequency end.

Since Coil A covers a band which very few Amateurs are interested in, this article will deal with the conversion of this unit to operate from 25 to 35 Mc.

Type 3 Mark II. Receiver

Adding A.V.C. and Audio Volume Control

BY G. M. BOWEN,* VK5XU

THOSE of us who are fortunate enough to own one of these receivers realise what wonderful little sets they are for mobile work as well as for standby shack receivers. However, they were never designed to receive phone signals and therefore a.v.c. was not incorporated. This fact, for Amateur work, is likely to cause the loss of one's eardrums when tuning over the band if we have the gain control on maximum and land on an S9+ signal.

Having had this happen to me a few times, the circuit was studied for an easy way to add a.v.c. It was quickly ascertained that the gain control was not the usual cathode bias type, but used a back-bias system and a 50K potentiometer (VR1). An isolating 470K resistor (R6D) connects this gain control line to the grid circuits of the two i.f. valves.

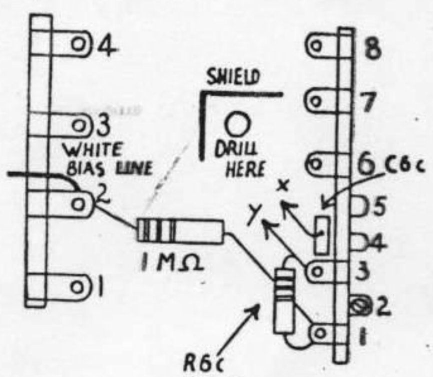


Fig. 1.

C6C is 0.001 uF. condenser and R6C is 150K resistor. Tag No. 2 (right hand strip) is earthed.

Getting the little grey cells to work, it was reasoned that a 2 megohm resistor connected from the bottom end of the third i.f.t. to the "bias" line on the other side of the resistor (R6D) would do the trick. Each one of us is loath to dive into the inside of a commercial receiver, but after much delving around to find R6D and the junction of R1D (1 megohm) and R6C (150K), it was discovered that a 1 watt resistor with its nice long leads fitted exactly between the two tie points (see diagram).

Subsequently it was found that a 1 megohm resistor worked better than the 2 megohm one. With the chassis upside down and the control panel away from you, you will see two solder tag strips running at right angles to the front panel. On the left one there are four soldered connections, and on the right, eight connections at the top nearest to you.

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Simply solder the 1 megohm resistor between the two soldering positions as shown in the diagram and a.v.c. is yours.

To really obtain the benefit of a.v.c. the r.f. gain control needs to be at maximum, or nearly so, and hence some form of audio volume control is needed. This modification is not quite so easy, but is still "a piece of cake" as we say! The most important item is a 500K miniature potentiometer and these are now available—mine is a Ducon with a diameter of one inch.

Drill a hole, immediately above the b.f.o. condenser, in the front panel to take the potentiometer, allowing enough clearance for the cover to be replaced when the operation is over. Mount the pot with its solder tags facing towards the central division screen. Now, with the chassis upside down again refer to diagram and then find the small shield around the second i.f. valve socket. Drill a hole as shown large enough to take two shielded leads from X and Y up to the potentiometer.

Lead X solders to the moving arm (centre solder tag) of the pot. and Y to the maximum in the usual volume control circuit arrangement. Disconnect C6C from the solder tag (No. 4 in diagram) and attach to the lead X. Do not forget to earth the braid and the potentiometer in the usual manner.

Now, connect up the receiver and note the vast difference you have succeeded in getting.

A further improvement can be had by diving into the power supply and soldering a 250 ohm 3 watt resistor in parallel across the bias resistor that you see attached to the output sockets. Now that you have a.v.c., it is unnecessary to have such a high value of fixed bias on the valves and the gain on weak signals is very much improved.

Do you need a switch to short out the a.v.c. when receiving c.w.? No! The r.f. gain control (marked volume on the knob) is backed off until the bias is high enough on the valves to stop the action of the a.v.c. and the audio volume control is then adjusted for comfortable level.

If you need proof that the a.v.c. is working turn the meter switch (on the tx of course) into position 1 and note how the receiver voltage rises and falls with the signal strength.

Don't be worried by the fact that the 500K potentiometer is in parallel with the detector diode load R1D (a 1 megohm resistor) for I found by experimenting with isolating condensers that there was no measureable difference whichever way I had the circuit. Since the above method is the easiest and works well, I leave it to you. The 500K potentiometer can be replaced by a 1 megohm one as the value is not critical.

Modifying the AR7 Receiver

PART TWO

BY G. M. BOWEN,* VK5XU

From the brief description in Part One it should be apparent to all owners that the principles embodied in the design of this receiver are standard and shouldn't deter anyone from making the following modifications.

CATHODE BIAS AND R.F. GAIN CONTROL

In order to have a receiver which can operate under a very wide range of input voltages and which will remain stable, the last ounce of gain cannot be aimed at and a 1 watt resistor (R18) was connected between h.t. and the cathode bias bus-bar. This provided anything from 15-30 volts bias for r.f. and i.f. gain control and in my AR7 it gave a minimum of 5 volts when the potentiometer (R19) was supposedly shorted out—resulting in lack of sensitivity and poor a.v.c. characteristic. Hunt out this resistor and remove it—the range of working conditions encountered in Amateur QSOs does not require a cut-off bias.

CONVERTER

If the heater chain is still on 12 volts it is necessary to choose replacement valves with 300 Ma. heaters, hence the choice of an ECH35 for the converter stage. Remove the socket and replace with a good micanol or isolantite; discard the shield and earth No. 1 pin as usual to the chassis immediately beside the pin. Rewire the socket with the heaters above earth by-passed with good mica or ceramic capacitors—value is not critical.

The oscillator grid capacitor (C14, a 100 pF.) should be silvered mica (or ceramic with a zero drift coefficient) and the grid resistor (R12) a 1 watt, 50K ceramic of very low capacitance. Each component should be rigidly mounted to ensure mechanical stability.

The screen supply and the oscillator h.t. is obtained from a dropping resistor (R13) and is by-passed with a pair of capacitors (C18). To reduce the converter noise to a minimum, ensure that the group of four parallel 50K resistors is replaced with an equivalent 12.5K stabilised carbon resistor or group.

If the original power supply using the pair of 6X5GT valves is still intact, the h.t. supply is very stable and there is no need for a voltage regulator tube here. But it was found after the power transformer burnt out! (mainly due to failures of cathode-heater insulation of the 6X5s) and another inserted and the rectifier changed to a 5V4G, that on 21 Mc. and higher, the changes in h.t. due to a.v.c. action caused the oscillator frequency to vary unduly and a v.r. tube was necessary to stabilise the h.t. at 100 volts. A VR105 will fit under the chassis quite easily.

R.F. STAGES

The above simple straight-forward alterations should improve the signal-to-noise ratio quite a bit and the next move is to provide a good hefty signal to the converter, as free of valve and component noise as possible. The AR7 has two r.f. stages from which this ideal can be achieved, believe it or not ye cynics.

Let us discuss the function of each stage as we need it to operate. First the aerial coupler, first r.f. valve stage. Here we need all the gain that it is possible to achieve so the logical choice will be a tube with a Gm well above 7,000. The RL7 or EF54 gives this with an equivalent noise figure of 700 ohms or less. It has the disadvantage of having a sharp cut-off, but in practice this has not been found to be, a handicap, except when my two next door neighbors—VK5ZY and VK5TD—start up and modulate all the signals

Remove the octal socket and replace with a micanol nine-pin loctal located with the grid pin nearest the coil container. Rewire heaters and by-pass the outer lead to earth as for the converter. Solder a small shield across the socket to isolate the output circuit from the input grid leads. The cathode resistor of 150 ohms—carbon 1 watt—is next wired and ceramic miniature by-pass 2,200 pF. capacitors attached to cathode and screen pins. A decoupling resistor of 1 to 2K is included in the screen lead from the h.t. bus-bar. A handy feature of this tube (like the EF50) is the 250 volt screen operating voltage. The suppressor is internally connected.

Remember that to get high gain it is necessary to have very closely spaced elements and therefore any voltage which may be applied from the transmitter accidentally will damage the tube within seconds. Therefore, include a self-bias cut-off protection by including a 100 pF. capacitor between the coil connection and the grid pin, and a 1 megohm ½ watt to earth. This circuit is a standard connection in Service equipment and as there is no a.v.c. applied to this stage now, it is a very wise precaution to take.

Drill a hole in the front panel, at the same level as the noise limiter control but on the left hand side of the

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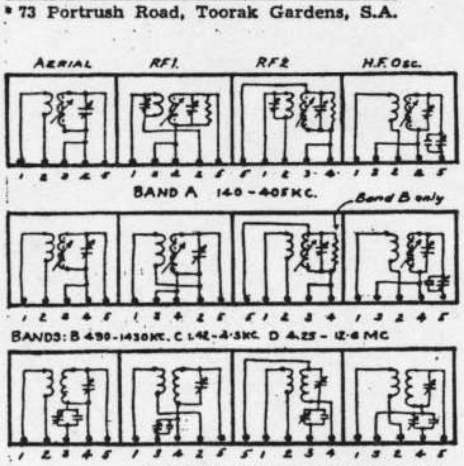
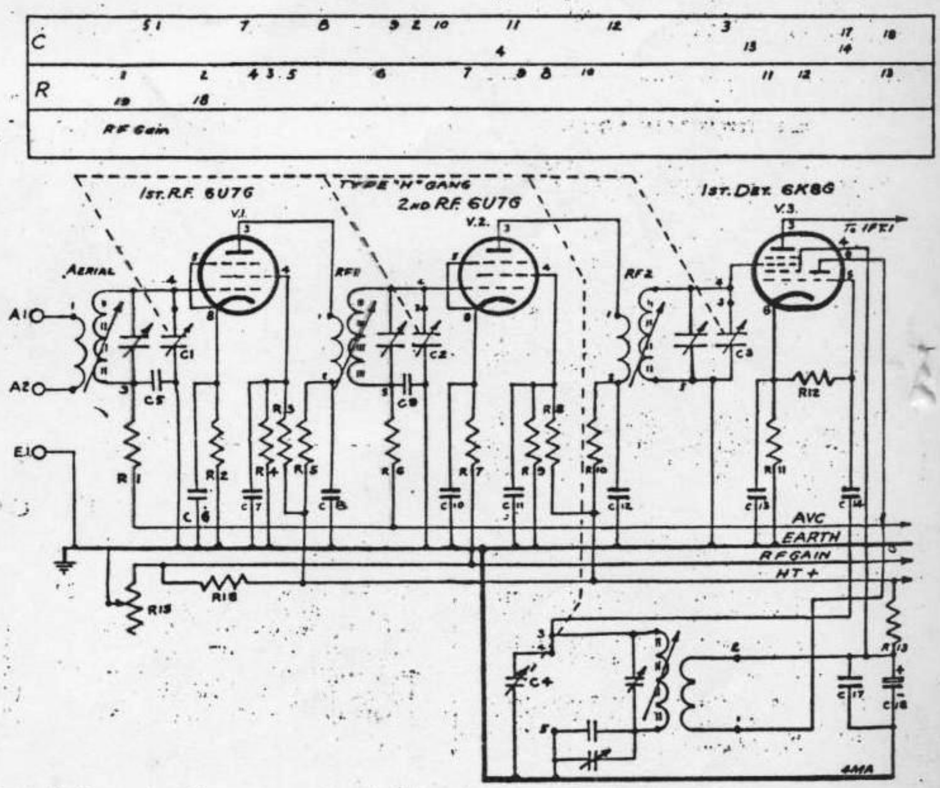


AR7 Coil Box Connections.



tuning dial, to take a small variable capacitor for an aerial tuning control. Any type will do here, but it should have a maximum value of 100-150 pF. to be able to accommodate the change across the tuning range. Connect this across the coil—not across the tuning gang—and when re-aligning these stages set it at half value. Don't be frightened by the fact that the stage may "take off" when a high impedance aerial is used—detune slightly and still get the greatest gain possible.

Now, what about the second r.f.? Well, having obtained maximum gain from the first r.f. at the expense of some selectivity, due to the low input impedance of the RL7, we should aim to get as much selectivity as possible to reduce second channel interference. With the coil circuitry as it is, this requires a valve with a high impedance input and the 6U7G or the 6K7G will fill the socket hole very nicely here. There is no point in going for gain in this stage as the signal-to-noise ratio is going to be determined in the first r.f. stage primarily. If single ended tubes are favoured it may pay to experiment with a semi-remote cut-off tube like the 6SG7. However, the a.v.c. line would then have to be modified to limit the action to a shorter operating base.

One further modification creates operating ease rather than improved signals. A small single pole single throw toggle switch can be easily mounted in place of the "a.v.c., b.f.o." one already there, and a further one mounted immediately above provides separate controls for the a.v.c. and b.f.o. which is an added advantage in most circumstances. Since the a.v.c. is derived from a connection to the primary of the third i.f.t. very little b.f.o. signal gets into the rectifier diode and with the r.f. gain control reduced it is hardly ever necessary to cut-off the a.v.c. when receiving c.w. The a.v.c. is obtained from a delayed action circuit anyhow.

A final word about the wiring of the first r.f. stage. Don't forget to remove the a.v.c. decoupling resistor R1 and condenser C5 and earth position 5 on the coil contactor strip.

Re-alignment of each coil box will now be necessary. Follow the instruction book or the text in Part One of this series. In order to get the antenna trimmer capacitor to resonate the coil over the range of the tuning required, it may be necessary to remove the slug from some coils or disconnect the coil trimmer in Band E.

APPENDIX

EF54-RL7 high slope r.f. pentode (VR136):

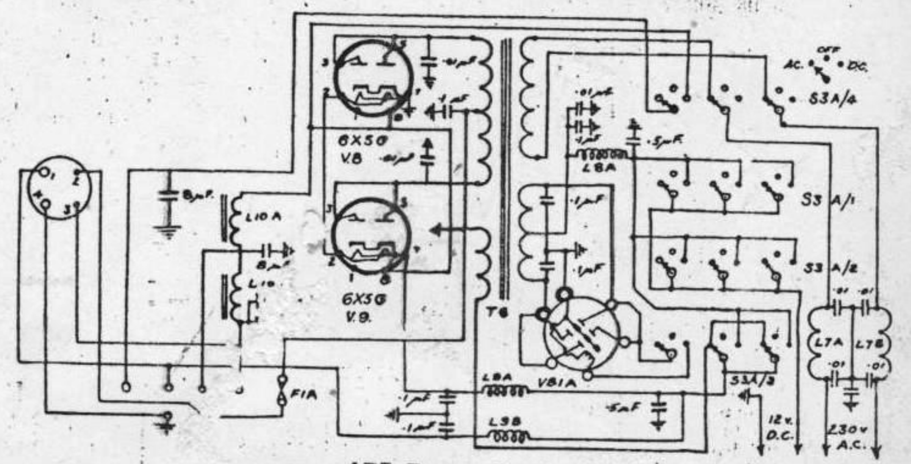
Socket: B9G loctal nine-pin.

Heater: 6.3v. 0.3 amp.; Ep 250 volts; Eg2 250 volts; Ip 10 Ma.; grid bias —1.5 volts; gm 7.7 Ma/V; Plate resistance 500K.

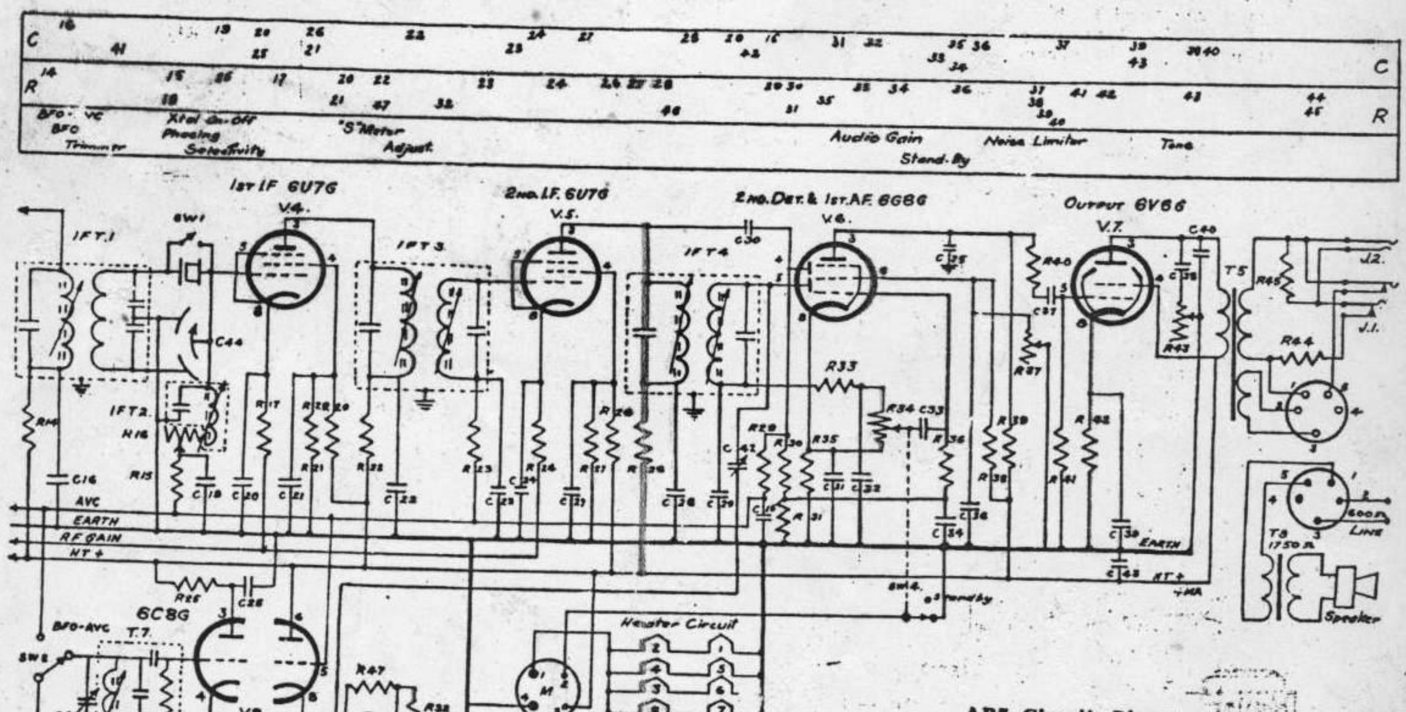
Socket connections—

1—Heater.
2—Plate.
3—Screen grid.
4—Cathode-suppressor.
5—Cathode.
6—Control grid.
7—Cathode.
8—Cathode.
9—Heater.

