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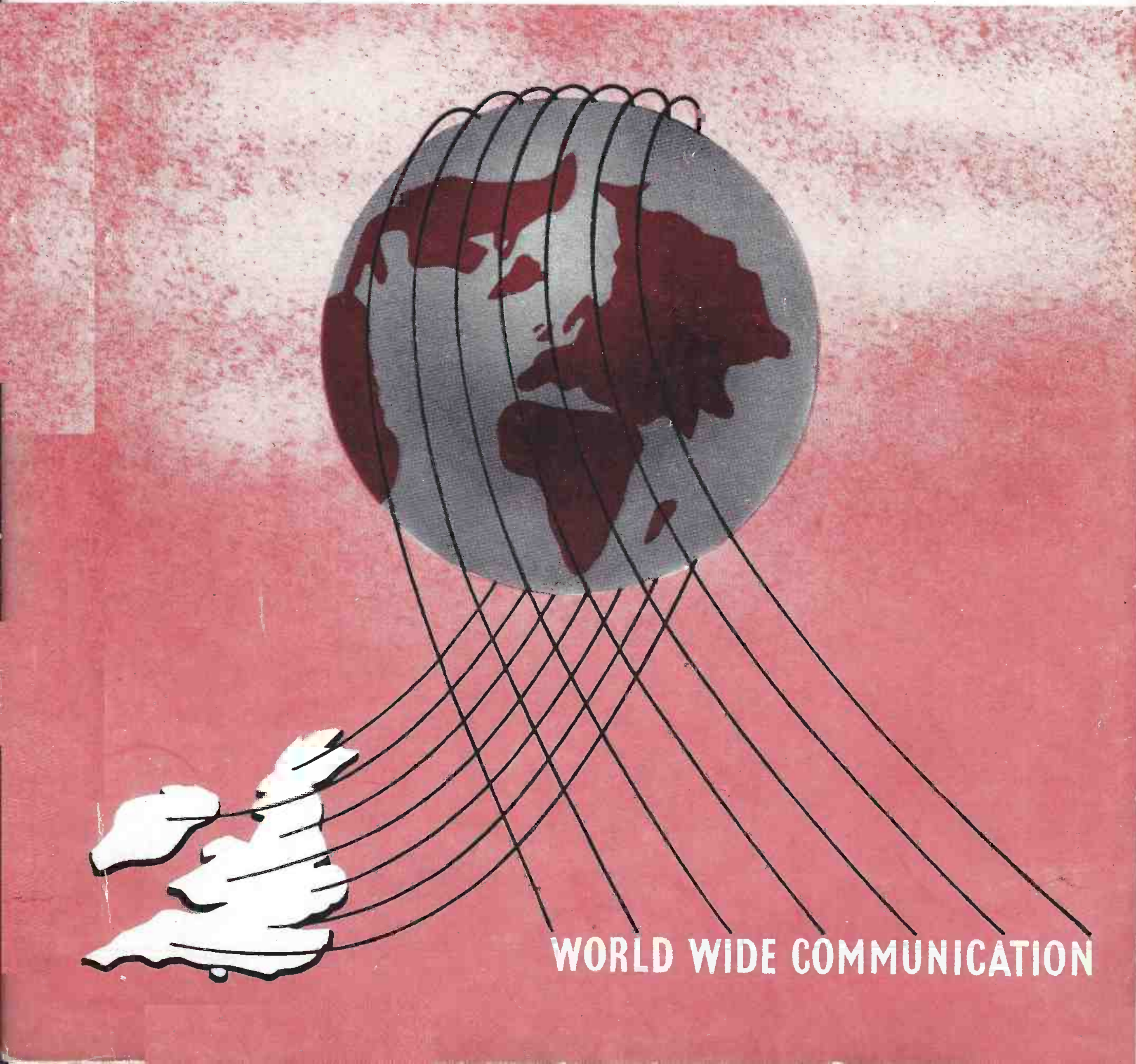
The SHORT WAVE Magazine

VOL. XII MARCH, 1954 NUMBER 1



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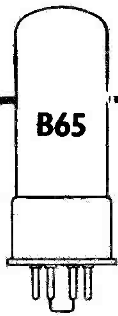

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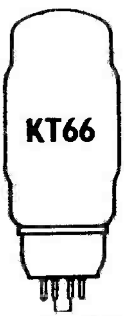

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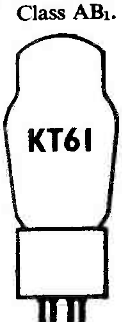

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SHORT WAVE MAGAZINE

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CONTENTS

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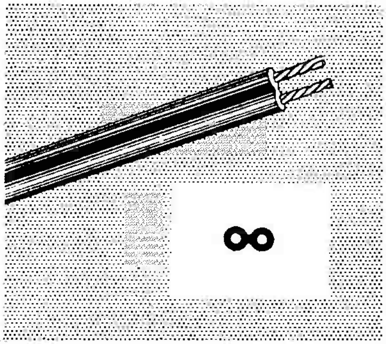

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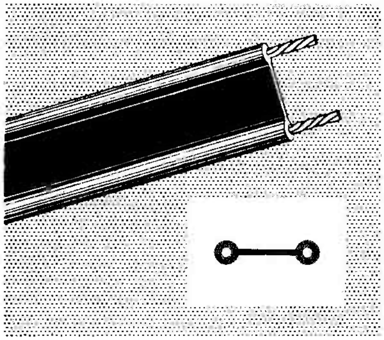

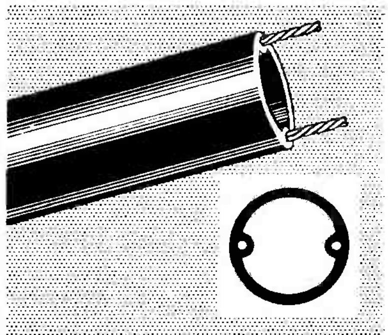

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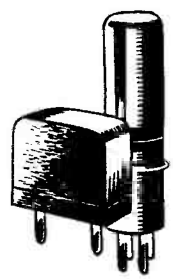

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The SHORT-WAVE Magazine

EDITORIAL

Outlook

Quite recently, we had a letter from an irate correspondent who concluded his fulminations with the following, written in red ink " . . . the amateur spirit is dead. Competitions and ladders are the curse of the hobby . . ."