Where by-passing is required, connect capacitors with as short leads as possible directly to the chassis at the nearest point.



AR7 Power Supply.



AR7 Circuit Diagram.

Modifying the AR7 Receiver

PART THREE

BY G. M. BOWEN,* VK5XU

It is proposed to discuss the installation of two types of noise limiters in this section of the modification scheme. Each circuit has its advantages and its limitations. The choice that you may make will probably be decided by the amount of time—and equipment of course—that you have at your disposal.

The shunt limiter using a crystal diode 1N34 in the circiut found in the A.R.R.L. Handbook is probably the simpler of the two to instal, but is not as efficient in its operation as the double series limiter using a 6H6 or 12H6. The use of the 12H6 is not advised unless you have inbuilt 100 c.p.s. filters in your ears since the cathode is well above earth potential and results in quite a fair amount of a.c. hum feeding through. This can be improved and the contact potential of the plate-cathode circuit reduced considerably by operating either the 6H6 or the 12H6 on about 4.5 volts and 9 volts respectively.

Experiments with the 6H6 have shown that cathode emission ceases where the heater voltage falls below 4 volts approximately. The cathode at this lower temperature doesn't follow the a.c. maxima quite so readily and a little experimentation with a series resistor in the heater lead will pay dividends.

Along with others, it was found that the 6H6 or its glass equivalent was better than the later miniature types of double diodes.

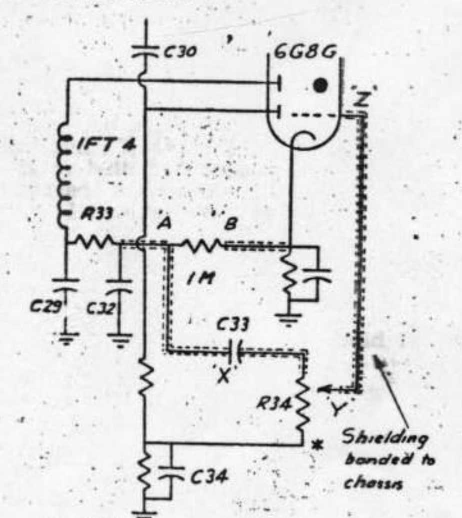


Fig 3·1

* This point is disconnected and grounded if a.v.c. is not required on the 6G8G.

INSTALLING A SHUNT LIMITER

Installing the 1N34 means rewiring the diode detector section so that a fixed resistor becomes the diode load instead of the volume control R34. Looking at the original circuit, it will be seen that R36, the grid resistor for the 6G8G, is returned to the junction of R30 and R31. These two form the a.v.c. diode load network; hence with the decoupling capacitor C34 portion of the a.v.c. voltage is applied to the first audio stage. Anyone wishing to retain the a.v.c. on this stage, and there are advantages in so doing, will simply bring the "earth" end of the volume control potentiometer to the same junction.

The first modification is to rewire R34 and include it into the grid circuit return and replace it with a diode load of 1 megohm. The lead from the decoupling resistor R33 and by-pass condenser C32 is a shielded one passing along the floor of the chassis from the

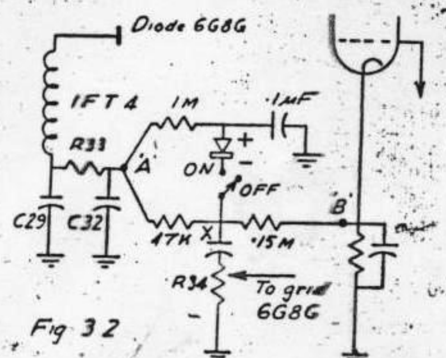


Fig 3 2

second i.f. stage to the front panel where the volume control is located. C33, the audio coupling capacitor, is placed on solder lugs close to the potentiometer and the return lead for the grid circuit, a shielded one, runs parallel to the other one. By transposing these leads on R34 they can still be used.

At the same time lay another screened lead so that an n.b.f.m. adaptor can be included if required. It is easier to do it at this stage than later on when components are replaced and new ones added.

For the 1N34 shunt circuit, use a double solder lug strip to mount the components. This can then be fixed on small stand-off pillars to the end of the chassis nearest to the audio control potentiometer. Remove the second phone jack and insert a s.p.s.t. toggle switch for "limiter-in," "limiter-out" control.

Although some Amateurs prefer to leave the limiter in all the time, there are occasions (like listening to the b.c. band!) when well modulated signals are severely distorted unless the limiter is taken out.

With the shunt limiter, screening the input and output circuits from each other doesn't present quite the problems that the double series limiter does. It is also less sensitive to parallel circuit capacitance than the series circuit and so far it has been found slightly better for the long shielded leads required in the AR7.

Without adding the limiter the circuit becomes the one in Fig. 3.1.

With the 1N34 limiter "A" and "B" become the points into which the limiter is included and the 1 megohm resistor is removed. Since the shielded leads AX and YZ are already installed the end at X needs only to be lifted and transferred to the input of the limiter.

As all the components of the limiter circuit have been mounted on the solder lug strip attached to the end of the chassis it is an easy move. The audio coupling capacitor, C33, is mounted close to the potentiometer on a stand-off pillar and short leads can be used. The output lead from the limiter goes to C33, the earth lead to the nearest point on the chassis, and the two leads to the on-off switch as direct as possible and clear of C33.

It all makes for a very neat and tidy installation with a minimum of physical alteration.

One word of warning is required. Note the polarity of the circuit and connect the 1N34 into it correctly. If you are not sure and the circuit appears to not be working, try reversing the diode.

If a 1N34 is not available use a diode with a very low forward resistance and as high a back voltage as possible. This is necessary because signals will feed both ways if the diode has "had it."

This installation made operation on 28 Mc. a possibility in spite of almost continuous auto QRM.

DOUBLE SERIES LIMITER

Eventually curiosity got the better of me and it was decided to pull out the shunt limiter and instal the latest thing in full wave series limiters complete with threshold control, etc. The components were reefed out and a 6H6 installed on a small bracket attached to the end of the chassis with the socket connections facing the front panel. Since the heater supply was still 12.6 volts and a dropping resistor was needed anyhow to reduce the heater voltage to about 4½v., this was attached to a solder lug bracket clear of the components so that the heat could be dissipated without any sad results.

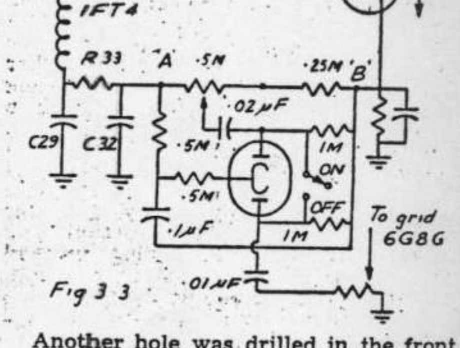


Fig 3 3

Another hole was drilled in the front panel immediately above the "off" etching to take the limiter on-off switch. The threshold control potentiometer went into the hole marked "phones."

(Continued on Page 12)

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EASY WAY TO GET DX CERTIFICATES*

BY "CANDIDUS"

Gone are the days when it took hard work to get real DX. There is now a system so radically different, so wonderfully simple, that the Amateur transmitter finds himself asking, "Why hasn't somebody thought of it before?" But, then, it's been the same with every invention which has been of benefit to humanity. The bright boy who thought of putting a crinkle in hairpins, the unknown genius who invented the water closet—humanity owes them something. And now, radio owes a debt of gratitude to those who have evolved this simple method of getting DX.

This new system works. It has been tried out on the 20 metre band with results that have staggered, indeed rocked, those privileged to hear the system in operation. It has a formula which is even simpler than that of Ohms Law, which, as some radio enthusiasts know, is a very easy formula to master.

The simplified DX Formula is:—

$$\frac{A + B}{C} = DXCC + QSL$$

where A = an Amateur Radio Station in Indo China (or anywhere else).

B = an Amateur Radio Station in Algeria (or anywhere else).

C = An Amateur Radio Station in Australia.

The formula is worked this way—A hears B but very faintly and, an optimist to the last, gives him a call. B does not hear A at all well, but obviously suspects that someone is calling him. C, down under in Australia, hears **both** the boys and, being a big-hearted Aussie, he steps into the breach. He calls them **both**. A then calls C who, in turn, calls B, who goes back to C plus A. C then calls A and gives him all the gen from B. And so it went on.

A couldn't hear B. Neither could B hear A. But they could both hear the enterprising C, who fed each with details about the other.

The naive part of this infernal triangle was that A and B promised not only to QSL C, but to QSL each other! A and B both got cards; but neither had heard a peep out of the other. It opens up a pretty problem which only a legal gentleman could solve, and that could become expensive.

Yet this is a good system. It gets results. I now have a working arrangement with a big-hearted Amateur who lives not far away, and whose transmitter has a kick like two tons of coal dropped from a great height. When I hear some choice DX, all I have to do is to give him a call and he does the rest. I get the cards and he gets the fun. You can't lose!

If this system grows, we might see a special certificate for "VERIFIED IMAGINARY CONTACTS VIA A THIRD STATION." Such an award will be eagerly sought by those who have faith in this new system. There will, of course, be difficulties, especially in the telephony band, but difficulties are but a challenge to the Amateur who has the right spirit.

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* Reprinted from "Break-In," January, 1957, with modifications.

C.D.E.N. NEWS

One of the most heartening pieces of news which emerged from the Federal Convention is the uprise of interest and impetus given Emergency Activity in VK5. A number of Type 122 sets have been released by the Army and pressed into service. Other Divisions are advised to seek from Department of Supply, details of equipment to be released in the near future which would be useful for emergency purposes.

For benefit of members, current list of C.D.E.N. Co-ordinators is set out hereunder:

Federal—G. Glover (VK3AG).
VK2—J. Corbin (VK2YC).
VK3—R. Busch (VK3LS).
VK4—V. Jeffs (VK4VJ).
VK5—J. P. Sullivan (VK5JK).
VK6—H. T. Mulder (VK6MK).
VK7—R. O'May (VK7OM).
VK9—F. Nolan (VK9FN).

Anticipation of an emergency and prewarning of the Control Station and Network generally will often mean the difference between success and failure.

For example, the approach of a storm, flood or fire is, in many cases, preceded in a given area by certain conditions which give due warning. Notifying the Network enables City Amateurs to be alerted ready to maintain watch during business hours; furthermore, it ensures that traffic originating in the City will be received by the Network which has been alerted.

Recently two cases have occurred where communication has been requested to an area in which a state of emergency was in progress and Amateurs in that area have not been listening. In both cases due warning had been given in the area and stations all around the affected area have taken up the relay without achieving results. In one case another Amateur voluntarily drove his mobile equipment fifty miles to the scene to establish vital communications.

The practise adopted by wide-awake members in areas where the fire danger is high is recommended to all Amateurs, that is, a tuner set to emergency calling frequency is fed into i.f. stages of b.c. receiver so that when a station comes up on the frequency the signal is super-imposed upon the XYL's favorite programme. The XYL then follows predetermined procedure to bring the OM into action.

If you have any ideas for suitable transistorised unit for this purpose, send circuit and short story to the Editor of "Amateur Radio" for publication.

The second Communications Study Period at Mount Macedon was attended by the following members of the W.I.A. who represented their respective Divisions:

VK2HO—H. J. Hart.
VK3WJ—George Robertson.
VK4FP—J. F. Pickles, Vice-President.
VK3AG—G. Glover, Federal Executive.

Thanks to the courtesy of the Commandant of the School, your Federal Co-ordinator was able to address all assembled and outline the Institute's past and present activities. He was also able to outline our future proposals and indicate the Amateur's place in the whole scheme.

MODIFYING AR7 RECEIVER

(Continued from Page 5)

The few resistors and capacitors were wired across and around the socket, isolating as far as possible the input and output circuits. Minimum capacitance to earth and complete isolation of input from output leads is the secret of success.

Data issued by the Hallicrafters Company for modifying the noise limiter in the SX28 stresses the need to have the double diode, 6AL5, as close as possible to the detector diodes. All circuits including this type of limiter seem to include a separate 6H6 or 6AL5 as audio detector and a.v.c. rectifier. I suspect that any lack of real success with this type of limiter in the AR7 may be due to the long leads and the use of the diodes in the 6G8G for detection, etc.

It does work but not really as well as it should. If it can be tolerated, leave the limiter in all the time, set the threshold by fixed resistors, mount the 6H6 immediately above the last i.f.t. and get as short leads as possible.

Ground the cathode of the 6G8G and return the grid through the volume control to the a.v.c line as shown in Fig. 3.1 for some fixed bias. Large signals will give higher bias and thus some measure of control over distortion will be achieved.

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OVERSEAS AWARDS

"SHORT WAVE MAGAZINE" AWARDS

Cards, from overseas claimants only, need NOT be sent with the original application, which must, however, include a full check list—band, call sign and date for each station worked—to justify the claim. From the check list, all or any cards may be called in for scrutiny, or details asked for in relation to particular contacts.

In no case can a Certificate be issued without proofs, or evidence considered good and sufficient that the claimed contacts have been confirmed.

From overseas applicants (only) claims duly certified by the headquarters of the Amateur Radio organisation for the country concerned can be accepted. All overseas claims must be accompanied by five I.R.C's.

WORKED ALL GM AWARD

The Aberdeen Amateur Radio Society is now offering the "Worked All GM Award (W.A.G.M.)" to licensed Amateurs able to submit proof of contact since October 1, 1946, with one GM2 station, fifteen GM3, one GM4, one GM5, one GM6 and one GM8. Contacts may be phone or c.w. or mixed, with minimum reports of RS33 or RST338. Cross-band contacts will not be accepted.

Claims for the award, accompanied by the 20 QSL cards and a remittance for 2/6 (or 10 I.R.C's.) should be sent to A. G. Anderson (GM3BCL), "Helford," Pitfoedels, Aberdeen, from whom full details may be obtained.

VA-JF CERTIFICATE

The Richmond (Virginia) Amateur Radio Club is issuing the VA-JF Certificate in connection with the 1957 Jamestown Festival which will be opened in April next to commemorate the 350th Anniversary of the first permanent English Settlement in America in 1607.

To claim the award, Amateurs must submit QSL cards confirming two-way contacts with twenty-five different stations in the Commonwealth of Virginia during the period January 1 to December 31, 1957.

Claims should be addressed to the Richmond Amateur Radio Club, P.O. Box 1985, Richmond 16, Virginia.

Modifying the AR7 Receiver

PART FOUR

BY G. M. BOWEN,* VK5XU

MAKING A 10-METRE COIL BOX

This section will be devoted to the making of a 10 metre band coil box and its alignment procedure. At the time when this coil box was made, the 33 Mc. beacon stations were still operating and as these were a guide for "break-throughs" on 50 Mc., the range was extended to cover this frequency. However, when you decide to tackle the task it is only a matter of altering the ratio of each air condenser to cover whatever you may wish to have.

As it was desired to keep the receiver coil boxes intact, another Band A box was bought and the coils therein removed and put away for r.f. chokes (that's only my Scotch ancestry; you may feel disposed to pitch them into the waste paper basket). Take care when removing the unit that the small bakelite spur, which holds the coil upright, does not get broken for this is exactly the size to support the new coil.

Freq. Range		Bandspread	
Dial Reading	Freq. Mc.	Dial Reading	Freq. Mc.
462	25	224	28.0
340	26	220	28.1
276	27	215	28.2
224	28	210	28.3
175	29	205	28.4
132	30	200	28.5
91	31	195	28.6
53	32	190	28.7
22	33	185	28.8
		180	28.9
		175	29.0

A set of 28 Mc. band coils manufactured by R.C.S. for their multiband unit was purchased and modified for the purpose. As this would be at least seven years ago, these coils may not be available now, so the exact details of each coil will be furnished in the text and by diagram. The location of the connecting wires can make quite a difference to the ultimate performance on this band.

A-band coil box has not a second aid trimmer, so four 21 plate condensers were obtained from disposals and installed into the vacant positions for C2, C4, C6 and C8. If these are not available from any source, it may be possible to obtain small Eddystone trimmers and make up the necessary capacitance with good silvered mica or special ceramic types with zero coefficients. Maximum capacitance range should be about 70 pF.

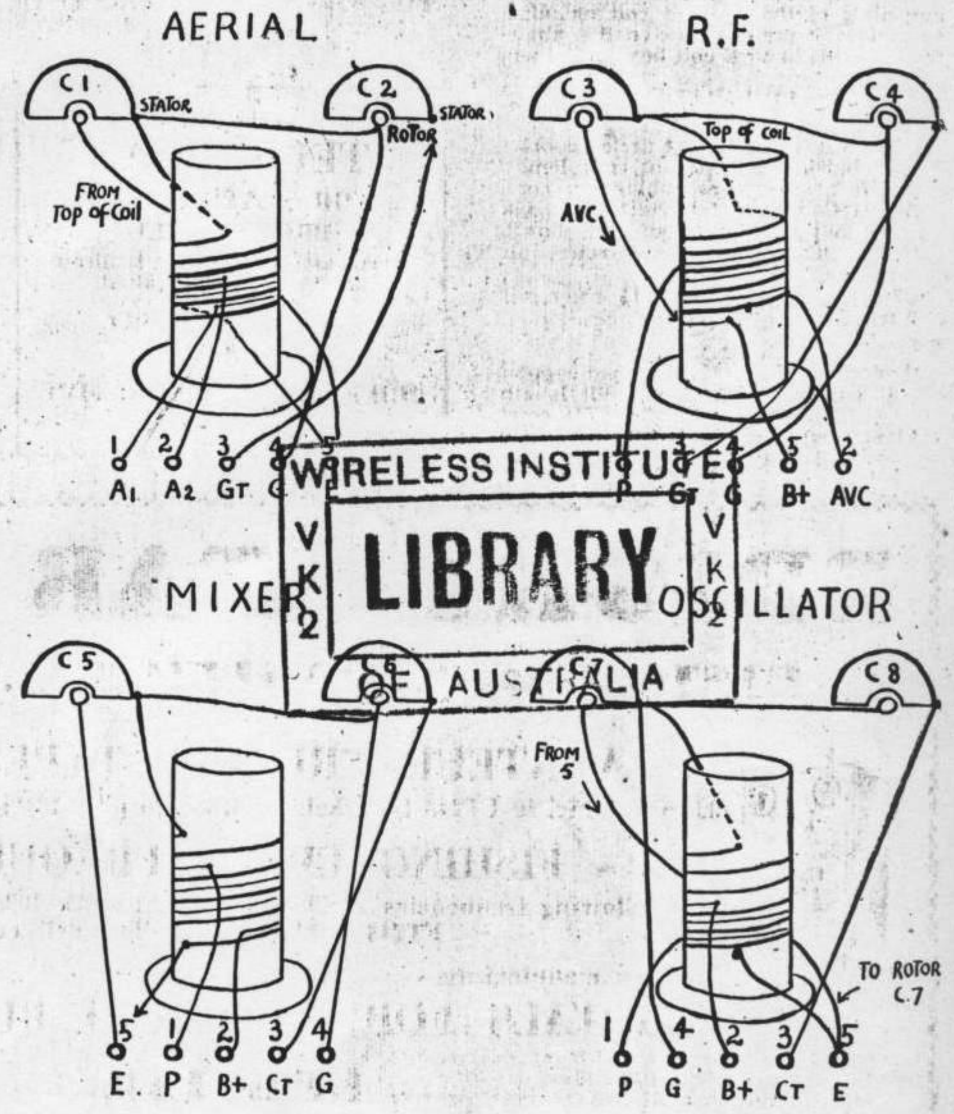
Before mounting the condensers make sure that the rotor contacts are clean and fit tightly, for very slight movements due to vibration can make the alignment a nightmare if there is the least bit of sloppiness. That same warning goes for all the components and rigid mounting of the coil and its associated wiring is of prime importance. Use bare tinned copper wire for all the leads, keeping them well away from each other if not tied to the same point. The primary winding on each coil may be wound with enamel covered wire—make sure that there are no dry joints, that's all!

Do not be tempted to add extra turns to the plate "tickler" winding on the oscillator coil or you may find that suddenly the oscillator will jump frequency as the plate circuit takes control (being usually of a higher Q than the grid coil with its 50K resistor across it for bias).

The diameter given for the grid coils, is taken across the outside of the windings. Some adjustment of the length of the coil may be necessary to obtain the range required, but generally all but major shift can be accommodated by adjusting the two air trimmers.

From the way that the receiver performs on this range, there does not seem to be any point in trying to use iron dust cores. They generally only add mechanical troubles and if R.C.S. and other manufacturers with more design equipment than most of us have at our disposal, still use air core for these higher frequency ranges, then maybe it's a good thing to follow suit.

Spread the turns if necessary or use a short-circuit turn as the National does.



Alignment procedure follows the system used for Band E coil box but with these preliminary steps. The oscillator unit is adjusted to cover the range required either with a modulated oscillator or frequency meter. Unfortunately it is not possible to use a grid-dip meter with these coils for very obvious reasons. Getting the oscillator on the high side of the signal is a little tricky because with the output of the modulated oscillator attached to the grid of the ECH35, there is practically

* 73 Portrush Road, Toorak Gardens, S.A.

no selection of the frequency by the mixer coil.

A good tip is to always swing the mod. oscillator down from the high frequency end until the signal appears and then, continuing on to about 900 Kc. lower, the signal that is wanted should appear.

If the condensers are similar to those described in the text, then the settings given in the coil data will allow a fair setting to start the alignment.

The conversion cannot be hurried, so be prepared to spend quite a lot of time without becoming discouraged. Aligning a new set of coils can take up to four hours—so good luck. When it has been done you will be satisfied.

The next article will have the band-spreading of the E band coil included, so you may prefer to leave the alignment of this band F coil box until then.

COIL DATA

Aerial—

Grid: 5 turns No. 22-24 tinned copper, ½" outside diameter of coil; length 5/16"; polystyrene tubing; air core.

Aerial Coupling: 2 turns No. 40 silk covered and interwound as shown.

C1: 18 plate; 9 stator, 9 rotor, air trimmer.

C2: 21 plate; 10 stator, 11 rotor, air trimmer.

R.F.—

Grid: 5 turns No. 22-24 tinned copper, ½" outside diameter of coil; length 5/16"; polystyrene former; air core.

Plate Coupling: 3½ turns No. 40 silk covered and interwound; air core.

C3: Same as for aerial box; half in mesh.

C4: Same as for aerial box; three-quarters in mesh.

Mixer—

Grid: 5 turns No. 22-24 tinned copper, ½" outside diameter of coil; length 5/16"; polystyrene former; air core.

Plate Coupling: 3½ turns No. 40 silk covered and interwound.

C5: Same as before; half in mesh.

C6: Same as before; seven-eighths in mesh.

Oscillator—

Grid: 5½ turns No. 22-24 tinned copper; ½" outside diameter; slightly longer than 5/16"; spread to obtain correct inductance value; air core.

Plate "Tickler": 2½ turns No. 40 silk covered; interwound as shown, starting below the grid coil.

C7: As before; one-eighth in mesh.

C8: As before; three-quarters in mesh.

N.B.—C1-C8 **do not** correspond to values in the AR7 circuit diagram, but only to this article's diagrams.

D.X.C.C. LISTING

Listed below are the highest twelve members in each section. New members and those whose totals have been amended will also be shown.

PHONE

Call	Cer. No.	C'nt-ries	Call	Cer. No.	C'nt-ries
VK3ATN	26	193	VK3JD ..	1	155
VK4HR ..	12	192	VK4KS ..	9	152
VK4FJ ..	21	192	VK6KW ..	4	150
VK6RU ..	2	188	VK4RW ..	23	147
VK3BZ ..	3	176	VK3LN ..	11	141
VK3EE ..	10	163	VK3JE ..	7	140

C.W.

Call	Cer. No.	C'nt-ries	Call	Cer. No.	C'nt-ries
VK3KB ..	10	225	VK3CX ..	26	210
VK4FJ ..	29	224	VK5BY ..	45	193
VK3BZ ..	6	222	VK2EO ..	2	183
VK4HR ..	8	218	VK3YL ..	39	178
VK3FH ..	15	215	VK4EL ..	9	175
VK3XU ..	48	213	VK6RU ..	18	172

Amendments

VK3JE ..	21	148	VK6RJ ..	42	128

OPEN

Call	Cer. No.	C'nt-ries	Call	Cer. No.	C'nt-ries
VK2ACX	6	239	VK3JE ..	12	210
VK4HR ..	7	233	VK3HG ..	3	201
VK4FJ ..	32	232	VK2NS ..	16	195
VK3BZ ..	4	231	VK4EL ..	10	175
VK3XU ..	61	221	VK6KW ..	13	171
VK6RU ..	8	218	VK2DI ..	2	170

Modifying the AR7 Receiver

PART FIVE

BY G. M. BOWEN,* VK5XU

BAND SPREADING THE BAND E COIL BOX

For this procedure it will be necessary to refer to the previous article Part IV. In that article the coil connections, the placement of the trimmer and series condensers are shown by diagram so that there should be no trouble in identifying the components as they are referred to.

In coil box E the range has been restricted to a 2 : 1 ratio (from 12.5 to 25 Mc.) by including a variable capacitor of about 70 pF. in series with the main tuning gang to obtain electrical bandspread. As a general rule this arrangement does not alter the upper frequency range since the capacity of the series capacitor will be large compared to that of the tuning gang. At the lower frequency end the series capacitor, having the smaller capacitance, will have maximum effect on the frequency, raising it as the capacitance is decreased.

The series capacitor therefore reacts in this coil box in the same way as the padder does in the usual b.c. receiver alignment.

Hence by decreasing this capacitor value the band coverage can be adjusted for any number of degrees. At this stage, if you have not already worked on the 28 Mc. band coil box, you are advised to study carefully the alignment procedure set out in that text.

The 14 Mc. band, fortunately, comes on the higher half of the dial readings and it is not necessary to alter the coils. In some coil units, in order to bring the frequency of 14200 Kc. onto the 250 degree mark, it may be necessary to add a further capacitor across the trimmer. If so, choose a silvered-mica or a zero-coefficient ceramic, or if you really wish to do the job, play around with the correct negative coefficient ceramics in the oscillator section until no temperature change drift occurs. This modification is a worthwhile addition if you have the time—and the patience!—to spend many hours at the game. But remember, you can overdo the size of the capacitor and make the drift reverse, so check carefully against a standard that you know cannot drift—and I don't mean a crystal oscillator either! WWV or Radio Australia, or some equally good standard must be used.

The value of the additional capacitance required will depend upon the amount of bandspread required, and also of course on the type of air trimmers in the coil box for these vary in make and capacity. My AR7 drifts to a lower frequency as it warms up and about 5 Kc. compensation is required at 15 Mc.

In Band E the coils have no slugs, and it is better not to try to include them to lower the frequency. If an aerial trimmer capacitor has not already been included in the modifications it should be done, as described in an earlier article. The exclusion of this control was a bad mistake for it is virtually impossible to align four stages and maintain the same sensitivity over such a wide range of frequency. This is especially so where different antenna systems are used.

ALIGNING PROCEDURE

Centre frequency 14.200 Mc. Start with the oscillator coil L4A. Short out the tuning gangs for aerial, r.f.1 and r.f.2; connect the Modulated Oscillator, or Signal Generator, to the grid of the converter valve with a 500K resistor to ground (having removed the grid cap connection to start with)—Mod. Oscillator on 14.2 Mc. with the crystal filter off, tune in signal which should appear at about 370 degrees.

Alter C8 to a smaller value and to hold the signal, the dial reading will have to be increased, i.e. more capacitance is added by the main tuning gang. Adjust C7 trimmer to return the dial reading to 370 degrees. **N.B.—C8 should be moved a very small amount each time.**

Gradually work back and forth now from C8 to C7 until the required bandspread is obtained, with the dial reading for 14.2 Mc. on 250 degrees. If C7 will no longer bring the upper frequency of 14.4 Mc. onto the dial reading, then open the box and add approximately 50 pF., reducing the capacity of C7 accordingly to approximately a quarter into mesh.

Put the box together again and without touching the dial adjust the trimmer C7 until 14.2 Mc. again appears at 250 degrees.

At this stage, it is a good plan to check that the oscillator is on the high side of the signal by swinging the mod. oscillator to at least 13 Mc. If no signals appear then you are correct.

Continue this jiggling process of C8 versus C7 until the coverage is approximately 200 degrees of bandspread for the 400 Kc. For general band coverage this seems to be adequate but if you are a c.w. man, then go the limit, for the low frequency end is the one which is most affected by this type of band-spreading system.

So much for the oscillator coil box. Remove each of the others and modify them to correspond approximately to the oscillator box. **Note carefully that the stud numbers are in a different sequence for each box, so refer to Part IV.**

The settings for C1 to C6 inclusive should be approximately that for C7 and C8. Fit the coil boxes together and the unit should be ready for aligning. **Don't touch the oscillator section.**

In coil box E the series capacitors are adjusted first, at the low frequency end of the range with the trimmers C1, C3 and C5 receiving second preference at the high end.

Set the mod. oscillator output to maximum and after removing all the shorting devices from the tuning gang, proceed to the usual two spot alignment process.

Mod. oscillator on 14.0 Mc.; adjust C6, C4 and C2 for maximum signal after picking up signal with main tuning; across to 14.4 Mc. and adjust C5, C3 and C1 (note the order of working towards the antenna input with the mod. oscillator output, from the r.f.2 box); back to 14.0 Mc. and so on gradually decreasing the signal from the mod. oscillator (see Part IV.).

Final adjustment of the capacitors should be made with the antenna noise input only.

If after a couple of weeks you have not succeeded with this modification, you won't need the receiver for you will have given Amateur Radio away together with the hair you have torn out!

So, good luck!

Next part will be on crystal filters and the AR7 filter in particular, so until then, I'm back to the pick and shovel.

* 73 Portrush Road, Toorak Gardens, S.A.

COLUMBUS MARATHON CONTEST

To commemorate the famous voyage by Christopher Columbus, during which he discovered the American Continent, the Istituto Colombiano of Genoa is inaugurating an annual contest for Radio Amateurs. A gold medal and a certificate will be awarded to the Italian Radio Amateur who in the 70 days preceding 12th October of each year, establishes contact with the greatest number of Amateur Radio Stations outside Italy. A second gold medal and a certificate will be awarded to the non-Italian Amateur who contacts during the same period the greatest number of Italian stations including those in Trieste, Sicily and Sardinia. Briefly the rules of the Contest are as follows:

Licensed Amateurs in all parts of the world may participate. Foreign Amateurs are to work as many stations as possible in Italian territory.

For the purposes of the contest the frequency bands on which valid contacts can be made are divided into three groups: Group A includes the 3.5, 7, 14, 21 and 28 Mc. bands. Group B the 144 Mc. band, and Group C the 420 Mc. band. The Contest starts at 0001 hours G.M.T. on 3rd August and ends at 2359 hours on 12th October of each year.

Any two-way contact between an Italian station and one outside Italian territory will count. Signal report must be exchanged using the RS(M) 33 (5) for telephony, and RST 338 for telegraphy. Each valid contact on the bands 3.5 up to and including 28 Mc. (Group A) will score one points. Contact on 144 Mc. will score two points, and on 420 Mc. four pts.

Candidates for the awards must forward to the promoting Committee before 31st July of the following year a claim indicating the score obtained in the contest. The committee, on the basis of the claims submitted, will request the Radio Amateurs with the highest score to send an extract from the station log giving the following information: Date, hour G.M.T., frequency band, type of emission, power input to the p.a. of the tx, call sign of the station worked, signal report transmitted, report received, points claimed. The extracts from the station logs must be certified as true copies of the logs by two licensed Radio Amateurs of the same country as the claimant

In the event of a tie in the scoring, the winner will be the station using the lower power in transmission. Judging: the decision of the Judging Committee is final. The address of the promoting committee is: Civico Istituto Colombiano, Premio Radioamatori Columbus Marathon, Palazzo Tursi, Genoa, Italy.

Modifications to the AR7

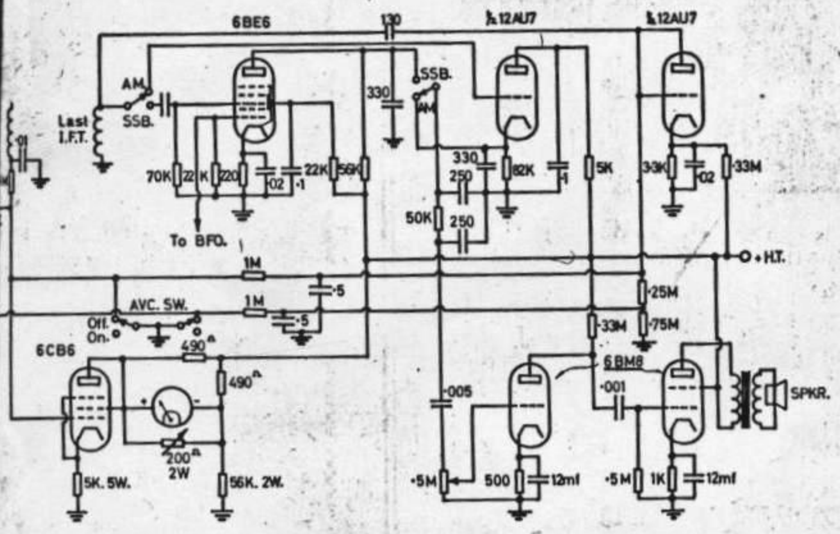
H. A. BEHENNA,* VK5BB

S wanting a second receiver, one that lent itself kindly to riments, I was fortunate to AR7 fairly cheaply. Not alter the original receiver, interest mounting toward looked the answer to it all. , much modified on purchase, , but on being switched on nly a doubtful quantity. e aid of the scope iron all ved back to the second r.f. ting with the converter, this

Should you have one of these receivers or any other type that can be bandspread, then I urge you to try this out, especially if your main receiver has no product detector. You will be surprised and mighty happy. When someone on s.s.b. calls you, you will know just what they are saying.

I have left the b.f.o. circuit out of the diagram, you can suit yourself here.

Please yourself on tube types, because the ones I used I had in the drawer.



ged to a 6AE8, being slightly an the 6K8. Next, a strip of al chassis was removed, which y held the i.f. sockets, etc., and iece of aluminium holding the f. (12AU7) and the 6BE6 was l over the hole caused by the p, being removed.

able socket was placed in the power input hole to take the m the power supply which was terior.

U7s were changed to EF39s, the r.f. and i.f. stages, and the wired. The 6BE6 acting as duct detector, half the 12AU7 infinite impedance detector, the alf as the a.v.c. amplifier. The a triode and S meter tube and io driver and output a 6BM8. ll find plenty of space left to the 6C4 b.f.o.

switching on I found it worked and apart from the odd dry etc., and adjustment of the S we were in business.

I say it worked, I must admit nsiderable time was spent on duct detector input voltages, to s.s.b. sounding right. Having nd receiver, I decided to go for ndspread, so very helpful with eption of sideband.

not use an antenna trimmer of the very narrow tuning

s.s.b.-a.m. switch is located in se-limiter hole.

Individual circuitry for each stage is standard and can be found in most issues of any good handbook.

Oscillator and b.f.o. are fed from voltage control tube, and a noise limiter is to be added later. ●

*ley St., Crystal Brook, South Australia.

☆

OPTIMISM

There is a peculiarity of man's mental make-up which makes him very prone to give himself the benefit of the doubt, when something he wants to do is in question. The fish that got away is always the largest, the 90 miles per hour might just as easily be due to a rather favourable speedometer as to the actual performance, and so on.

Short wave reception is something like that. Everybody at some time or another, who has listened in on short wave has heard a distant station at good strength. He has been thrilled to the teeth over an unexpected purple patch which he struck at 2 a.m. when all sane people were in bed and snoring. He has emerged triumphant, after an hour's frenzied listening, with the call sign of an elusive foreigner.

Next time you meet him, he is full of the tale—how he received the particular station at full speaker strength, loud enough to wake the house, and the quality! Just like a local.

What he means, of course, is that he brought in some static, a fair amount of fading, and so on, but undeniably he did bring in the station. He badly wanted it to be equal in every way to a local, and his natural enthusiasm brought him very near to his objective. This was not deception—it was merely a little optimism.

There is no harm in it at all, except for the dis-service it is apt to render, S.w.l'ing as a whole.

When QSL'ing, always send an honest report, as much detail as possible, be brief and to the point. It is as easy as that.

—Chas. Abernethy, L2211.