Well, are they? Let us look at the facts. In the first place, nobody need enter a contest or run for a ladder unless he wants to—there is no compulsion about it! Secondly, how many do in fact go in for competitive radio? Taking all our own contests and ladders into account and then doubling the total of operators involved—to cover those who, while not actually appearing in the lists, either aspire to a place on a ladder, or enter a contest without sending in a result—we arrive at a figure which is less than one per cent. of the whole circulation of SHORT WAVE MAGAZINE.

Clearly, such a minority interest cannot possibly have the effect implied by our correspondent, which is that competitive operating has killed the spirit of Amateur Radio. And, anyway, is the spirit of Amateur Radio dead? As defined by an old timer it may well be rather a different thing today from what it was thirty years ago. But in the last 30 years the whole tempo and focus of the national life has changed, and Amateur Radio has changed with it. Amateurs themselves still represent a cross-section of the whole nation, just as they did thirty years ago. Since the ordinary human virtues of generosity, kindliness and co-operation have not changed, it follows that they are just as evident in Amateur Radio today as ever they were—if you look across the whole cross-section, and not just a narrow segment of it.

Those who make vague allegations about the spirit of Amateur Radio being dead are nearly always found to be the very individuals in whom the virtues to which we refer are conspicuously lacking. They want everything, while giving nothing. And there are more of them about, because there are something like ten times as many amateurs on the air today as there were thirty years ago.

Austin Forsyth
G6FO.

Transmission with Transistors

TESTING AND CIRCUITRY—160 METRE CRYSTAL CONTROLLED CW TRANSMITTER—HOME CONSTRUCTED TRANSISTORS

J. M. OSBORNE, M.A. (Oxon.) (G3HMO)

This important practical article will be of great interest to all readers keen to embark upon an entirely new line of experiment in the field of Amateur Radio. The author, having already obtained verified results—as reported in our February issue—using a home-made transistor and circuits of his own devising for a communication transmitter in the 1·8 mc band, discusses here the application of transistors for CW and phone operation. In a further article to appear in SHORT WAVE MAGAZINE, *he will show how point-contact transistors can be made on the amateur bench. Experimental work now in hand suggests many other interesting possibilities for the use of transistors in the amateur bands, and it seems likely that operation on higher frequencies should be feasible. This is only a beginning—we shall see great development as time goes on.—Editor.*

TRANSISTORS have come to stay and a few months ago the writer decided that it was time to take a practical interest in them. As a result of much experimenting it has now been found possible to make at home Point Transistors with quite useful characteristics. Further, using one of these transistors in a simple crystal-controlled transmitter, contacts have been established — as reported in the February SHORT WAVE MAGAZINE—over ranges of 30 miles or so.

The Point Transistor is nothing more than the conventional germanium diode with two cat's whiskers instead of one. One called the *emitter* behaves like the grid in a triode. This controls the current flowing through the other whisker, called the *collector*, which is equivalent to the plate. The germanium itself may then be compared to the cathode and is referred to as the *base*. It will be appreciated that the transistor has two big advantages over the valve : No heater is required with the corresponding saving in power and wiring. Also the size of equipment using a transistor can be reduced to minute proportions. A present disadvantage is, however, that owing to temperature limitations, the power which can be handled by the conventional point transistor is about 50 to 100 mW input ; and it must be admitted that as self-excited oscillators their frequency stability is generally poor.