MORSE CODE PRACTICE

The New South Wales Division of the Wireless Institute of Australia provide a comprehensive service for Morse practice. Apart from the nightly Morse Practice Sessions on (approx.) 3550 kc. commencing at 7.30 p.m. E.A.S.T. at 5 w.p.m. and finishing at 8.15 p.m. at 16 w.p.m., there is the Morse Tape Service, which has proved very helpful to those who own or have access to a Tape Recorder. Since the C.w. Tape Service was started early in 1963, 580 hours of Morse on Tape has been sent out to interested parties. Figures at the end of last month were—

New South Wales	284	hours
Victoria	115	"
Queensland	81	"
South Australia	27	"
Western Australia	16	"
Tasmania	10	"
A.C.T.	17	"
New Guinea	30	"
Total hours of Morse Distributed	580	

Included in this total is 199 hours copied on to "Customer's Own Tapes". The majority of it on to 3-inch reels recorded at 1⅞ i.p.s. Radio Clubs find it better to own and keep their own tapes. Now Morse has been discontinued in the Post Office, chaps are finding it difficult to obtain Morse practice.

The Morse Tapes are on 5-inch reels (1,200 feet) and the recordings have been made at 3¾ i.p.s. Two hours of Morse are on each reel. The Service is free to anyone wishing to learn Morse. Each user is asked for 1/6 per tape to cover "out of pocket expenses".

To obtain a tape application should be made to the Education Officer, VK2 Division, Wireless Institute Centre, 14 Atchison Street, Crows Nest, N.S.W.

The following tapes are available:—

- Special Tape for "Raw Beginners," Letters and Figures with comments.
- No. 1—One hour at 5 w.p.m., plus one hour at 6 w.p.m.
- No. 2—One hour at 7 w.p.m., plus one hour at 8 w.p.m.
- No. 3—One hour at 10 w.p.m., plus one hour at 11 w.p.m.
- No. 4—One hour at 12 w.p.m., plus one hour at 14 w.p.m.
- No. 5—One hour at 15 w.p.m., plus one hour at 16 w.p.m.

CHANGE OF ADDRESS

W.I.A. members are requested to promptly notify any change of address to their Divisional Secretary, not direct to "Amateur Radio."

Modifying the AR7 for S.S.B.

A. S. MATHER, VK2JZ*

THE modifications to be described will make the AR7 an almost ideal s.s.b. receiver and it will rival for Amateur-band operation the many excellent commercial receivers that are finding their way into Australian Amateur Stations, with the exception of the dial calibration. But even that could be remedied as will be discussed in the course of the article.

Although this article deals with the AR7, most of the modifications could be applied to any commercial receiver of a similar vintage.

It will be noted that it still leaves the AR7 with its normal coverage, as a communications receiver should it be desired; but for the Amateur bands, it should be used in conjunction with a crystal locked converter, so only 3.5 Mc. to 4 Mc. is tuned for optimum results.

Rather than attempt to show each modification separately, I thought it would serve the best purpose if the complete new circuit diagram was shown so it could be compared with the unmodified circuit and it will be obvious that there is very little left of the original.

The modifications will be dealt with under separate headings, any of which will improve the performance of the set either for a.m., c.w. or s.s.b.

TUBE COMPLEMENT

It is assumed that the filament wiring of the set has been altered to allow parallel operation of all filaments on 6.3v. a.c.

The 6U7Gs were replaced with EF39s and the 6K8G with an ECH33. The 6G8G second detector is removed and the socket is used for the 6SN7 audio a.g.c. tube. To this is added a 6BU8 product detector, a 150C1 voltage regulator, a 6BH6 100 Kc. marker oscillator, 6H6 noise limiter, and a 12AU7A a.g.c. rectifier and a.m. audio amplifier.

CAPACITORS

As there is a considerable amount of work to be done under the chassis, it is important that you remove all the original paper condensers and replace them with the newer, more efficient and smaller polyester types. The space gained will greatly facilitate the work of modifying the AR7, and although the originals may test satisfactorily, they have to be discarded. This applies to the 8 μF. and 25 μF. tubulars which can be replaced with advantage with the latest miniature types.

BANDSPREAD

A slow tuning rate is most important for s.s.b. and a crystal locked converter is used to hetrodyne 28, 21, 14 and 7 Mc. to 3.5 Mc. A Band C coil box is modified to tune from 3.5 Mc. to 4 Mc. over the full range of the tuning dial. This takes care of 21, 14 and 7 Mc. and the first 500 Kc. of the 28 Mc. band.

* "Wolarol," 14 William St., Singleton, N.S.W.

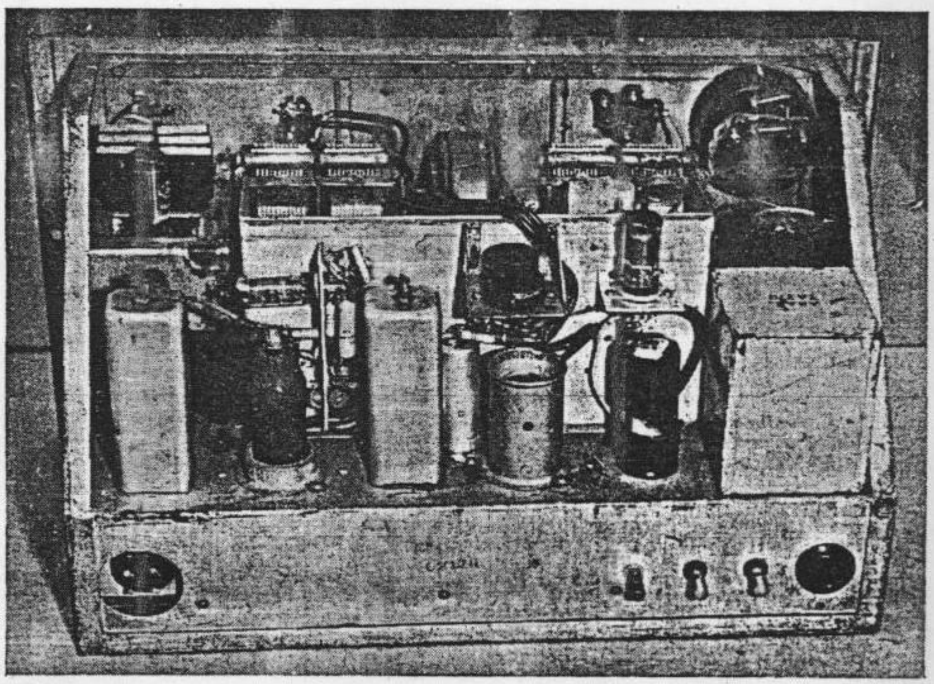
Rather than have less bandspread, I thought it better to settle for 3.5 Mc. to 4.0 Mc. tuning and use the original Band C coil box if necessary to tune all the 28 Mc. and 29 Mc. band if necessary.

AR7 coil boxes were very plentiful from disposals so a Band C box was modified by cannibalising another box for the series trimmers. The coils are not touched and only the trimmers were added in series with the coils and the original parallel trimmers and the 420 pF. ganged condensers as shown. It will be noted that no padder condensers are used in the oscillator section.

A 50 pF. trimmer was fitted to the hole formerly occupied by the tone control and wired across the aerial tuning gang to peak the antenna coil on weak signals.

We now have electrical bandspread which will greatly help in tuning s.s.b. This can be further improved by the addition of a manual vernier. Mine was designed and presented to me by John VK2AKB and used a ½" diam. rubber wheel to engage when wanted the edge of the AR7 tuning dial and turned by a 1" metal knob.

The bandspread is, however, so good that I find that the extra vernier control is seldom used.



Rear view of Modified AR7. Xtal filter and V11 will be seen at top left. Components along rear of chassis are (left to right): IFT3, V5 (with shield removed), IFT4, V6, V8, V13 and output transformer. Mounted on brackets are V10 (above V5), V9 (above V6 and V8) and V7 (above V13).

The slug, series trimmer and parallel trimmer in the oscillator section are first adjusted to spread the oscillator tuning as evenly as possible between the 450 and 50 markings on the tuning dial.

Linear bandspread is not possible with this system and the best I could do was:

450	dial mark —	3.5 Mc.
310	" "	3.6 "
230	" "	3.7 "
160	" "	3.8 "
100	" "	3.9 "
50	" "	4.0 "

The 100 Kc. marker makes these adjustments easy and the 2nd r.f., 1st r.f. and aerial coil were then aligned to the new frequency coverage.

It is at this point that the reader's ingenuity could improve the performance of the AR7 as it was an intriguing thought that perhaps the dial could be made to count in the opposite direction. That is when the dial turned in an anti-clockwise direction which increases the frequency, the dial readings would also increase.

Therefore, if one was patient and with a more linear method of bandspread, each division could be made to equal 1 Kc. on the dial.

To read the frequency on any band (7 Mc. excepted in my case) the dial reading would be the band frequency plus the dial reading as the receiver tunes 3.5 Mc. to 4.0 Mc., 500 Kc.

Then, of course, it would be possible to fit a modern type dial and calibrate each band directly on it. I would certainly like to hear from anyone who has progressed along these lines. So much for that.

CRYSTAL FILTER

We now come to the half lattice crystal filter. This subject has been covered many times in "A.R.," "QST," "CQ," etc., and will only be dealt with in a general way in this article.

I use a channel 46 (455.5 Kc.) and a channel 47 (457.407 Kc.) crystal in the series mode of a half lattice configuration between the mixer and the 1st i.f. valve.

Although channel 44, 45, 48 and 49 crystals are shown shunted across the output of IFT1, I found that they had very little effect on improving the bandpass characteristic of the filter, but I left them in.

It would, of course, only be necessary to use any two adjacent channel crystals that are within the tuning range of the IFT's and the mixer oscillator frequency adjusted accordingly. Now I will stick my neck out and say I don't know how anyone manages to adjust such a filter as this without a wobbulator and c.r.o. No doubt some sort of results are possible using a frequency meter and output meter, but this is tedious, time consuming and the results at best a compromise.

The small effort required to build up a simple wobbulator will repay you with a classic bandpass curve approx. 3 Kc. wide with the maximum dip between peaks and very steep sides, 60 db. down and no secondary lobes.

With such a set up, you can immediately see where you are going and adjustment of IFT1, IFT2, IFT3 and IFT4 will quickly give you the required bandpass characteristic. This all sounds delightfully simple and it really is.

The original crystal holder and phasing condenser are removed and the 150C1 V/R and six FT241 sockets are installed on the metal cover above IFT1 and IFT2 as shown.

This filter will increase the i.f. gain so all leads must be kept as short as possible to avoid any instability, and shield the leads from IFT1 to the crystal sockets and from the crystal sockets to the grid of the first i.f. tube.

THE PRODUCT DETECTOR

The 6BU8 product detector is fitted between IFT4 and the 6SN7 a.g.c. socket (originally the 6G8G socket). The original circuit was first described in "CQ"[1] and later in "A.R."[2] When used as shown, the output is such that the first audio stage can be eliminated and the 6V6G can be driven directly from the transformer secondary, a step up of 1.3. The 6BU8 only requires about 3 volts r.f. drive, and as the b.f.o. injection voltage is normally taken from a tap near the cold end of the 6C8G b.f.o. coil, it is not sufficient. By removing the 0.05 μF. by-pass condenser at the plate of the 6C8G and feeding the control grid of the 6BU8 through a 0.001 μF. condenser from the 6C8G plate, approximately 4 volts of r.f. is obtainable.

[1] "A New Product Detector," "CQ," August 1959.

[2] Sideband Notes, "A.R.," April 1962.

Remove the connection from the a.g.c. line to the b.f.o. switch so when the b.f.o. is turned on, the a.g.c. line is not shorted to ground.

It is well to remember here that if you do not have sufficient b.f.o. injection voltage (the re-inserted carrier) then strong s.s.b. signals will cause overmodulation and the r.f. gain will have to be reduced with resultant loss of output to the audio stage.

The 6BU8 will, however, handle extremely strong signals before overload and easily out-performs all the other product detector tubes that I have tried.

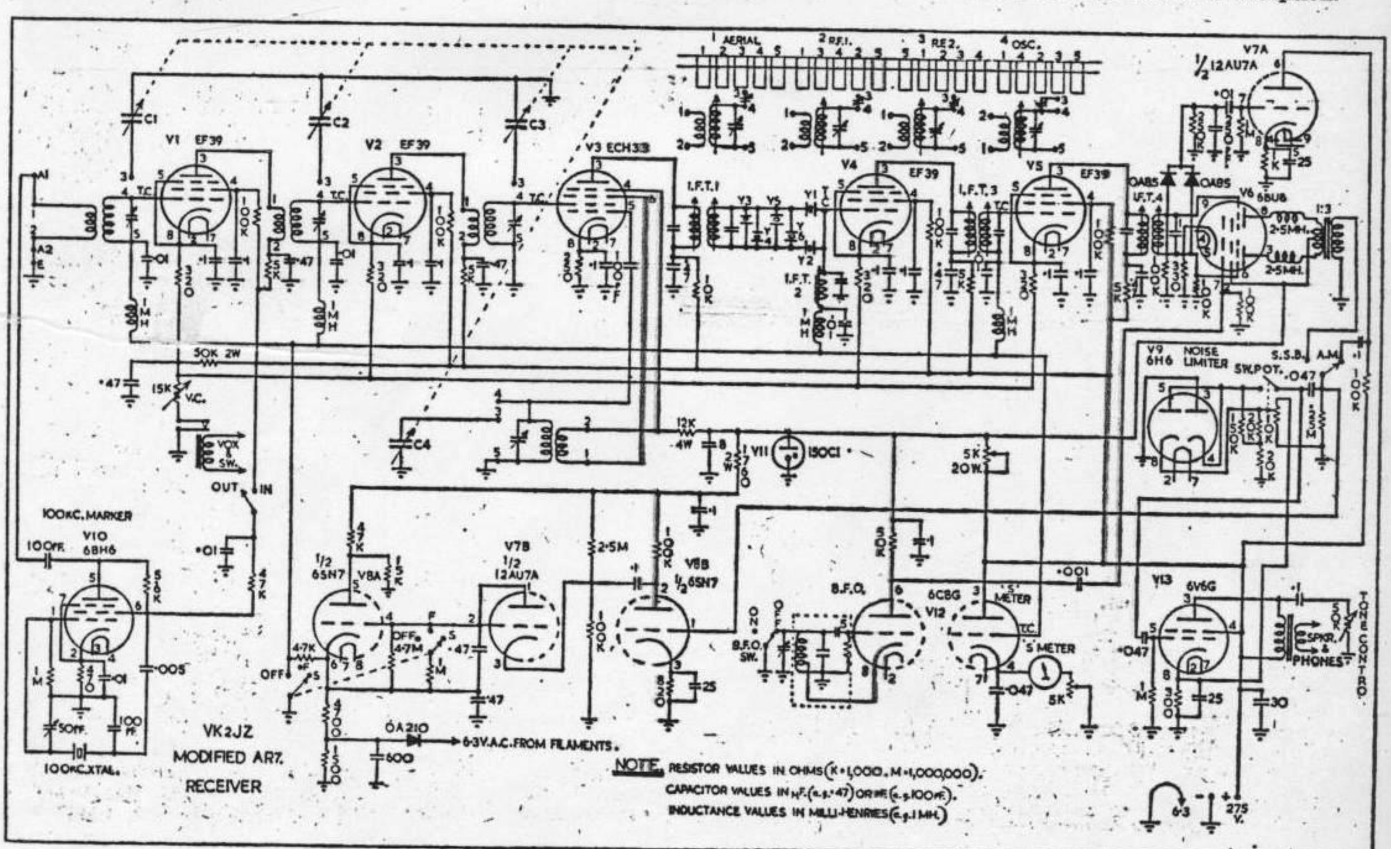
The output of the product detector is fed to one side of the s.p.d.t. rotary wafer switch fitted to the hole vacated by the phasing condenser.

The other side is connected to the output of the a.m. detector so this becomes the a.m.-s.s.b. switch.

A.M. DETECTOR AND AMPLIFIER

My receiver is used almost exclusively on s.s.b., but is capable of resolving quite easily any reasonable a.m. signal, DX or otherwise, in what is known as exalted a.m. reception, with the b.f.o. on.

The r.f. gain can be advanced and the 6BU8 makes quite a good a.m. detector without benefit of the b.f.o. as the tube apparently works in the form of a plate detector. However, I had a spare hole to be filled in and as greater signal handling ability with less distortion is obtainable from a diode detector, it was decided to install a diode rectifier for a.m. reception.



As the input to the 6BU8 is balanced and the secondary of IFT4 was already loaded with two 100K resistors to earth, a full wave rectifier using two OA85s was also connected across IFT4. The rectified output across a 250K resistor by-passed with a 250 pF. condenser is fed to one half of V7A to bring the a.m. output to approximately the s.s.b. output of the 6BU8, and fed to the a.m.-s.s.b. switch as previously stated. As no a.g.c. voltage is taken from the am. detector, it is unimportant whether the rectified voltage is positive or negative.

AUDIO A.G.C.

The audio driven a.g.c. circuit was described in "QST"[3] and readers would do well to consult the original article as I will only deal with its operation briefly.

A 6SN7 and half of V7 are used to give fast or slow a.g.c. controlled by a two-pole, three-position rotary switch mounted in the hole formally used for the selectivity pot. This switch selects a.g.c., off, fast and slow. The 7.5 volts negative bias needed for the a.g.c. operation is obtained from the filament voltage by means of a OA210 silicon diode, 600 µF. capacitor and a 1,500 ohm bleeder. The operation of the audio driven a.g.c. is as follows. V8B is an audio amplifier and when the delay voltage established at the cathode of V7B is exceeded V7B conducts and the 0.5 µF. condenser in the plate circuit is rapidly charged.

The negatively charged end of this condenser is connected to the grid of V8A and as the cathode current of V8B decreases, the cathode voltage goes instantly to ground and so will the a.g.c. line. If sufficient audio voltage is available, the a.g.c. line will drop to —7.5 volts.

By paralleling a 1 meg. resistor across the 4.7 meg. resistor between grid and plate of V8B, fast a.g.c. is obtained in the middle position of the a.g.c. switch.

In the first or "off" position the a.g.c. voltage is grounded through the 4.7K resistor. The 100K and 0.05 µF. RC combination in the cold end of the grid circuits of the controlled tubes are replaced with 1 mH. R.F.C.'s and 0.01 µF. condensers to reduce the time constant and obtain full advantage of this system. We have now covered the four most important modifications, so now we will adopt a more orderly approach and return to the front end.

R.F. AND I.F. STAGES

In the original circuit the cathode resistor of the 1st r.f. tube is taken straight to ground. This is now paralleled to the cold end of the other controlled stages and grounded through a 15K pot. The extra variable resistance in conjunction with the positive voltage applied via the 50K resistor gives better control on strong signals than the original 5K pot.