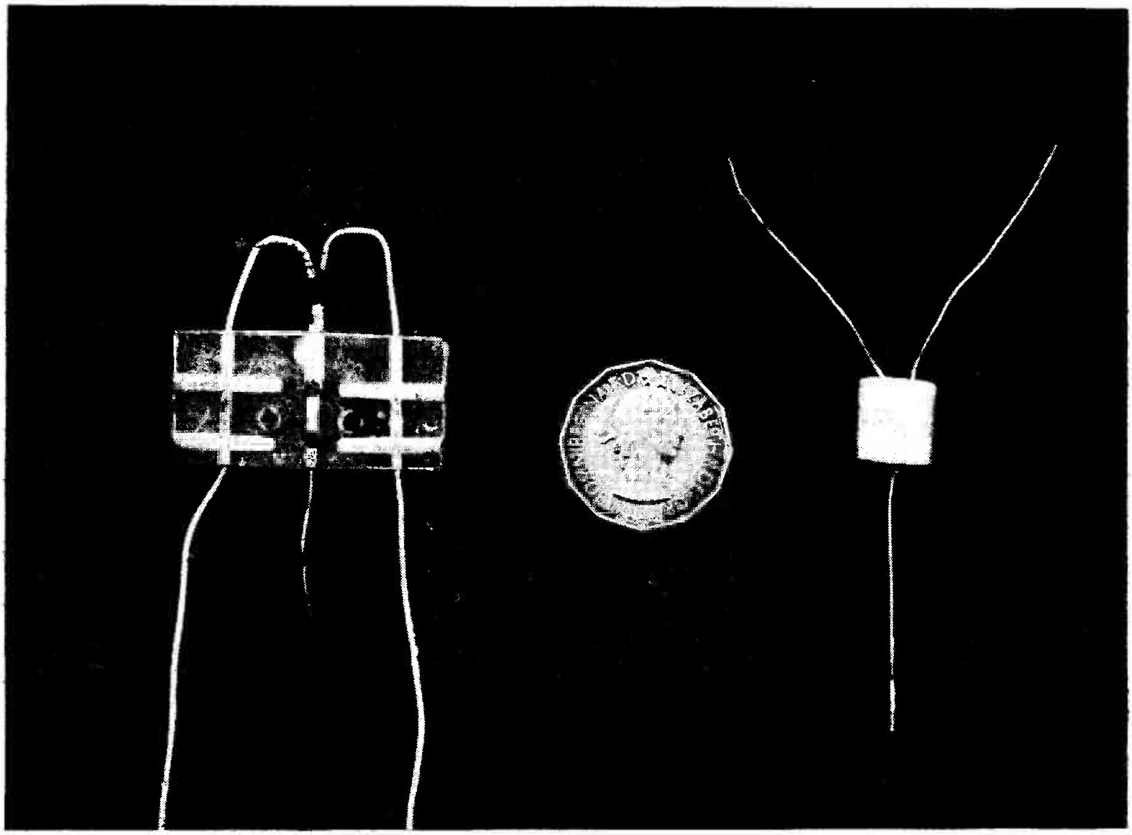
The Transistor Amplifier

In thinking about transistors, and using them in practical circuits, it must be realised that while the transistor will do much the same as the valve, it does it in a different way, and that although there is a basic similarity in most of the circuits, the details differ in one or two important respects. To illustrate this, consider the simple LF amplifiers in Fig. 1. The most noticeable feature is the reversal of the polarities of the power and bias supplies in the transistor amplifier as compared with the equivalent valve amplifier.

Input Circuit

It is not obvious from Fig. 1 that the transistor is a *current operated* device. To change the collector current the emitter current must be varied, while in the valve a change in grid *volts* produces the change in anode current. This means that the lower the resistance from emitter to base the smaller is the change in emitter voltage required to produce a given change in emitter current. Ideally, therefore, we should like a zero resistance between emitter and base.

In practice the emitter-base circuit forms a conventional crystal diode in which we have a high reverse resistance and low forward resistance. If the emitter is given a positive bias, current flows easily through the diode and we have a low resistance of about 500 ohms. Hence the input impedance of a transistor is very low while, as is well-known, the input to the grid of a valve is comparatively very high. While a crystal microphone may be connected straight to the grid of a valve, a moving coil matched to 500 ohms by a suitable transformer would be required to give the right input to the transistor.



At left, the home-made transistor, as constructed by G3HMO. The crystal itself is just above the centre-line through the perspex block, which is used simply as a support for the germanium triode and its electrodes. At right is a commercial transistor, the G.E.C. GET-1 germanium triode. The 3d. piece is for size comparison.

Output Circuit

The collector circuit is very much the same as the normal plate circuit of a valve—except that the collector is connected to negative HT. Being in effect a crystal diode circuit in the reverse direction, only a small current will flow and therefore the output impedance is high, say, 10,000 ohms. To obtain maximum output the load should be matched to this value in the usual way. In practice, for an experimental amplifier, a high-resistance headset provides a suitable load.

Current Amplification

Now the goodness of a transistor is measured by its ability to amplify current. The most remarkable feature of the point transistor is that a change of 1mA in the emitter can produce a change in the collector of perhaps 3mA, an amplification of three times. No explanation of this phenomenon is offered here as even the experts don't seem to have agreed on the reason yet. It is, however, the crux of the whole matter and the current amplification factor, usually denoted by *alpha,* is the best measure of goodness of a transistor, just as the (voltage) amplification factor is in the valve.

Testing Transistors

In the December issue of SHORT WAVE MAGAZINE there appeared an article on Transistor Test Circuits. While the treatment is logical, the results are not of much practical value since the characteristics are not measured under working conditions. However, the method described in that article under the heading "Current Amplification" for measuring *alpha* is very useful, and should be employed to check any new or doubtful transistor before it is put into operation. A practical circuit for doing this is shown in Fig. 2. In any transistor circuit a high resistance should be connected in the battery lead as a current limiter. This avoids damage to the transistor which would occur if the current "ran away." It does mean, of course, that a

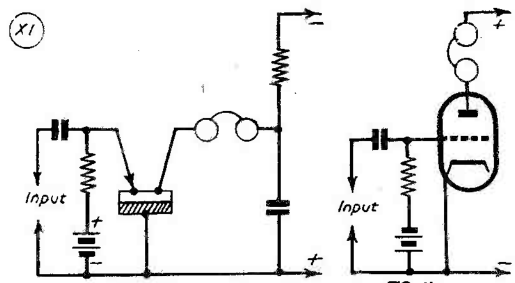


FIG 1a FIG 1b

Fig. 1. Comparing the circuitry of a transistor with a valve in the ordinary audio connection.

certain amount of power is lost in the resistor and a higher voltage is needed for the supply. It is worth noting that while testing circuits using a transistor the method shown here provides a useful variable voltage metered supply for the collector circuit.

In transistor terminology the initial letters of the terms "emitter," "collector" and "base" are used as the subscripts to V and I to indicate emitter current (Ie), collector volts (Vc), and so on, in the usual way. To measure *alpha* set Vc at −10 volts and measure Ic, leaving the emitter disconnected. Now connect the emitter and adjust Ie to 1 mA. Reset Vc to −10 volts and read Ic. The change in Ic in mA is numerically equal to *alpha*.

Input and Output Impedance

The input impedance can be measured using the ohms range of a normal multimeter. The positive terminal (which is at a negative potential owing to the internal cell) is connected to the base and the negative to the emitter. The value should be the normal forward resistance of a germanium diode, say 200 to 800 ohms. The output impedance is measured by connecting the negative terminal to base and the positive to collector. Alternatively, it may be calculated from readings of Vc with the emitter disconnected (*see* last paragraph). The Ic value may be between 5 and 50 thousand ohms.

Transistor as a PA

Suppose the transistor has an input impedance of 400 ohms, a current amplification of 3 and an output impedance of 10,000 ohms. Further, let us match the output with a load of 10,000 ohms. For an input signal of $\frac{1}{2}$ mA the input power is $\frac{1}{2} \times \frac{1}{2} \times 400$ (I^2R) which comes to 0·1 mW. The effective output impedance is the transistor output impedance in parallel with the load, *i.e.*, 5,000 ohms, and the output current is $3 \times \frac{1}{2}$ mA. The total power output is $3 \times \frac{1}{2} \times 3 \times \frac{1}{2} \times 5000$ (I^2R) making 11 mW. Of this half appears in the load making a useful output of $5\frac{1}{2}$ mW. The power gain is therefore $\frac{5 \cdot 5}{0 \cdot 1}$ or 55 times.

Oscillators

Now any amplifier with an overall power gain can be made to oscillate. All that is necessary is to feed back some of the output in the right phase to the input. This is delightfully easy in a transistor as the output is in phase with the input. To understand this phase relation compare the transistor and the valve in Fig. 3. Suppose that the grid voltage in *(a)* is increased (made more positive), then the increase in current through RL drops the voltage between anode and cathode. The anode goes negative for positive input. Now in the transistor *(b)*, the current is flowing the other way through RL so that increasing this current by making the emitter more positive causes the collector volts to go less negative, *i.e.*, more positive. Therefore the collector goes positive for positvie input. *Hence direct feed-back from collector to emitter will enable oscillation to be maintained.*

Simple Receivers

The frequency stability of such a circuit is poor and not suitable for a QRP transmitter. But it is a satisfactory way of applying reaction in a single-stage receiver. Using the rectifying action of an unbiassed emitter, a simple reacting detector receiver can be constructed along these lines. Two circuits are given in Fig. 4 showing different methods of connecting the emitter.

In Fig. 4 *(a)* the emitter is tapped well down the coil to provide the low input impedance. In Fig. 4 *(b)* by coupling the emitter to the

Table of Values

Circuit Fig. 2.

R1	= 10,000 ohms	M1, M2	= 0-5 mA meter
R2	= 20,000 ohms	M3	= 0-50 v. meter
VR1	= 10,000 ohms	B1	= 6v. Bias Battery
VR2	= 100,000 ohms	B2	= 45-150v. HT Battery

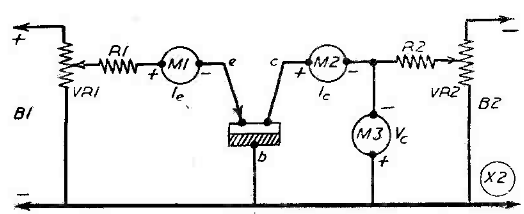
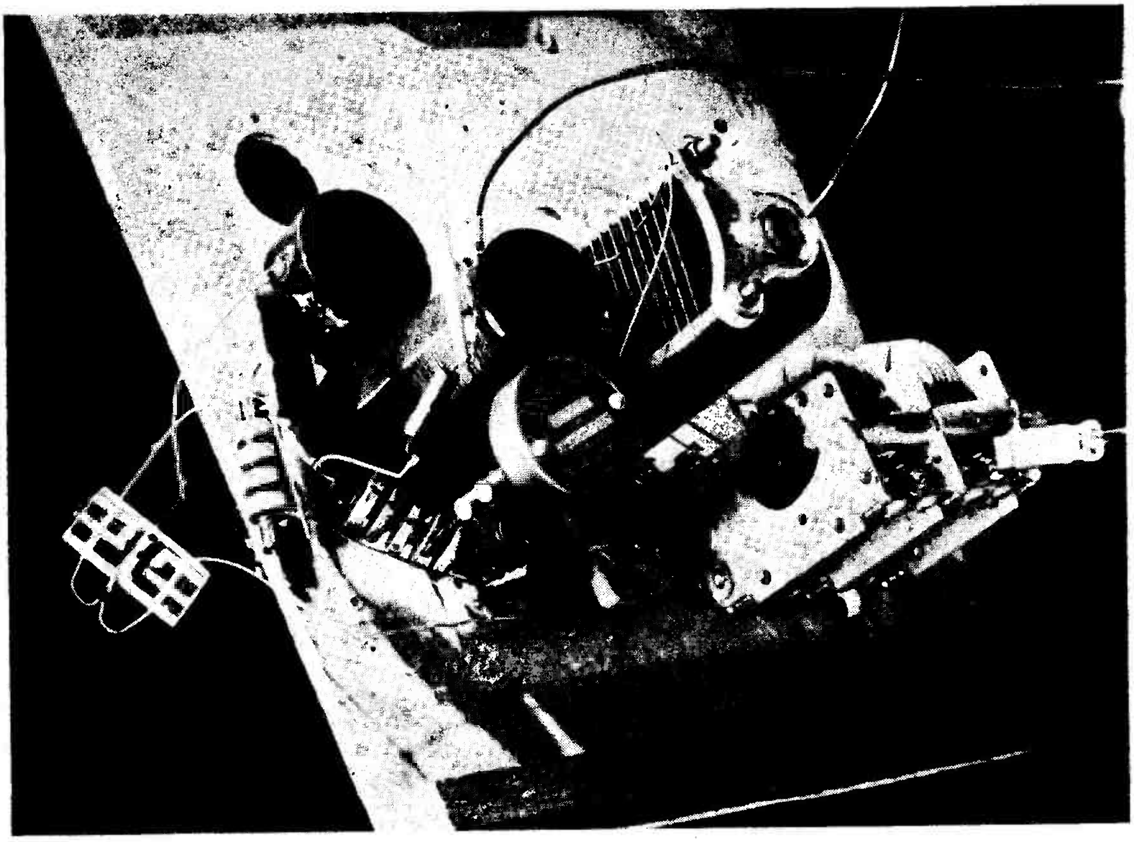


FIG 2

Fig. 2. Circuit for measuring the current amplification factor of a transistor. This is the essential value for determining its goodness.