The ground connection between the 15K pot is made by a relay by the vox system or a key switch for manual operation.

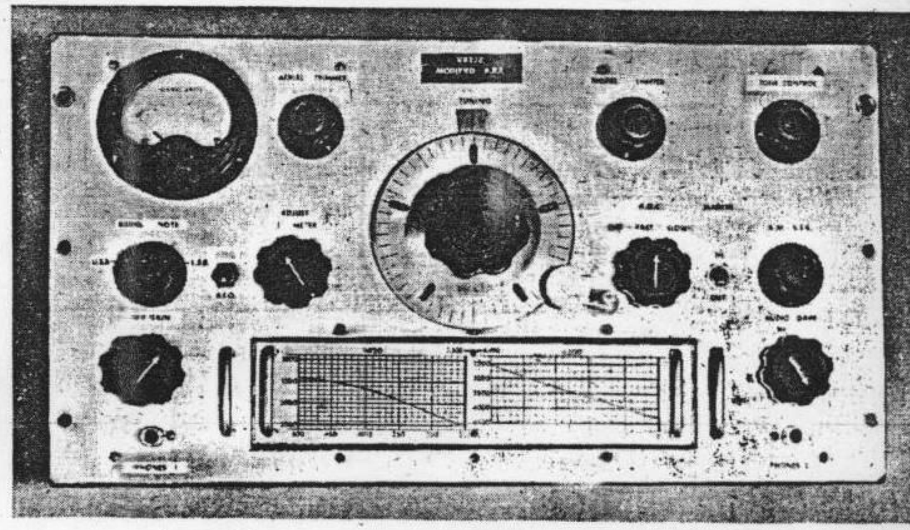
The cathode resistors were altered to 330 ohms and 100K series screen resistors were used to conform to the manufacturer's published data.

Series screen grid supply is recommended because it gives a better signal handling ability to distortion ratio. It can be seen that in the in-operative position the four EF39s only are not conducting and the rest of the set draws normal tube currents.

MIXER

The mixer circuitry has not been greatly modified, a ceramic trimmer and series trimmer were used in the oscillator section of the coil box to improve the stability. Also, the 100 pF. oscillator coupling capacitor was replaced with negative co-efficient disc ceramic and a 3 pF. negative co-efficient capacitor placed across the oscillator trimmer in the coil box.

The ECH33 oscillator plate and screen are fed through four paralleled 47K 1 watt resistors from the regulated 150 volt supply to give 100 volts.



Modified Front Panel of the AR7.

REGULATED SUPPLY

The 150C1 is adjusted to draw 15 mA. through a 5K 20 watt variable wire wound resistor and the regulated voltage is applied to 6BU8 plate and screen, ECH33 plate and screen grid, and b.f.o. plate.

CALIBRATION OSCILLATOR

The crystal calibrator tube and the 10X socket are mounted horizontally between IFT3 and IFT4, as can be seen in the photograph.

The original crystal toggle switch is used to supply h.t. to the 6BH6 in the "up" or "in" position. The output is run through shielded cable and coupled to the aerial terminal through a 100 pF. condenser. The variable trimmer is used in conjunction with WWV to bring the oscillator right on frequency.

Another coil box which will tune one of the receivable WWV frequencies or a separate receiver will have to be used as the modified Band C box and crystal locked converter will not do this.

NOISE LIMITER

I think that at best, noise limiters are a compromise as I have never had a really satisfactory one. When the ratio of the noise is large in relation to the signal, then most limiters will function satisfactorily, but the trouble arises when the signal is only a little way down below the noise. Any clipping or limiting, then affects the signal to the same extent as the noise.

As i.f. limiting upsets the bandpass curve of crystal filters, audio limiting had to be used.

I use a circuit previously described in "A.R."[4] which limits the positive and negative audio peaks. The original article did not show a grid leak on the 6V6 which is necessary, and I use a 10K s.w. pot across to the 6V6 bias, to obtain the threshold voltage and to switch the limiter out when unwanted.

TUNING

You will find that with the bandspread now available, the b.f.o. can be set in the optimum position for upper or lower sideband reception; and all tuning done with the main tuning control.

Once the optimum position for the b.f.o. control has been determined, it can be designated u.s.b. and l.s.b. and then left in either position for reception of the appropriate sideband.

TONE CONTROL

As I still had a hole left over, I used it to re-instal the original tone control of the AR7. I never use it, I doubt if anyone will, so leave it out if you have not drilled the extra hole in the top right hand corner of the panel as I had for a previous modification.

VENTILATION

As five additional tubes have been added, which means extra heat dissipation, the cabinet was drilled to take the small eyelets used on ladies' belts, 112 on the top and 64 on the back.

CONCLUSION

Of necessity, I have only given very brief outlines of the modifications, but

(Continued on Page 16)

[3] "Improved Audio Driven A.g.c. Circuit," "QST," September 1960.

[4] "Painless Noise Limiting for 13/6," "A.R.," August 1959.

C.C. CONVERTER FOR 576 Mc.

(Continued from Page 13)

OPERATING CONDITIONS

6BL8 oscillator: 100 v. at 5 mA.
6BL8 doubler: 185 v. at 5.5 mA.
12AT7 doubler: 220 v. at 5 mA.
12AT7 tripler: 220 v. at 4.5 mA.
6J6 doubler: 65 v. at 3 mA.
6C4 cathode follower: 230 v. at 4.5 mA.
6CW4 mixer: 65 v. at 3 mA.
EC88 r.f. amplifier(s): 160 v. at 12.5 mA. each.
Total current drain (excluding EC88s) 35 mA. at 230 v.

PERFORMANCE

No accurate test equipment was available for checking the performance of the converter, however an approximate measurement indicates a noise figure of about 10 db. At the time of writing, an r.f. amplifier using a special low noise u.h.f. tube is under construction and this should bring the noise figure down to 5 db. A description of this amplifier should follow soon.

Activity on 576 Mc. is very limited and as a result, literature on this band is very scarce. The author would welcome any correspondence regarding this and other u.h.f. bands.

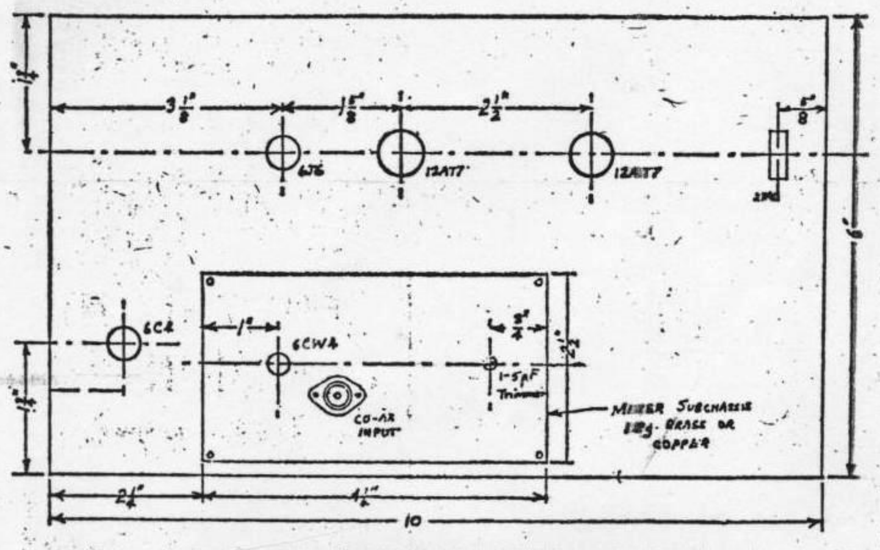


Fig. 4.—Converter Layout. Chassis: 18 gauge aluminium, 10 x 6 x 2½ inches.

HINTS AND KINKS

PRINTED CIRCUITS—COMPONENT REMOVAL

Removal of components from printed circuit boards can be simplified by the use of the following equipment. Furthermore, heat damage to diodes and transistors can be kept to a minimum by this method.

Procedure: Use a vacuum cleaner fitted with a suitable length of strong walled p.v.c. tubing (or brewer's hose) of about 15-20 mm. diameter connected to the suction side of the cleaner.

Suitably fit into the working end of the larger diameter p.v.c. tubing, a short length of 3-4 mm. teflon tubing (about 1 inch length is ample).

Apply a hot soldering iron to the area of printed circuits until solder melts freely, then suck away the molten solder. Solder shall be completely removed, leaving the pigtails and the feed-through holes clear, giving easy access to bend pigtail for component removal.

Where suspect transistors are removed for testing, continued application of suction has a cooli[illegible] affect on the pigtail.

The 15-20 mm. tubing should not be longer than that to give convenient use of the vacuum cleaner on the workshop bench. The 1 inch length of 3-4 mm. teflon tubing is specified for two reasons:—

(1) To keep the suction pressure up.
(2) When solder is sucked up, it will set and lodge in a long length. It is a good practice to clean out the tubing (the 1 inch length) after each clean up of a solder point.

Caution! Teflon (tetrafluoretylenpolymere) will give off slight gasses above 250-275°C., which under prolonger dosage can be fatal.

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AMENDMENTS TO R.D. CONTEST RULES

Rule 2: Members and non-members of the W.I.A. will be eligible for the awards.

Rule 14: Northern Territory and A.C.T. will both count as separate call areas for award purposes only.

☆

ACKNOWLEDGMENT

It is regretted that credit was omitted from the article "Profile of VK3ZEB" published in the last issue. We are indebted to N. Town, VK3ANK for providing this article.

PORTABLE BATTERY CHARGER

(Continued from Page 7)

could be operated to more than full brilliance, while a charging rate of 2 amps was being maintained through the battery.

CHECKING "SLIP" ON THE COUPLING UNIT

This was done by using a small neon lamp as a "strobe-light." Only one lead was used. This was connected to the spark plug, the other was insulated. (See Fig. 3.) When the engine is running at full load, hold the neon near the coupling unit. If there is no "slip," the coupling will appear to be stationary. This test should be carried out in darkness for convincing results.

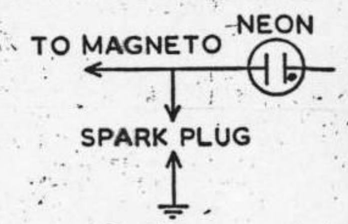


Fig. 3.

NOISE SUPPRESSION

No attempt was made to regulate the voltage or provide any means of filtering. Likewise ignition suppression was not incorporated, but may be considered according to requirements. The complete motor-generator was mounted on a Holden muffler, which provided a rigid base and a good means of silencing the exhaust. To remove condensation from the silencer, a drain plug was fitted at its lowest point.

USE

The prototype was tested over a period of two weeks in December 1962, when it gave a reliable performance with adequate charging and lighting facilities in a mobile marine station. The unit is continuing to prove invaluable, when operating a portable station in areas where electric supply is unavailable.

☆

MODIFYING AR7 FOR S.S.B.

(Continued from Page 11)

those who tackle the job should have no trouble doing them their own way.

It should be obvious that extensive use of plastic covered shielded wire will have to be made, especially to the various controls.

I trust that you have been interested in the modifications to the AR7. You will no doubt be able to criticise or improve many of them, and I would like to hear from others who have carried out modifications.

An extra triode, for instance, could be made available by replacing the 6V6G with a 6BM8 or similar output triode-pentode. However, these modifications will do two things for sure. Give you a really hot s.s.b. receiver which is a pleasure to operate, and teach you a little more about s.s.b. receiver techniques whilst you are carrying them out.

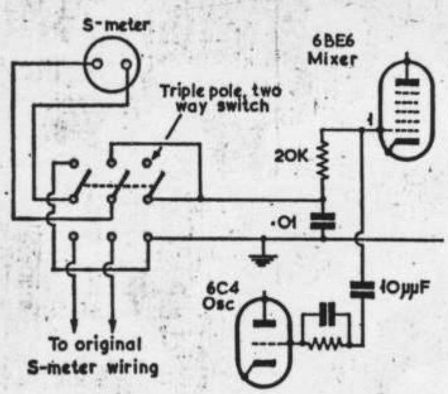
Determining Mixer Current*

FOR BETTER RECEIVER PERFORMANCE

S. E. JANES, G2FWA

VERY few of us can be sure that our receiver mixer stage is functioning for optimum performance. It is customary to inject the oscillator output into the mixer valve by one of several methods, after which one hopes for the best—but there is really no standard of comparison. If the oscillator output is low the result may be poor front-end performance. On the other hand, excessive injection will give a high noise-level and possible unexplained "birdies". In addition, it may also be responsible for t.v.i. caused by the receiver tuning.

The construction of a 21 Mc. bandspread coil for an HRO receiver first raised the problem of knowing what the oscillator output voltage should be and its relation to the positioning of the cathode tap. Then the up-dating of this HRO by means of modern valves brought to light an interesting table which is repeated in each A.R.R.L. Radio Amateur's Handbook; in the 1961 edition, for example, it is on page 95. This shows the recommended operating voltages for several modern mixer valves, with a column giving the various grid currents for optimum performance. This latter point appears to be generally overlooked not only in receiver construction but also in other applications, such as the mixer in s.s.b. transmitters.



Mention should be made concerning the method of bias for the mixer valve. If this is obtained solely by means of a grid resistor, then the injection voltage is not so critical **providing it is adequate.** It should be made optimum, however, if maximum signal-to-noise ratio is desired. If cathode bias is used the injection voltage is somewhat more critical, while fixed bias on the injection grid makes the whole arrangement quite critical.

The original mixer in the HRO required 45 volts for screen grid injection, but only 10 volts is necessary for the 6BE6 used in the re-valved HRO. This requirement is satisfied by an injector grid current of 0.5 mA. through a 20K resistor. The separate oscillator valve in this case is a 6C4, in the circuit which has become the accepted standard for modernising the old HRO types.

It was found that the range of HRO coils showed a grid current variation in excess of 5 : 1. For example, the 14 Mc. bandspread coil produced grid current off the scale of a 1 mA. meter! This was reduced to the correct 0.5 mA. by lowering the cathode tap by one turn in the direction of the grounded end. With some coils, it may be found difficult to re-set the oscillator cathode tap, but any effort will be well rewarded. In particular, the construction of a good 21 Mc. bandspread coil will be facilitated by this check for finding the correct position for the tap.

If it is desired to have a permanent means of checking the mixer operation use may be made of any existing S meter. In the case of an HRO, this is a 1 mA. movement and it seems logical to take advantage of its presence. The diagram shows a method of switching the meter to perform the two functions. This refinement becomes a simple and direct method of reading the mixer grid current, and it is very satisfying to have this check on receiver performance. It must be remembered, however, that d.c continuity to ground must be maintained for the injector grid of the 6BE6 and the switching as shown satisfies this condition. It is **not** necessary to close the S meter leads when measuring grid current, as the original switching for this function simply open-circuits the leads to the S meter when not required. ●

* Reprinted from "The Short Wave Magazine," February, 1963.

☆

Further Notes on Modifying AR7 for S.s.b.

The author of this article (appeared last issue "A.R.") has sent along the following three points:—

On page 9 (bottom of column 1) maximum dip should of course be minimum dip.

The secondary of IFT1 is balanced to ground as in the original circuit of the AR7. (The condensers are inside the can.)

VK4DA has suggested that by reversing the position of each two-gang condenser, that is by putting the left hand one on the right hand side and vice versa, the tuning control will then count 0 to 500 as the frequency is increased.

☆

YL/XYL AMATEUR CALL SIGNS

How many licensed female-operated Amateur Stations are there in Australia at present—10, 20, 30, 40 or 50?

According to information taken from the current Call Book and associated P.M.G. amendment lists the total is 18, made up of VK1 1, VK2 6, VK3 6, VK4 1, VK6 2, VK7 1, VK9 1. Out of this total at least a dozen have been heard operating on various bands in the past few months.

—BERS195/L3042.

A Sweep Generator for Aligning High Frequency Crystal Filters

It is all pretty straight-forward, except for a couple of small traps—the varicap has an inverse cube law and is rather non linear (!), but if you make sure that when you are using it for measurements that the diode bias is large compared with the sweep voltage, the linearity is all that is to be desired.

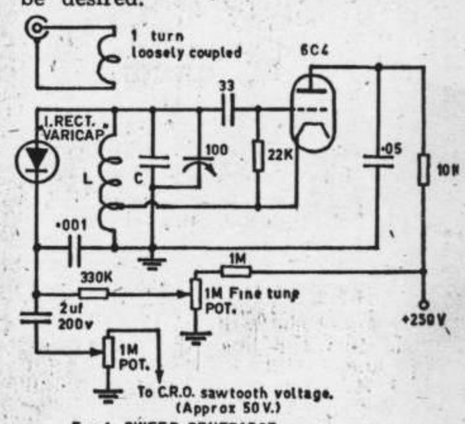


Fig.1. SWEEP GENERATOR

Operate with the highest bias for best results, and only use the bias control for fine tuning.

Use a low frequency sweep (10-15 c.p.s.), and with the poor high frequency response of the probe (with my c.r.o.) it is quite practicable to use an external calibrated oscillator as a "marker", as shown in Fig. 3.

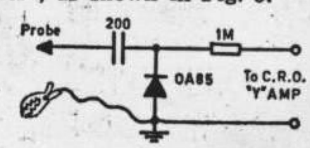


Fig.2. THE PROBE.

The oscillator can be very loosely coupled to the circuit under test. Loose coupling of the sweep oscillator to the filter (etc.) is most desirable to prevent "pulling" effects, and a kind of variometer link would be a great advantage.

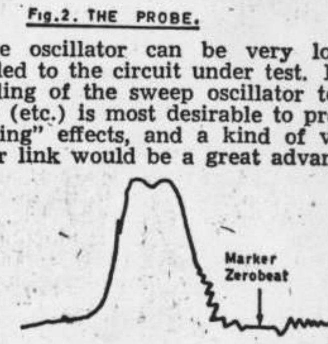


Fig.3.TYPICAL RESPONSE CURVE.

None of the values I have shown are critical, having been selected by the hmm-let-me-see-this-ought-to-do method.

The only thing to add is that at low sweep frequencies a d.c. oscilloscope is an advantage, as with an a.c. coupled scope, with the display nearly filling the screen, some distortion is occasioned by the a.c. coupling finding a "mean level".

The sweep range of the unit described at around 6 Mc. is from 400 Kc. to 500 c.p.s.

—I. Macmillan, VK3CS.

THE AR7 AND S.S.B.