The lash-up 160-metre transistor transmitter used by G3HMO for the over-the-air tests described on p.728 of the February issue. The home-made transistor can be seen lower left; the circuit of this transmitter, which was found to work quite well as a local phone receiver and to be capable of taking modulation, is as Fig. 5 (a) in the accompanying article. The transmitter has put an RST-449x CW signal over a distance of 34 miles with an input of a 50th of a watt.

" hot " end of the coil through a trimmer, C3, variable coupling can be obtained without the inconvenience of tapping the coil. The DC path for the emitter is completed in this case by an RF choke. The selectivity will be poor with only one tuned circuit, but such a receiver will give good phone reception of the locals on 160 metres.

The Transmitter

Crystal Control. For the QRP transmitter, crystal control seems desirable, if not essential. The method of incorporating the crystal shown in Fig. 5 is very simple and has proved most effective in a little Top Band transmitter. The reaction condenser in the previous circuit is replaced by the crystal, resulting in a solid lock and a T9 note. The crystal operates in the series mode as in the Squiers circuit explained in the July, 1951, issue of Short Wave Magazine. In this case we are not interested in overtones as the crystal is used at its fundamental frequency of 1858 kc.

Aerial Coupling and Loading. The tuned circuit may be connected in either the emitter circuit, as in Fig. 5 *(a)*, or in the collector circuit, see Fig. 5 *(b)*. It was expected that more power would be available in the latter case but with the home-made transistor used much better results were, in fact, achieved with the former connection. The aerial is connected directly to the tuned circuit using the Collins Coupler method of matching. The aerial current is too small to be detected by a thermo-ammeter and the use of a simple field-strength meter provides the easiest way of loading up. A suggested meter is shown in Fig. 6. A wire lying near the aerial lead provides enough input for the tuned circuit. The rectifier is a germanium diode and the meter one half of the familiar " surplus " Visual Indicator, Type 1, which is a sensitive micro-ammeter. In the particular aerial in use at the writer's QTH loading was achieved with C6 fully open, which agrees with the loading of the standard Top Band transmitter on this aerial.

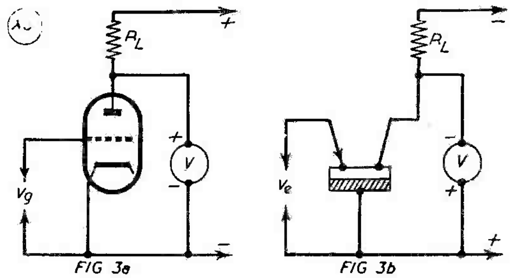


Fig. 3. Comparison of the phase relationship between the input and output in a valve (A) and a transistor (B), connected as an amplifier.

Keying. The key is in the battery lead. This gives perfectly satisfactory results and means that no switches are required. Press the key and the aerial radiates, raise the key and the set is closed down. No warming up, no heater supplies—just cold QSO's !

Modulation. Modulating a crystal oscillator is not satisfactory, but results have been obtained over a couple of miles using a form of plate modulation. The necessary modifications to the transmitter are shown in Fig. 7. A carbon microphone is connected to the primary of a suitable input transformer with a 3-volt energising battery. The secondary is put in the collector circuit and provides the equivalent of plate modulation. As only an estimated 20% modulation is obtained it is probable that better results would be possible using another transistor as a modulator. However, deeper modulation of a crystal oscillator may be unsatisfactory.

As was mentioned in the report in the February issue of SHORT WAVE MAGAZINE, local phone stations are receivable (with B.B.C. programmes in the background) on the Transistor transmitter. A headset is substituted for the modulation transformer—that's all !

Here we have a true transceiver capable of a few miles' range with a power input of about 20 mW. This is probably a good deal less than the PA *heater* supply in any valve QRP rig capable of equivalent performance.

Setting Up Procedure

There are several controls to be set to get the best results, all of which mutually affect each other. None of them seems to be very critical, but patience in trying different settings will be very rewarding.

(1) Put a voltmeter between the battery end of R1 and earth. Put a milliammeter in series with R1 to measure the collector current.

(2) With the HT plugged in, lock the key down and advance VR1 to 20 volts.

(3) Set C6 at maximum and C2 at about half mesh. Swing C1, watching the collector current. A pronounced rise of 10% to 20% in the current indicates oscillation.

(4) If no oscillation is obtained, try first increasing C2, and secondly, increasing the HT. Avoid increasing the input to more than 40 mW.

(5) Put the station receiver on the crystal frequency with the BFO on and gain settings about half. Rotate C1 while listening for the beat on the receiver. Check that the crystal is holding and that the note is satisfactory on keying.

(6) Connect aerial and put the pick-up lead of the field strength meter near the lead in. Tune the meter for maximum reading (the reading may be very small to start with.)

Table of Values

Circuits Figs. 3, 4, 5, 6, 7.

R1	= 10,000 ohms	C1	= 200μμF Tuning
VR1	= 50,000 ohms	C2, C3	= 50μμF Air Trimmer
L1	= Top Band Coil tapped 1/5th turns from earthy end	C4	= 2 μF Paper
		C5	= .01 μF Mica
B1	= 20-150v. HT Battery	C6	= 500 μμF Tuning

(7) Adjust C6 and retune C1 to get the optimum field strength reading, as when adjusting any Collins coupler network.

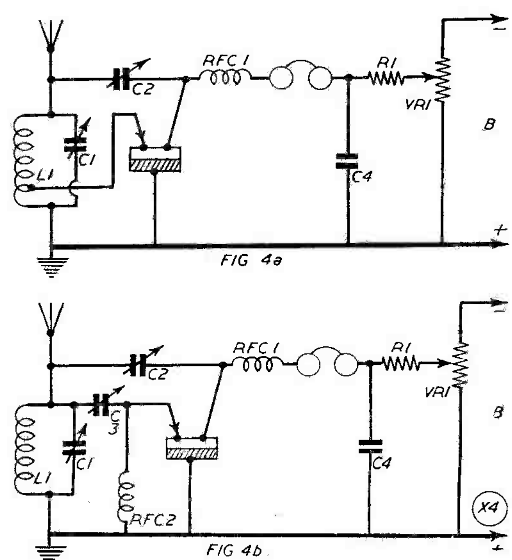


Fig. 4. A simple one-stage transistor receiver with reaction, controlled by C2, showing alternative methods of connecting the emitter (circuits A or B). In both circuits, L1/C1 are proportioned for the band to be tuned.

(8) Increase or decrease C2 and retune C1 with the object of finding the optimum emitter coupling.

(9) In difficult cases a 500-ohm variable resistance may be included between the base and earth. The whole procedure may be repeated at different settings of this resistor.

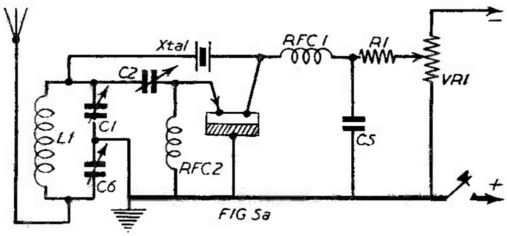
(10) Repeat all adjustments to get maximum output consistant with clean keying.

The Home-Made Transistor

The characteristics of the transistor used in this transmitter were: Input 500 ohms; Output 5,000 ohms; *alpha*, 4. The high value of *alpha* was obtained at the expense of a low value of output impedance. This is desirable, however, as the value of *alpha* decreases rapidly with increasing frequency and may be several dB down at 2 mc. The commercial GET-1 transistor will oscillate at this frequency but so far results have not been as good as with the home-made transistor. In the specification of the GET-1 *alpha* is said to be 3 dB down at 250 kc.

The cost of a commercially-made transistor is high. The only English one available to the public is the GET-1 at £3 and the delivery (at the end of 1953 anyhow) is about two months. R.C.A. transistors are priced at £6 to £12, according to type, and require a licence to import. So there is a lot to be said for making one's own transistors! In addition, the construction and processing offer almost endless scope to the keen experimenter and the satisfaction when one achieves a really good value of *alpha* is a reward in itself.

There is nothing impracticable about making a point-type transistor at home. It requires, in addition to the tools normally to be found in the workshop, a pair of fine tweezers, a strong magnifying glass and possibly a few simple chemicals. The materials used are a high reverse-resistance germanium diode, a small supply of fine phosphor-bronze wire and a few other oddments to be found in most home workshops. However, the task should not be undertaken lightly. Considerable patience and dexterity are required and success does not usually come quickly.



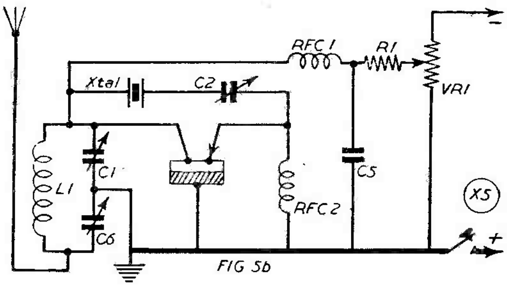


Fig. 5. Crystal controlled transistor transmitter circuits as evolved by G3HMO in the course of his experiments with home-made transistors. It will be noted that the C1, L1, C6 network is the usual Collins-coupler arrangement. Setting up procedure is discussed in the article.

A fully descriptive article on making up point-type transistors at home is in process of preparation, and will appear in due course.

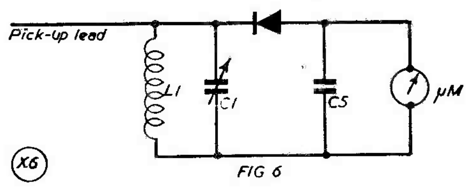


Fig. 6. It is a great advantage to have a sensitive RF indicating device available when setting up transistor transmitter circuits. This is the usual crystal-diode arrangement, but in this case it calls for a low-range microammeter and fairly tight coupling to the aerial lead on the transmitter. The usual rules apply as regards coupling, and maximum readings off the aerial indicate greatest RF output from the transmitter.

Finally, it should be mentioned that the results given in this article are not necessarily the optimum obtainable, but merely a record of what has been achieved to date. The information is passed on in the hope that it will prove a useful guide to those who wish to try this new form of valveless wireless now that spark is out—shades of 1920!

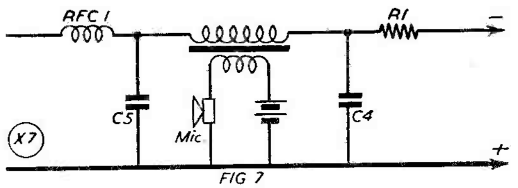


Fig. 7. With either of the transmitter circuits of Fig. 5 (A) or (B) modulation can be applied by the method shown here. With a strong oscillator and the crystal holding well, it becomes correspondingly more difficult to obtain full modulation. In general, the rules against modulating a crystal oscillator also apply to transistor transmitters, and an obvious line of development is a transistor PA driven from a transistor CO, with two more transistors operating as speech amplifier-modulator.