C. A. CULLINAN,* VK3AXU

ALTHOUGH designed some 25 years ago, the AR7 receiver still ranks as an exceptionally fine general-purpose communications receiver and is much sought after by discerning Amateurs for a number of reasons.

These include the fact that it can be put into use in Amateur service without any modifications, and in this regard, is somewhat unusual in equipment obtained from Services sources. Because of its straightforward design it is capable of being modified for special services, without very much trouble and in a manner which does not destroy its re-sale value. Also its performance, as a general-purpose receiver, is outstanding when its owner learns how to use all its capabilities.

However, in common with all general-purpose receivers, it does need modification for special services such as the Amateur service and some time ago a very fine series of articles appeared in "Amateur Radio" covering some worthwhile modifications.[1]

With the advent of s.s.b. into Amateur practice the AR7 revealed some shortcomings, in what was for it, a new type of use. It must be remembered that when the AR7 was designed, a long way back in the late thirties, s.s.b. was little used except in overseas radio telephone circuits, probably none was used in the Defence Services, and as a result the specification for the AR7 did not include provision for s.s.b. It is also well worth while remembering that many similar receivers of overseas origin did not include provision for s.s.b. until within the last couple of years, when the popularity of Amateur s.s.b. created the necessary demand.

All this is not to say that an unmodified AR7 cannot be used on s.s.b. It can, but the operation of resolving both s.s.b. and d.s.b. is a rather difficult operation. Yet with a few simple modifications, which need not destroy the looks or re-sale value of the set, the AR7 can be made into a receiver that is a pleasure to handle on s.s.b.

The purpose of this paper is to outline such a series of modifications made to the AR7 at this station.

Four modifications were made, these being:—

- Improvement to frequency stability of both r.f. and beat frequency oscillators.
- Fitting a product detector for better c.w. and s.s.b. work.
- Improving the tuning rate, mainly by bandspreading.
- Fitting an improved tone control.

PRODUCT DETECTOR

For mechanical reasons it is desirable to fit the product detector first. The product detector theory has already been covered in articles[2] in "A.R." and will not be repeated here. Due to its action it gives an apparent reduction in some forms of QRM and is very helpful with static. It is not generally realised that the product detector requires a very small input and as a result its output is also low. This misconception has given rise to the thought by many Amateurs that it is not worth using. This is far from the case as the disadvantage of low output is more than made up by its worthwhile characteristics. One thing the product detector does do is to show up ordinary a.m. transmissions which have either f.m. or frequency drift in them; it also displays perfectly the ability or otherwise of an operator's netting abilities.

Fitting the Product Detector.—This is provided with an Oak wafer switch, so that either diode or linear detection can be used. The switch is mounted in the top right hand corner of the front panel (looking at the front of the AR7). With a square along the top of the panel draw a light pencil line in the same line as the centre of the crystal switch. Then with the square laid on the right hand end of the panel, cross this pencil line with another which is in line with the tone control and the noise limiter shafts.

At the point of the cross, drill a hole through the panel and mount the wafer switch, keeping it as close to the back of the panel as possible. Note that the switch is a four-position one. This arrangement reduces leakage across the switch.

A hole to take a large rubber grommet is now drilled in the chassis to take the wires from the switch, and to those of the voltage regulator valve which will be fitted in the second stage of the modifications. This hole is drilled alongside the end of the gang condenser shield and just back of the crystal filter shielding. Make certain that the hole does not foul anything under the chassis.

Turn the chassis over and along the end wall of the chassis underneath the output transformer, drill a horizontal line of small holes to provide ventilation. On this end wall mount a nine-pin socket, on a couple of pieces of copper tubing. Use countersunk screws so that the outside of the chassis will be smooth. To find the location for this socket, first mount a 7,500 ohm, 20 watt, resistor on the back wall of the chassis just under the second aerial terminal. This resistor will project out into the chassis, being mounted with a long bolt. The product detector valve must clear this resistor as much as possible without being placed too near the b.f.o. shield.

Little comment is needed on the circuitary of the product detector. The two voltage splitting condensers are mounted as close to the plate of the second i.f. valve as possible, and a short section of co-ax used to connect the junction of these condensers to the product detector valve socket. The two grid resistors of the 12AU7 valve and the cathode resistor should be wired directly to the valve socket and to the nearest common earth point.

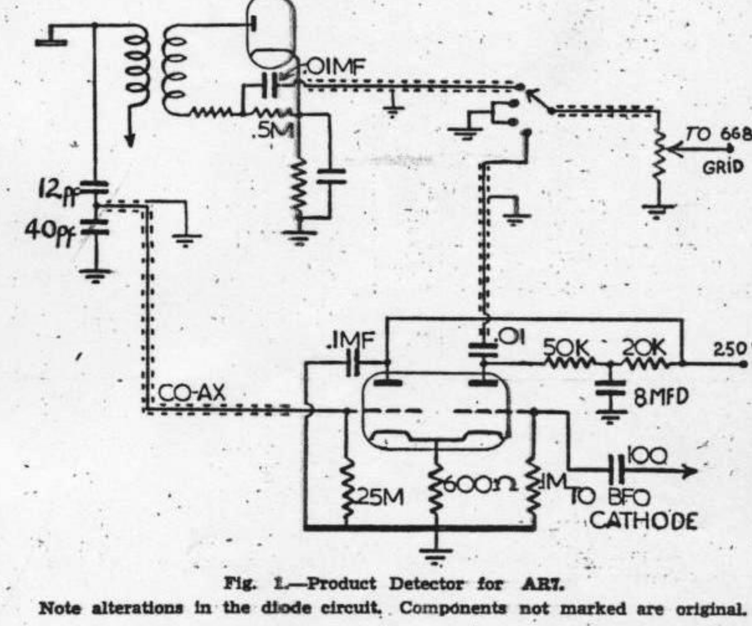


Fig. 1.—Product Detector for AR7.
Note alterations in the diode circuit. Components not marked are original.

After installation of the product detector, it will be necessary to re-align the last i.f. transformer due to the slight extra loading of the product detector. It will also be necessary to re-adjust the slug of the b.f.o. coil slightly. Do not worry over the use of the piece of co-ax in the circuit. Its position places its capacity across the lower of the voltage splitting condensers and is part of the design. It will be noted that the circuit shows that the volume control of the 6G8G has its low potential end connected to earth. In most AR7's, this is returned to the a.v.c. net-

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work to give audio a.v.c., but in the receiver here this was not done by the manufacturer, although the components were included. Possibly there was a wiring omission in the factory, or some models were altered for a definite requirement. This is mentioned because the instruction book does not show this variation.

In using the product detector it will be found that a.m. stations can be read without the b.f.o. being switched on, if a high signal level is fed into the detection system. This is mainly due to the fact that the diode is also operating and is coupled into the 6G8G cathode. By turning back the r.f. gain control this leakage disappears and a.m. stations then require use of the b.f.o. to obtain detection.

There is a slight tendency for the set to motorboat when using the product detector, when the audio volume control is turned up very high, but this is of no consequence here as the speaker output as this point is too high anyway and would only worry the neighbours. So much for the product detector.

FREQUENCY STABILITY

Whilst the stability of the AR7 is of a high order, it can be improved still further and is a must for s.s.b. Two things were done here, the first being to fit a 5 pF. negative temperature condenser from the stator of the h.f. oscillator to the frame of the condenser. This was fitted at the top of the condenser when looking down into the set and has helped quite a lot. All coils then want re-aligning slightly to bring them back to calibration.

The second approach to the stability problem was to use voltage regulation on both oscillators. A voltage regulator valve, VR150, was mounted horizontally in the set in the space between the wafer switch for the product detector and the shield of the crystal, keeping it as far away as possible from the latter. A small octal socket was mounted on the end wall of the chassis, using short sections of ¼ inch copper tube as spacers. The cathode of this valve is taken to the common earth system under the chassis, whilst the anode is connected to one end of the 7,500 ohm 20 watt resistor mentioned before. The h.t. connections to the h.f. and b.f. oscillators were traced and were connected at the resistor where it goes to the anode of the regulator valve. The b.f.o. dropping resistor was short circuited. The dropping resistors to the h.f. oscillator were not removed, but a 6J8G valve was substituted for the original 6K8G.

These simple modifications have made a big difference to the frequency stability and it is now felt that most of the drift which occurs when tuned to WWVH is due to the b.f.o. The drift is far less than that observed on many Amateurs, including the s.s.b. stations.

TUNING RATE

S.s.b. demands that the receiver have a very slow tuning rate as it is necessary to tune the receiver and set the b.f.o. within a few cycles of the original carrier. As mentioned before, the AR7 can do this but it's a rather tedious affair and if several stations are in an s.s.b. network and are not exactly netted, then matters become very complex for the listener. The first thing to be done is to improve the ability to set the b.f.o. and this is done by substituting a large diameter knob for the small one. A bakelite knob of the same diameter as that on the main dial will just fit, without fouling the b.f.o. switch. A similar knob should be placed on the crystal filter phasing control, not only to balance the looks of the set, but to give an added vernier effect when tuning the crystal filter. The next thing to be done is to bandspread the coil boxes. Data for bandspreading for the 14, 21 and 28 Mc. bands has been given in the excellent series of articles mentioned before.

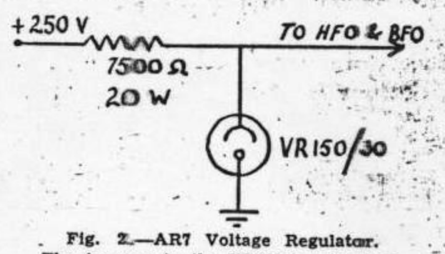

Fig. 2.—AR7 Voltage Regulator.
The jumper in the VR150 is not used.

However the amount of bandspread on the 7 Mc. band leaves a lot to be desired. Therefore a coil box was modified and bandspread is now such that the box covers only 7.0 to 7.19 Mc. Whilst this amount of bandspread makes the AR7 appear to have the selectivity of a crystal set, it does make the tuning in of s.s.b. stations a very simple matter.

Details of the modifications are as follows:

1st r.f. coil.—14 turns of 18 gauge enamelled wire wound on a ¾" slug-tuned former. Length of winding, 1". Primary, 3 turns of 30 en. wire interwound with bottom three turns of the secondary.

2nd r.f. coil.—As above, but primary has six turns.

Mixer coil.—As above, but primary has nine turns.

Oscillator coil.—9 turns of 18 gauge en. wire wound on a 1" diameter former, slug-tuned. Length of winding, ¾". The plate winding is four turns of 30 en. wire interwound with bottom turns of grid winding.

Across the small trimmer condenser in the coil box are mounted two silver mica condensers, one of 100 pF. and the other of 25 pF. (if a band C box is used it will have two trimmers. Connect these in parallel and delete the 25 pF. condenser). On each coil assembly locate the short lead that connects the grid end of the winding to the stator of the gang condenser. Replace this lead with a silver mica condenser of 20 pF.

The boxes are re-aligned by using the slug to set the box to 7.0 Mc. with the dial at 500, and the trimmer is used to set the box to approx. 7.2 Mc. with the dial at 0.

As in use here, 7.15 Mc. occurs at 130 on the dial when 7.0 Mc. is found at 500. There is a certain amount of interaction between the trimmer and the slug in each box when aligning the coils. The method used here was to connect a signal generator to the grid of the mixer valve, through a small condenser with a half meg. resistor as grid leak to earth.

With the gang condenser at minimum capacity the oscillator trimmer was adjusted to get a signal on the high side. The generator was then moved lower in frequency and the slug adjusted. Several repetitions were required to get the tracking correct. When this was done, the signal generator was moved to the grid of the 2nd r.f. stage and the mixer grid coil was adjusted. The same procedure was carried out with the other coils.

If it is thought that this is too much bandspread, then it is possible to remove the 25 pF. condenser from the coil assembly and increase the value of the series condenser from 20 pF. to 47 or 50 pF. This will then place 0 on the dial at about 7.450 Mc. when 7.0 Mc. falls at 500 on the dial.

This method of bandspreading could be used with the existing coils in an existing D box, but a spare one was not available here, so a spare C box was used.

TONE CONTROL

The tone control as fitted to the AR7 is the type used in most b.c. sets and simply cuts off the higher audio frequencies. The tone control shown in the circuit was installed.[3] When the arm of the pot. is at the earthed end, there is a certain amount of treble cut, but this is not carried to extremes. With the arm of the pot. at the other end, there is treble accentuation and an amount of bass cut. If a linear pot. is used, the system will give a flat output with the arm in the centre position.

This type of tone control assists greatly when listening to stations which are "boomy" due to distance or other causes. It also helps the intelligibility under bad conditions and has been found a worthwhile feature.

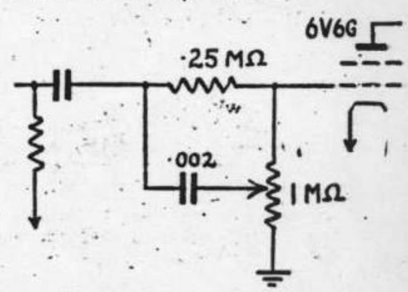

Fig. 3.—Tone Control for AR7.
Components whose values are not shown are normal receiver components. This tone control gives treble cut, through flat response to bass cut with slight treble increase.

TUNING S.S.B.

The method of tuning s.s.b. is to tune the receiver with the r.f. gain control at maximum, for greatest output from the receiver, for any given audio volume control setting. This peaks the sideband in the bandpass of the receiver's i.f. system. The r.f. gain is then turned down, the b.f.o. switched on, and adjusted until the speech becomes natural. If necessary, the r.f. gain is adjusted as well as the b.f.o., but this is not as important with the product detector as it is with the diode detector. Audio volume is controlled

(Continued on Page 9)

A SUBSTITUTE FOR TRANSISTORISED AUDIO IN 12 VOLT RECEIVERS

V. KERR,* VK4LK

WITHOUT question the transistor is supreme for the audio portion of the so called "hybrid receiver," however when costs are taken to account, that is driver and output transformers plus the cost of transistors, almost half of the total cost of a receiver goes for the audio portion.

Once the mobile-portable fraternity really recognise the convenience, plus efficiency, offered by the 12 volt type of valve, it goes without saying these will have a universal application for r.f. purposes in any receiver designed for mobile or portable use. If and when transistors do get on a comparable price level with the "humble valve," the mixture of both will no doubt be very desirable.

Recently the acquisition of a new jalopy with a 12 volt electrical system called for a review of the previous 6 volt "buzz box" which provided the necessary entertainment while motoring. It could have been converted for 12 volt vibrator operation without a great deal of effort. After taking into account the cost of a 12 volt vibrator transformer and vibrator, the decision was made to come into line with present trend for automobile receivers and make a "hybrid job" of it.

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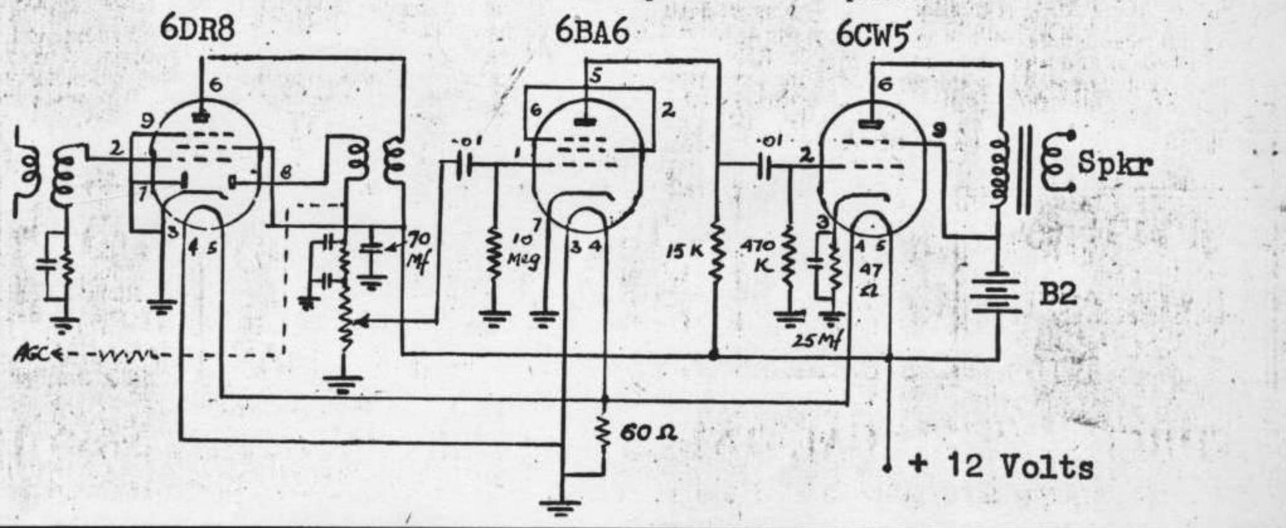
My "favourite wholesaler" was unable to supply the needs for a transistorised audio end without some delay, in the interim the r.f. portion of the receiver had been completed using the 12 volt types. Having an urge to see just how it performed after the change over, the output from the diode of the 6DR8 was fed into a conventional amplifier and tune up proceeded with.

Having got thus far, the thought struck me, if these high gm types do so well as r.f. amplifiers, why not see how they will fare as audio types on low voltage. Searching about, the 6CW5 appeared to be a suitable subject for trial. It was quite a surprise the amount of audio which it produced with only 12 volts for plate and screen, however the addition of a 9 volt transistor battery, in series with the 12 volt supply (B2 on circuit diagram) really started the thing making real noise and without much apparent distortion. I might add it would be hardly fair to feed the output from the 6CW5 to a 3 or 4 inch speaker and expect good results. In my own case it is fed into a 9-7 speaker with a 2,500 ohm transformer between the 6CW5 and the voice coil of the speaker. All the values of resistors, etc., have been arrived at by cut and try methods, and the values shown have proved to give the best performance in this set-up. The 6BA6 is hooked up as a triode, otherwise things remain conventional.

The 60 ohm shunt resistor across the filaments of the 6DR8 and 6BA6, while not the correct value to match in with the 0.71 amp. filament of the 6CW5, appears to work quite satisfactorily in the series-parallel filament hook-up, this being the nearest to the correct value on hand it was naturally used.

To anyone who would like to try a receiver using the 12 volt types, I can recommend the inclusion of the audio portion as detailed, thus saving quite an amount when compared with the cost of a fully transistorised audio portion.



THE AR7 AND S.S.B.

(Continued from Page 3)

with the audio volume control. In many instances best results are obtained with the r.f. control right off.