Screening Materials for TVI

RESULTS OF COMPARISON TESTS

R. GLAISHER (G6LX)

This article describes a very careful investigation, carried out by the author himself, into the screening properties of a wide range of materials normally considered to be of value for transmitter screening against TVI. He discusses in detail, the methods by which a standard was determined and the tests carried out, and his findings establish the most practicable materials to use for the purpose. This is one of those rare articles which gives the solution, found by pure experiment, to an urgent practical problem.—Editor.

PREVIOUS articles by the author on TVI suppression—" The Cure of TVI," SHORT WAVE MAGAZINE, October-December, 1952—provoked a certain amount of correspondence, from which it became obvious that grave discrepancies were being experienced in the results obtained with coppermesh screening materials. In some cases it was suggested that mesh gave little or no attenuation, and in others that the effectiveness of the material as a screen decreased after a few months' use. As a result of this a careful study was made of all the available literature on the subject of screening. Although it was obvious that great attention had been paid to the effectiveness of various materials as screens, the methods used in their evaluation appeared to be entirely qualitative ; there seems to be no standardised method for measuring the attenuation of a shielded enclosure. It was therefore decided to devise a means of measuring the effectiveness of screening materials at television frequencies and to use this to effect comparisons between the materials normally used.

After discussions with several amateurs and professional engineers it was decided to use simple apparatus consisting of a VHF signal generator feeding into an amplifier and a field-strength meter. The signal generator, PA stage, and a suitable non-inductive load were enclosed in a cage made of the material under test, and the leakage was measured with an indicator consisting of a rod aerial, a tuned circuit, a crystal rectifier, and a 150 μA meter.

Judging by some of the comments passed in letters received, it should have been possible to drive this meter off the scale at a distance of ten feet ! In fact, though, the screening proved to be far too effective, and it was obvious that the output of the screened transmitter would have to be increased considerably if any useful comparison was going to be made. Accordingly a three-stage crystal-controlled transmitter was built, feeding into a suitable non-inductive dummy load ; this gave a measured RF output of 12.5 watts at 50 mc. The transmitter, power-supply, and load were mounted on a framework 14 inches long by 9 inches high by 6 inches deep made of bright angle-steel. The framework was attached to a heavy base-plate made of 14 gauge copper plated steel, and the other five sides were covered with the screening material under test. The mains supply to the transmitter was filtered by a two-section resonant filter housed in a separate copper-plated steel box bonded to the underside of the base-plate.

Screens of various solid and mesh materials were cut to size so that they could be fitted tightly over the framework. About 20 different screens were tested, ranging from zinc household mesh to 14 gauge copper-plated steel.

Radiation Check

For measuring the output the construction of a special receiver was contemplated, but fortunately a television field-strength measuring set of U.S. manufacture was obtained on loan. This consisted of a battery-operated superhet receiver fitted with an output meter giving a direct reading of the strength of the received signal. The meter had three ranges, and by varying the length of aerial rod the range 25 microvolts to 1 volt per metre could be covered. It was thought that this wide range would suffice for the range of attenuation likely to be experienced in the tests.

When used with the unscreened transmitter the indicator had to be located at least twenty feet away, even in its most insensitive position, in order to keep the meter on the scale. At this distance a simple screen constructed of household zinc mesh gave an attenuation factor of about 20 dB. This screen was adopted as a standard, and gave a reading of 500 millivolts on the meter at a distance of 8 feet, using an aerial rod one metre long.

Scope of the Tests

A series of tests was then undertaken using screens constructed of several different types of

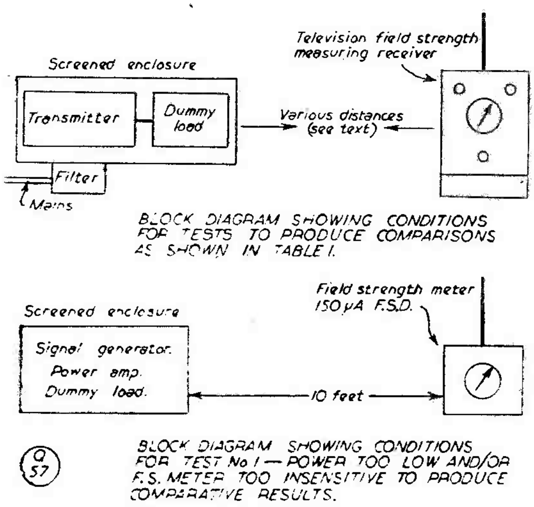


Fig. 1. Diagrams showing the test set-up, as explained in the text, to determine the relative screening value of different materials.

mesh and solid sheet materials of various thicknesses. In each case the material was new and in a bright, clean condition. Special attention was given to the bonding on the framework by drilling holes in the screens to line up with tapped holes in the framework. In addition, tags of 18 SWG tinned copper sheet were soldered to the bottom edges of the mesh screen to correspond with tapped holes in the side members of the chassis.

The results of these tests are given in Table 1. From this it will be seen that the last nine materials gave attenuation factors of more than 60 dB referred to the standard. These results are considered to be fairly pessimistic, as several writers had suggested that 120 dB attenuation was easily attainable with mesh, and well over 150 dB with solid materials. Even considering the original 20 dB attenuation of the household mesh standard, these figures did not show the effectiveness expected.

The outside of the transmitter was therefore carefully explored with a probe connected to the field-strength meter, and it was found that some signal was leaking through the exposed parts of the transmitter chassis (20 SWG tinned steel) and also around the joint between the chassis and the base-plate. The chassis was then reinforced with 16 SWG copper sheet soldered directly to the base-plate, and a further test with a probe indicated that a considerable improvement had taken place.