No bandspreading has been applied to the 3.5 Mc. band as, so far, it has not been found necessary.

Due to the large bandspread on 7.0 Mc., there is an apparent lack of selectivity. This is typical with all systems using such a large amount of bandspread and a 455 Kc. i.f. system. The crystal filter of the AR7 will help a lot and the receiver's i.f. channel should be lined up with the crystal, which is nominally on 455 Kc. Changing crystals can cause a lot of poor reception when the filter is in use and each set should be adjusted with its own crystal in circuit. Replacing the second and third i.f. transformers with the latest Aegis high selectivity transformers will also help. The crystal filter input transformer should not be replaced unless a satisfactory replacement is available.

A Command Q5'er, connected to the grid circuit of the 2nd i.f. stage by twisting a couple of turns of wire around the grid lead will work wonders as far as selectivity is concerned. However, it will probably be found that under the condition of extreme selectivity that is then obtained the tracking of the AR7 is not perfect. A similar check on a lot of other receivers will reveal the same thing.

Finally, remember that a receiver is only as good as its operator and these modifications will make the operator's life a lot easier and allow him to get more enjoyment from his receiver, the old faithful AR7.

REFERENCES

1. "Modifying the AR7," "Amateur Radio," May, June, July, August, September, 1957; December, 1958; January, 1959.
2. "Amateur Radio," April, 1959.
3. "Radiotron Designer's Handbook," pages 662 and 663.

Commercial Kinks

with Ron Fisher VK3OM
3 Fairview Ave., Glen Waverley, 3150

Over the period that I have been writing Commercial Kinks, several pieces of gear have stood out as top favourites by the number of enquiries received. Those that have so far been covered include several units from the Yaesu range, the Trio 9R59, plus several other popular transceivers. Apart from these, the war time AR7 receiver rates very high on the enquiry list. Thousands of these receivers must have been released through disposals sources over the last twenty five years and it seems to be a surprising thing that many of these are still in original condition. As an aid to those who are lucky enough to own one of these, over the next few months I will present a run down on the set and then a few of the more popular modifications that have been proven over the years. Because of space limitations it will not be possible to publish the full circuit diagram but these will be available from **Commercial Kinks** in the usual way.

THE AR7 PART ONE

— description and specification.

Sensitivity. The absolute sensitivity is such that a radio frequency input of one microvolt modulated to a depth of 30 per cent at 400Hz applied through a standard dummy antenna gives an output greater than 50 milliwatts in the 600 ohm line with a signal to noise ratio of 1:1 in milliwatts or better. The specifications demand a minimum sensitivity of one microvolt absolute to give an output of six milliwatts under such conditions. Actually the output is as high as two hundred milliwatts on some bands. These readings are taken with the volume control adjusted to give a signal to noise ratio of 1:1 in watts.

Power Output. With the same input as above (1 microvolt) from a signal generator or antenna, and with the volume control advanced beyond the noise ratio of 1:1, maximum undistorted output to the speaker is nearly two watts. Output to the headphone jack is about 40dB below output level depending on the type of headphones used.

Image Ratio. Two stages of radio frequency amplification are used and these provide the following image attentuation. 8MHz. 50dB. 12MHz. 40dB. 13MHz. 54dB. 19MHz. 35dB. 24MHz. 26dB.

IF Selectivity. (1) Crystal in—Attenuation at 5kHz off resonance to be better than 50dB.

At 1kHz off resonance to be better than 2dB. Selectivity control at maximum. (2) Crystal out—Attenuation of at least 6dB at 3kHz off resonance.

ANTENNA INPUT. The input to the antenna coil is designed for double or single wire input and has an average input impedance of 400 ohms. If a single wire is used it should be connected to terminal A1, a jumper wire being connected from earth to terminal A2.

COILS. The frequency range of the receiver is covered in five bands. The plug-in coil units are lettered from A to E and cover as follows.

Band A	140 to 405kHz.
Band B	490 to 1430kHz.
Band C	1420kHz to 4.3MHz.
Band D	4.25MHz to 12.5MHz.
Band E	12.5MHz to 25MHz.

The electrical contacts on the coil acceptor unit are constructed of phosphor bronze silver plated and are self cleaning by friction.

Parallel trimming condensers are employed on bands A B C and D, and series capacity tuning on band E.

The main tuning of the receiver is accomplished by means of a four gang capacitor each section of which has a capacity of 11 to 240pF. The whole assembly is mounted on a ⅛ inch plate to ensure rigidity.

The oscillator coil is tuned 455kHz higher than the signal frequency and this is maintained over each band by correct adjustment of the inductance slug and padder capacitor mounted inside the coil shield. Band E has no padder or variable inductance. Correct tracking on this range is maintained by spacing the turns of the secondary winding during manufacture and adjusting C8 at the low frequency end of the band.

Crystal Filter. Continuously variable selectivity is possible by means of the front mounted control while the phasing control allows the rejection of any portion of either of the two sidebands. The rejection remains constant at any position of the selectivity control. The crystal is a special AT cut having a high Q and low drift. The resonant frequency of the crystal is 455kHz plus or minus 100Hz. The phasing capacitor is a different type, that is two capacitors in parallel with the variable plates common to both arranged in such a way that when the capacity of one section is increased, the other is decreased. This means that the total capacity remains constant and thus the resonant frequency of the associated IF transformer remains constant.

Next month full alignment procedure will be described and the following month details on how to modify the BFO to give reactance tube control for increased stability and also a Squelch circuit for use on net frequencies.

PROJECT AUSTRALIS

with David Hull VK3ZDH, Chairman, Project Australis.

SUMMARY OF AMSAT-OSCAR-B SPACECRAFT SYSTEM.

1. AMSAT Deutschland Repeater (designed by Karl Meinzer, DJ4ZC)
   Input freq. passband between 432.125 and 432.175MHz.
   Output frequency passband between 145.975 and 145.925MHz.
   Power output (high power mode) is 14W PEP.
   Downlink passband is inverted from uplink passband.
   Repeater is 45 per cent efficient using envelope elimination and restoration technique.
   Linear Operation — SSB and CW are preferred modes.
   Repeater is commandable to either 3.75 or 14W PEP output.
   Telemetry beacon at 145.980MHz (200mW).
2. AMSAT Two-to-Ten Meter Repeater (designed by Perry Klein K3JTE)
   Input freq. passband between 145.85 and 145.95MHz.
   Output freq. passband between 29.40 and 29.50 MHz.
   Power output is 2W PEP.
   Downlink passband is not inverted from uplink passband.
   Linear Operation — SSB and CW are preferred modes.
   Telemetry beacon at 29.50MHz (not same as OSCAR 6).
3. Morse Code Telemetry Encoder (designed by John Goode, W5CAY)
   24 analog input channels.
   Converts each analog value into a two-digit Morse code number or "word".
   A third digit precedes the telemetry value and gives the line number in which the word is located.
   Format is arranged 4 words per line, six lines per telemetry frame.
   Morse code rate is commandable to 10 w.p.m. or 20 w.p.m.
4. Teletype Telemetry Encoder (developed by Peter Hammer, VK3ZPI and Edwin Schoell, VK3BDS).
   60 analog input channels.
   Converts each analog channel to a three-digit number transmitted in Baudot code.
   Each three-digit value is preceded by its channel number, making a five-digit telemetry word.
   The data is arranged 10 words per line by six lines per telemetry frame.
   Two lines of status information follow the analog matrix and give the spacecraft time (i.e., time in "counts" from launch, 1 count = 96 minutes).
   Output keys 435.1MHz beacon in FSK: 850-Hz shift; 45.5 Baud: (reversed from U.S. standard). Also keys 145.98 and 29.50MHz beacons as AFSK, on command.
5. 435.1MHz Beacon Transmitter (developed by Larry Kayser, VE3QB and Bob Pepper, VE2AO)
   Beacon output freq. is 435.10MHz.
   Power output is 0.4W at an efficiency of 45 per cent.
   Beacon is FSK modulated 850-Hz shift.
6. 2304MHz Small Beacon Transmitter (developed by San Bernardino Microwave Society)
   0.1W at 2304MHz.
   Turned on by command only for 30-min. periods.
   CW keyed — HI followed by 30-sec. carrier. Also keyed with Morse code telemetry on command.
7. Codestore — Message store-and-forward system (built by John Goode, W5CAY)
   896 bit memory capacity using COS-MOS shift register memory.
   Loaded via command link.
   Output code speed is 13 w.p.m.
8. Experiment Control Logic (designed by Jan King, W3GEY)
   Selects the spacecraft operating modes.
   Protects satellite against excessive battery drain by reducing repeater output power or by shutting it off completely.
9. Input Solar Power-Battery Charge Regulator (developed by Karl Meinzer, DJ4ZC and Werner Haas, DJ5KQ)
   Converts 6.4V at arrays to 14V to charge battery or to supply the spacecraft experiments.
   Senses overcharge of battery and reduces charging current.
   Senses failure of either of the two redundant regulators and switches to the opposite regulator automatically.

AMSAT-OSCAR-B SPACECRAFT

A-O-B (to be known as OSCAR 7 after launch) is an international effort now involving four nations. The A-O-B systems developed in each country are as follows:

Germany:	AMSAT Deutschland Repeater, Spacecraft Structure, Battery Charge Regulator, 28V Power Regulator, Antenna System — DJ4ZC, DJ5KQ.
Australia:	Two Redundant Command Decoders, Teletype Telemetry Encoder — VK3ZPI.
Canada:	435.1MHz Beacon Transmitter — VE3QB and VE2AO.
United States:	2M-10M Repeater, Morse Code Telemetry Encoder, Experiment Control Logic, Instrumentation Switching Regulator, Solar Panels, Battery — K3JTE, W3GEY, WA4DGU, W3DTN, Marie Marr.
	Codestore — W5CAY.
	S-Band Beacon Transmitter — K6HIJ.

Commercial Kinks

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THE AR7 (part two). This month the full alignment procedure will be described.

IF Amplifier. Slight mal-adjustment of the IF transformers will have a marked effect on the sensitivity and selectivity of the receiver. As the IF transformers are of an extremely stable type using permeability tuning and silver mica fixed condensers, it will usually be found that one or two turns of the iron core slug is all that is necessary to bring them into their original state of alignment.

Disconnect the aerial leads and power and speaker cables. Take the dust cover off and remove the receiver from the rack. Stand the receiver on its side with the underneath facing to the right and away from the rack. Reconnect the power and speaker cables. Connect an output meter across the 600 ohm secondary of the output transformer. An ordinary 5 volt AC meter with a 600 ohm 1 watt resistor across it is quite suitable. Remove the grid lead from the cap of the 6K8 and connect the output of a calibrated signal generator to the grid cap through a .005 mfd capacitor. The grid should at the same time be returned to earth through a 100K resistor.

Place the crystal switch in the I position, selectivity control at 8, and phasing control to centre scale. Tune the signal generator through 455kHz slowly and adjust the attenuator until a reading of half scale is indicated on the 'S' meter when tuned to a maximum peak of the IF amplifier. It should be noted that the meter reading will gradually increase until the very sharp peak of the highest amplitude is passed. Return to this peak as this indicates that the generator is exactly on the crystal filter frequency. Switch the crystal **OUT**. Using an aligning tool adjust the iron core slug screws on the top and bottom of the IF transformers. Those above the chassis are for the grid circuits, whilst those below are for the plate circuits, except in the case of IFT2, the crystal filter circuit which is below chassis. IFT2 below chassis and IFT4 above chassis should not be altered at this stage.

Starting from IFT1 turn the iron slug screws in or out until a maximum reading appears on the "S" meter with a minimum input from the generator. As the "S" meter reading increases the input from the signal generator should be decreased, thus keeping the "S" meter reading at approximately half scale. Having adjusted both grid and anode circuits to resonance (with the exception of IFT2 and IFT4 grid) as indicated by maximum reading on the "S" meter (with minimum signal input from the signal generator), check these alignments and the correct setting of the signal generator as follows:-

Switch the crystal filter into circuit, and with the selectivity control set on "10", and the phasing control in the central position, adjust the attenuator on the signal generator until a reading of approximately half scale on the "S" meter is observed. At the same time keep the audio gain control in a position which allows approximately 6 milliwatts on the 0-5 volt range of the output meter.

Rotate the signal generator frequency control slowly backwards and forwards over 455kHz, noting the peak on the "S" meter. If only one sharp maximi is observed, the alignment is correct. Should, however, two peaks occur, incorrect adjustment of the iron slugs, or incorrect setting of the signal generator, is indicated, and the procedure outlined above should berepeated.The correct peak is the highest, and at the same time, the sharpest one. Now adjust T4 grid circuit for maximum peak on the output meter. After checking these circuits several times, only one sharp peak should appear on the "S" meter, and the sensitivity should be of the order of 10 microvolts. Under these conditions, with a 10 microvolt input and 6 milliwatts output the indicated output should drop to 3 milliwatts when the generator modulation is switched off. This reading is taken with the crystal in the **OUT** position.

With the crystal in circuit, the signal-to-noise ratio should be improved. Test to see if this is so, and if this is not the case, it will generally be found that the IF frequency is not the same as the crystal frequency, i.e., 455kHz.

If the test is successful, the signal-to-noise ratio will be further improved on alignment of IFT2 crystal filter grid circuit. The method of accomplishing this is detailed in the next two paragraphs.

Insert coil unit "B" and tune in a broadcast station. Switch the crystal into circuit and set the selectivity control to "O". Adjust IFT2 for the best tonal quality on music, ignoring the volume level. When the tuning control is rotated over the station's carrier, the effect noticed should be the same as with the crystal out of circuit, except for a slight additional sharpness.

On either side of the correct adjustment of the iron slug in IFT2, the tonal response will be low and drummy, and as the dial is rotated over the station, distinct hollowness, due to the crystal filter cutting the sideband, will appear on either side of the station. The reason for this adjustment is to obtain a symmetrical and variable selectivity curve.

Where possible this adjustment should be made with the aid of a signal generator and a cathode ray oscilloscope although the instructions given in the previous paragraphs are satisfactory for normal service use.

BFO Alignment.

Upon completion of the alignment of the IF stages, the alignment of the BFO should be proceeded with as follows:-

Place SW2 in position 2 and SW5 in position 3. With a CW signal tuned in by "S" meter, and 22V applied to pin 1 of octal socket outlet, and front panel "BFO note" control in central position, adjust slug of BFO coil for zero beat. Then to ensure satisfactory normal operation, set SW2 and SW5 to position 1 and rotate "Local CW potentiometer" (R63). A note variation of at least 3kHz each side of zero beat should be obtainable. Set for zero beat. If receiver is later used on local control, R63 can, if necessary, be further adjusted to compensate for any slight changes in BFO or Reactance tube circuit values. The net result is to give correct CW operation under all conditions, i.e., signals tuned to maximum by "S" meter continue to give zero beat with "BFO note" control at central position whether receiver used locally or remotely controlled.

RF and HF Oscillator Circuits.

As with the IF amplifier, extreme accuracy is required for the RF and HF oscillator circuit alignments. The components employed in these circuits are of extremely stable type and only a fraction of a turn of the trimmer condensers, and a very small adjustment of the iron core slugs, will be required. These adjustments should be sufficient to restore the alignment of the circuits to their original accuracy. Such adjustments should only be made if you are certain that they have been made necessary through tube replacements, rough handling or extreme temperature changes, etc., and that you have the facilities to make the adjustments correctly.

The adjustments are made through the holes in the coil acceptor housing, and are marked L1, L2, L3, L4, C1, C2, C3, C4, C5, C6, C7 and C8.

L1 is the inductance adjustment on the aerial coil, L2 the inductance adjustment on the first RF coil, L3 the inductance adjustment on the second RF coil, L4 the inductance adjustment on the HF oscillator coil, C1 is the HF trimmer capacitor on the serial coil, C2 the series trimmer on coil band "E", C3 the HF trimmer capacitor on the second RF coil, C4 the series trimmer capacitor on coil band "E", C5 the HF trimmer capacitor on the second RF coil, C6 the series trimmer capacitor on coil band "E", C7 the HF trimmer capacitor on the HF oscillator coil, and C8 is the padder capacity on the HF oscillator coil. To align the RF and HF circuits connect a signal generator through a standard dummy antenna to the aerial terminal A1, the earth terminal of the dummy antenna being connected to A2, and bridged across to the earth terminal. Plug in the coil units, from Band "A" to Band "E" in turn, and check the dial readings against the calibration curves drawn on the face of the coil unit under test. Note that the BFO should be "ON" and that in conformity with the procedure outlined previously the BFO note control should be set to "O", i.e., 455 kHz. This should be tested in accordance with instructions detailed previously, before checking the receiver coil calibrations.

Observe whether zero beat occurs at the correct dial setting on the receiver. Should this be so, the calibration is correct, and there will be no necessity for adjustments to the HF oscillator circuit. If the calibration is incorrect, i.e., if the dial reading does not agree with the calibration given on the face of the coil, a small adjustment to C7 will correct the situation at the high frequency end of the band, and an adjustment of L4 will correct for the low frequency end (except in the case of Band "E" where there is no inductance adjustment). In the case of Band "E" coil, the series trimmer C8 is adjusted in place of L4.

To check the RF grid circuits alignment, switch off the BFO, and, using a 400Hz modulated signal from the signal generator, tune in a signal at approximately 15 degrees on the dial. The frequency at which the signal generator should be set for each band may be read approximately from the calibration curve on the coil unit. Adjust the trimmer capacators C1, C3 and C5 for maximum peak on the "S" meter, with minimum input from the signal generator. As there will be a certain amount of interlocking between the RF circuits and the HF oscillator at the highest frequencies, it will be necessary to rotate the tuning dial to and fro over the signal to obtain the greatest peak. If this peak is obtained in the incorrect position of the dial, it will be necessary to re-check the oscillator calibration.

If Band "A" will not follow the calibration curve, capacitor C8, the series padder capacitor should be adjusted, re-setting C7 and L4 after this has been done. As these settings mutually effect each other, they may have to be checked several times.

Some difficulty may be experienced on this band with oscillation, especially if the receiver is very far out of alignment. This will occur when the RF circuits are resonating at too high a frequency, causing instability, and therefore difficulty in alignment. If the oscillator section is corrected as above, and the grid circuits are adjusted individually by connecting the signal generator to the grid cap of the second and first RF tubes in that order, the difficulty will be overcome provided precautions are taken to see that the receiver is not set to a higher frequency than 409kHz.

After checking the high frequency end of each band, adjust inductances L1, L2 and L3 for maximum peak at the lowest frequencies. Each adjustment should be checked several times.

If the receiver is properly aligned, it should have a sensitivity of approximately 1 microvolt when modulated 30 per cent. The signal to noise ratio should be 1 to 1 (in watts) or better and the image frequency attenuation at the highest frequency 26dB.

This completes the alignment procedure. In next month's issue some interesting modifications will be discussed.

Contests

with Peter Brown VK4PJ

Federal Contests Manager, G.P.O. Box, 638
Brisbane, Qld., 4001.

CONTEST CALENDAR

The Ross Hull VHF-UHF Memorial Contest is **N O W.**
January up to 20th Ross Hull VHF-UHF.
January 12th & 13th Y U 80 meter CW DX Contest.
January 25th & 27th C Q WW DX 160 CW contest.
February 2nd & 3rd ARRL International DX Phone.
February 9th & 10th 0600 GMT to 0800 GMT.

John Moyle Memorial National Field Day.

A section for everyone.

February 16th & 17th ARRL International DX. C W.
February 24th Central Coast ARC Field Day.
March 2nd & 3rd ARRL International DX Phone.
March 16th & 17th ARRL International DX CW.

If, If If, we are to make a "SMASHING" success of the ROSS HULL you should have started on your log ?????????
Stop me if you have heard that one about "putting it . . . . ."

John Moyle Memorial National Field Day comes up next month.
Have you got your "put put"?
Have you got your site?
Have you got your mates ?
Have you got your ice-box?

REMEMBRANCE DAY CONTEST.

I have been too busy finalising this contest to write notes as promised. Be patient and you may get an answer to your comment, if you forwarded one with your log, direct.

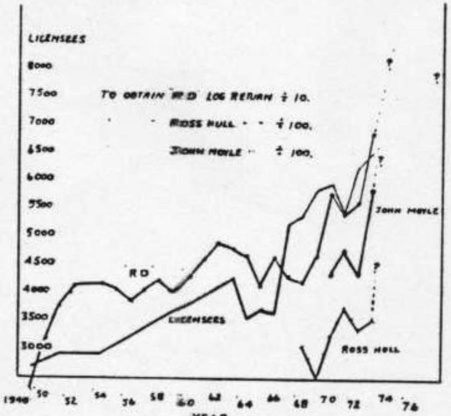
If you were not happy about the CW scoring get in touch with your Federal Councillor . . . or forever remain silent.

Most comments were on the enjoyment received from the contest, and CW scoring. What a beaut contest it will be next year.

If you are "with it" you will read the graph message right away, but PLEASE read on and make sure.

The graph shows the log return for the REMEMBRANCE DAY, ROSS HULL and JOHN MOYLE contests for each year. The "R D" contest has been taken back to the beginning but in the other two contests, for clarity the last few years only have been shown.

The full single line shows the licensees for each past year read directly from the left hand column. The line jointed by large dots shows the "R D" contest logs return for each year when the related figures in the left hand column is divided by **TEN**. To obtain the ROSS HULL and JOHN MOYLE log return for any year the related figure in the left hand column is divided by **ONE HUNDRED.**



Message No 1.
As the graph is drawn, when the "R D" line is below the "Licensees" line we have less than one person in ten returning a log.

Message No 2.
When the "Ross Hull" line is below the "Licensees" line less than one person in one hundred is returning a log. We had about 36 logs in 1972-3 and over 6500 licensees; or in round figures one log in two hundred licensees. To get the Ross Hull above the line we need over 65 logs. We should be able to reach that "no hands". VK3 could do that on its own.
What about some more HF helpers assisting the VHF chaps run the Ross Hull line right off this graph for 1973-4. You still have time to get a log in.

Message No 3.
The John Moyle Memorial National Field Day Contest is on the second weekend in February.

Message No 4.
To make the graph direct reading we would have to extend down 2½ inches and the "R D" line would be in the **FIRST INCH.**

The Ross Hull and John Moyle lines would **not be worth marking in.** Draw your own graph up and see. Disappointing isn't it?????

THE GREAT CONTEST CONTEST

When. January 1974 to August 1974.
Objects. To estimate the number of logs entered for each of the next Ross Hull, John Moyle and Remembrance Day Contests, and to assist in obtaining those figures.
Rules. Mark on the graph the goals that you think we can achieve in 1974.
Update the graph with contest results.
Set a high standard within our capabilities.
Trophy. Your trophy will be satisfaction in achieving your aim.

ARRL INTERNATIONAL DX COMPETITION

Dates. Phone: First full weekends in February and March.
CW: Third full weekends in February and March.
Times. Starts at 0001 GMT Saturday and ends at 2400 GMT Sunday.
Object. DX stations QSO as many stations in the 48 contiguous US and Canada call areas as possible. Repeat contacts on additional bands are permitted.
Points. Each complete contact counts 3 points.
Exchange. Send RST and DC input power. W-VEs will transmit RST and state or province.
Multiplier. On each band your multipliers are the 48 contiguous states, plus VO and VE1 through VE8, a total of 57. Your final multiplier is the sum of multipliers worked on each band. QSO points times final multiplier equals claimed score.
Logs. Logs must contain dates, times GMT, bands, exchanges and points. Logs to ARRL, 225 Main St., Newington, Connecticut, USA. 06111 no later than 2nd May.

All Bands 1.8 to 28MHz Single and multi op. Single and multi TX. Usual certification. Photos, comments, suggestions welcomed.

CQ WW DX 160 CW Contest.

Starts 2200 GMT Friday January 25th. Ends 1600 GMT Sunday Jan 27th. The stateside "DX window" is 1825-1830.

Did you get DXCC out of October contests????

YU 80 Meter CW DX Contest.

Starts 2100 GMT Saturday Jan. 12th. Ends 2100 GMT Sunday Jan. 13th.

Exchange. RST plus QSO number.
Scoring. Contacts between stations in the same country, 1 point.
Other countries on the same continent, 2 points.
Countries in other continents, 5 points. YU contacts, 10 pts.
Multiplier. One for each DXCC country and each YU prefix worked.
Final Score. QSO points by sum of DXCC's and YUs.

Mailing deadline is March 15th to SRJ Contest Committee, PO Box 48, 11001, Belgrade, Yugoslavia.
Call areas in VK will be considered as separate areas for awards. Usual summary sheet and declaration. 3 per cent duplications disqualifies. Entries may be single or multioperator.

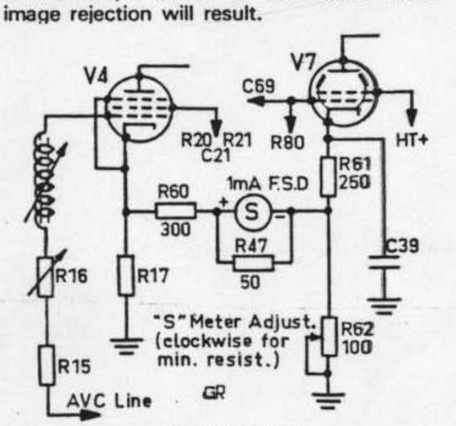
Commercial Kinks

with Ron Fisher VK3OM
3 Fairview Ave.. Glen Waverley, 3150

THE AR7 (Part three).
This month a few simple modifications for your AR7.
The first was described by Gordon Bowen in a series on the AR7 published in AR back in 1957.

AN ANTENNA TRIMMER FOR THE AR7. Drill a hole in the front panel, at the same level as the noise limiter control but on the left hand side of the tuning dial, to take a small variable capacitor. Any type will do here, but it should have a maximum value of 100 to 150pf to be able to accommodate the change across the tuning range. Connect this across the coil, not across the gang, and when re-aligning these stages set the trimmer to about half capacity. You will now be able to keep the RF stage peaked at all frequencies throughout the tuning range with a definite improvement in sensitivity.

A further improvement in both gain and sensitivity can be made by substituting a modern tube in place of the original 6U7G. Back in 1957, Gordon Bowen suggested using an RL7 or EF54. However, today, other types come to mind like the 6EH7 which has a Gm of 11000. A word of warning — leave the 6U7G in the second RF stage. As the tuned circuits associated with this stage have been designed to match the high impedance input of the 6U7, a better 'Q' and hence better image rejection will result.

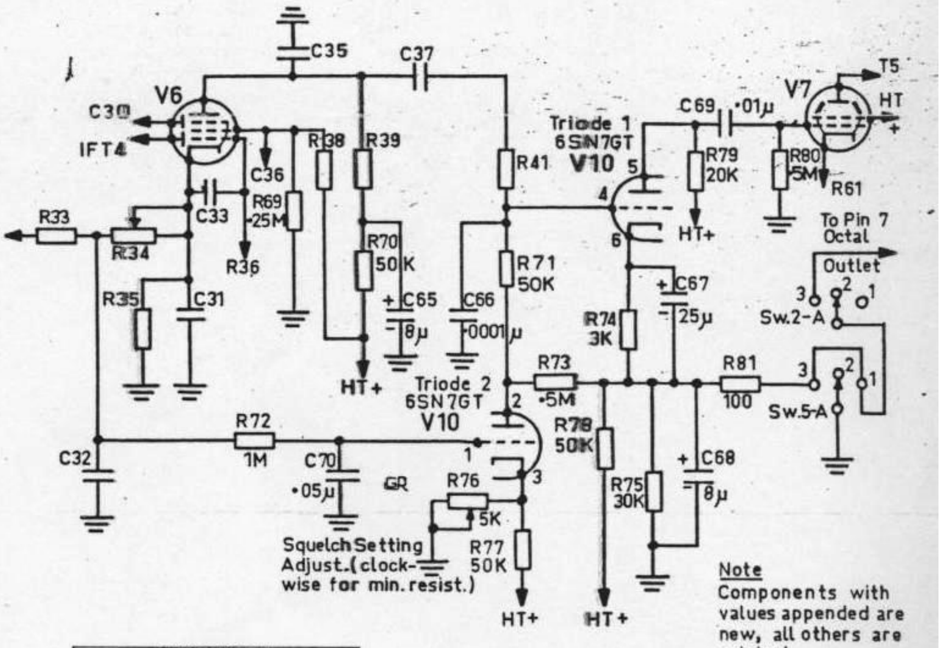


"S" METER

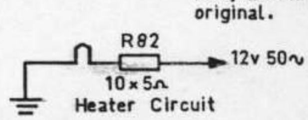
POWER SUPPLY. If the original power supply using the pair of 6X5GT valves is still intact, the high tension supply is very stable and there is no need for a voltage regulator. However if your AR7 has a typical "ham" built power supply a voltage regulator should be included to stabilise the oscillator HT to 100 volts.

IMPROVED BFO. Better BFO stability can be obtained by modifying the original to the circuit shown.

One half of a twin triode 6C8G tube is used in a series electron-coupled Hartley circuit as the beat frequency oscillator. Control of the BFO is achieved by means of a reactance tube using one half of a twin triode 6SN7GT tube connected across the tuned circuit of the BFO.



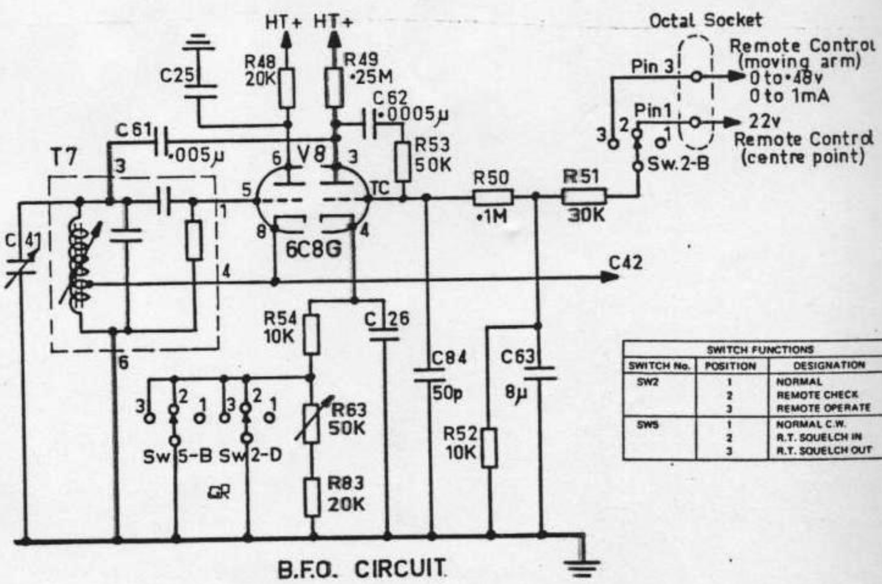
SWITCH FUNCTIONS		
SWITCH No.	POSITION	DESIGNATION
SW2	1	NORMAL
	2	REMOTE CHECK
	3	REMOTE OPERATE
SW5	1	NORMAL C.W.
	2	R.T. SQUELCH IN
	3	R.T. SQUELCH OUT



SQUELCH CIRCUIT

The effective shunt reactance thus added is dependent upon the grid-cathode potential of the reactance tube and so the frequency of the BFO may be varied by changing the voltage applied to a control line which feeds a voltage divider in the grid circuit of the reactance tube. A certain negative voltage on the control line will result in the BFO operating at 455 kHz, giving zero beat on the CW signal; an increase or decrease in voltage causes the BFO frequency to shift, with corresponding change in beat note.

Provision is made for operation of the receiver under normal conditions, i.e., full manual control. For "normal CW" (i.e., both SW2 and SW5 set at position 1) additional resistance (R63 and R83) is inserted in the cathode of the reactance tube to give a grid bias equivalent to that present when on zero beat with remote control. For all other conditions, including "normal R.T." operation this cathode resistance is shorted out. When "normal R.T." is used, there is also no external voltage applied to the reactance tube grid (the BFO control line being opened at SW2B), so this tube draws large current and BFO is rendered ineffective, its output being greatly reduced and frequency shift increased



SWITCH FUNCTIONS		
SWITCH No.	POSITION	DESIGNATION
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	3	REMOTE OPERATE
SW5	1	NORMAL C.W.
	2	R.T. SQUELCH IN
	3	R.T. SQUELCH OUT

B.F.O. CIRCUIT

so that the resultant beat note is beyond audibility.

No doubt many AR7's in use today are serving as IF strips for VHF converters or perhaps for HF net operation on 160 metres or other bands. Therefore the inclusion of a squelch circuit could be of great value. One half of a 6SN7 is used.

The rectified carrier appears across R33 and R34. This is applied to the grid of triode 2 of V10 through an RC circuit. The cathode of triode 2 is set by a potentiometer located in the former "Noise Limiter" position. This control is set so that an increase in the signal gives additional negative grid bias on triode 2 sufficient to cut off the plate current. This plate current flows through R73 which appears also in the grid circuit of triode 1. Triode 1 is an audio amplifier connected between the 6G8G (V6) and the 6V6G (V7). In the normal "no-signal" condition, triode 2 draws plate current and biases to cut off triode 1. An incoming signal removes this bias and the signal is delivered to the output circuit.

Provision has been made for local or remote control of squelch operation as required. For in-out switching of squelch, the junction of R75 and R78 is taken, via R81 to SW5A, and also to pin 7 of octal outlet, via SW2A. When this point is earthed (either locally by setting SW5 at position 1 or 3, or remotely after SW2 is set at position 3), triode 2 of V10 cannot draw plate current to cause cut-off condition in triode 1 of V10 and so silencing occurs. R81 reduces rate of discharge of C68.

Remote in-out switching of squelch is obtained by earthing pin 7 via the control line.

That concludes this series on the AR7. However, if you have any ideas that you have tried and proved, do not forget to let me know. When it comes to modifications and improvements, the subject is never closed.

QSP

EMP

"Ever hear of it?" asks WINJM in Sept. '73 QST Emergency Services column. "It stands for Electromagnetic Pulse, and is a phenomenon which results from a nuclear burst. Basically EMP has an effect similar to lightning but is not the same thing as it is caused by sudden release of nuclear energy. The EMP effect of a high altitude burst can extend thousands of miles beyond any of its other effects, possibly causing burnouts in unprotected communications equipment over such an area. EMP could wipe out much of our communications, especially our amateur communications just when it is most needed. Any piece of radio equipment using an antenna over four feet long is subject to burnout by EMP. So there you have it, a threat to communications that most of us never knew existed. Nothing is more susceptible to EMP (and lightning too, for that matter) than a repeater."

AUSTRALIAN STANDARDS.

The Standards Association of Australia has been busy lately on a number of revised and new standards affecting radio and similar components and accessories. A.S. 1042 (revises A.S. C42-1964 metrically), deals with electrical meters, definitions, classifications, permissible errors and reference conditions, variations, markings and so on. It extends to accuracy concepts as well as shunts and so on. Another, AS1127 Part 4, deals with dimensions of loudspeakers to facilitate rationalization and mechanical interchangeability. In continuation of AS1099 is another series of standard tests including two water-bath methods which obviously do not refer to the cooling of linear finals. Earlier standards published this year include AS1381 on fixed capacitors and amendment 5 to the Wiring Rules.

Intruder Watch

with Alf Chandler VK3LC

1536 High Street, Glen Iris, 3146

Just received a list of active Intruder Watch observers in the USA — 525.

There are 15 active in VK. Pity we cannot get more to take an active interest in this crucial activity. It doesn't take a lot of time, nor does it take much energy — just report when you hear and identify an Intruder. There are plenty in our bands. The identification tape has been played over the different State Sunday morning broadcasts quite recently and, if you require it, it could be played as often as necessary. Any Member wanting a copy can obtain one from me by submitting a blank reel or cassette. How about it? In the December issue of "QST" is a story by W1NF about Intruder Watching. It is good reading and well worth while your study. Since the summary displayed in the January issue the following are some stations that have been reported. —

14000-14200	A2	Jammer — a whizzing sound spreading across the band
14010	A1	F7A calling TBO
14103	A1	TB0 calling F7A
14023	A1	XBP sending calls only.
14039	A1	PBJ sending calls only
14075	A1	OUY calling ALT
14079	A1	WUF sending calls only
14100	A1	PJN calling BRA.
14122	A1	KLW using continental morse
14133	A1	SPH sending Vs and calls spreading from 14128 to 14138.
14268	A1	NDT-NPO-NPN calling GMV.
14293-14298	F1	RTTY stations signing HMB22, HMD7, HMD8, HMY26 in Korea and ZEO66 in Hong Kong. Read-outs have been submitted.
7019	A1	HMF21, HMR56, HME28, HMK71 signing "freq 11230-7015-13780-9404 Pyongyang

Keep these sort of reports coming in!!