The zinc mesh screen was then replaced on the transmitter and on setting up the field-strength meter at its original distance of 20 feet an increase in attenuation was immediately apparent. The meter was then moved in to give a reading of 500 millivolts per metre with the standard screen, and the original readings were repeated. Little change in the individual readings was found, but the whole series had moved up by 20 to 25 dB. These figures appeared to be of the right order, but no absolute readings could be obtained, only comparative ones.

A few members of the South London TVI group had attempted to use mesh screens made of material similar to the 35 strand copper in use at G6LX. In some cases, though, these screens had given unsatisfactory results compared with solid sheet materials. Samples of this mesh were examined and it was noticed that considerable oxidation had taken place, the material looking quite dull beside the new mesh used in the test screens. A screen was constructed from this mesh and tested on the framework. The difference in attenuation between the new mesh and the oxidised mesh was marked, the new mesh being 15 to 20 dB better. The oxidised mesh was then lightly sandblasted, but although the surface appeared bright and clean, no great improvement was found when the screen was retested. This suggested that oxidation between the cross-overs of the mesh strands was causing the trouble.

Bonding Copper Mesh

The attention of the writer was drawn to a note appearing in the "Hints and Kinks" section of *QST* for December, 1952, in which WØNZQ mentioned that he had suffered similar troubles with the oxidation of copper mesh

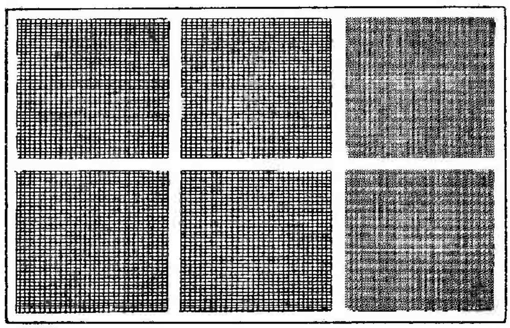


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Fig. 2. A good all-round screening effect is obtained with copper mesh, as shown in the Table derived from the experiments carried out by G6LX. Copper mesh can be further improved by a system of bonding, this being done by running molten solder to the pattern shown here. The squares are approximately two inches.

TABLE I

TESTS WITH NEW CLEAN MATERIALS

Material	Radiation	
Household mesh (Coarse Zinc) (*Used as Standard*)	500 millivolts per metre	
Coarse copper mesh (12 *strands per in.*)	60 mV/m (18 dB)	
Bronze speaker mesh (16 *strands per in.*)	9 mV/m (35 dB)	
Copper mesh (23 *strands per in.*)	1 mV/m (50 dB)	
Copper mesh (35 *strands per in.*)	490 μV/m	
Brass sheet (20 *SWG*)	400 μV/m	
Aluminium sheet (20 *SWG*)	390 μV/m	
Copper sheet (20 *SWG*)	360 μV/m	
Tinned steel sheet (20 *SWG*)	396 μV/m	*All better than 60 dB down*
Copper-plated steel sheet (20 *SWG*)	310 μV/m	
Dural sheet (20 *SWG*)	380 μV/m	
Copper sheet (16 *SWG*)	280 μV/m	
Copper-plated steel sheet (16 *SWG*)	240 μV/m	

due to weathering. It was suggested that the conductivity of the mesh could be improved by running lines of solder across the mesh at regular intervals in a criss-cross pattern (see Fig. 2).

In order to check the effectiveness of this procedure, a further screen was constructed of new mesh and treated as suggested in the *QST* article. The earthing tags along the bottom of the frame were carefully covered with plastic tape and the frame was "weathered" in a tropic proofing chamber until the mesh appeared well oxidised. The sealing tape was then removed from the tags, which were still bright and clean, and the screen was tested on the framework. The results obtained were beyond expectation: in fact, the treated weathered screen was about 6 dB better than the one constructed of new clean material.

Summary

To summarise, close-stranded copper mesh treated as shown in Fig. 2 provides an easily-worked material that appears to give effective screening around the present television frequencies in Band I (50 mc region). Solid sheet materials give so little improvement over the mesh that the additional cost and difficulties involved are not warranted; the difference between the mesh and the best of the solid materials tested (16 SWG copper-plated steel) was only a few dB at 50 mc.

When UHF television is established, however, the situation may be different, as mesh screens become less efficient with increasing frequency, whereas solid screens stay reasonably constant in effectiveness or even improve at higher frequencies.

HF Signal Booster

AERIAL COUPLING UNIT FOR THE RECEIVER

N. P. SPOONER (G2NS)

Here are more words of practical wisdom from a contributor of long standing, who always has something useful and interesting to say about the simple approach for better results. The idea discussed here is not new—but there are countless stations to which it could profitably be applied.—Editor.

ALTHOUGH cheap surplus relays will carry out almost every conceivable combination of station switching likely to be required, many amateurs who use them quite liberally elsewhere in the layout often hesitate to include a relay in the aerial change-over circuit. The directional properties of the transmitting aerial are thus lost for reception—unless of course some sort of complicated drill with crocodile clips is tediously gone through. The resulting line of least resistance usually produces an odd piece of wire as "a separate receiving aerial," together with a more vigorous handling of the receiver gain controls. While it is quite true that "If you can't hear 'em, you can't work 'em" this very action of "turning up the wick" often defeats its own object by drowning an already faint signal in a sea of noise.

In describing a simple signal booster that does not peak the unwanted noises the writer is prompted by the thought that many weak signals are perhaps being abandoned when by the insertion of a variable condenser and a coil between that odd piece of wire and the receiver aerial terminal they could be turned into copy. A few minutes' work will demonstrate the benefit of such a device and the required junk-box components are a 150 μμF variable condenser, the base from any old 4-pin valve, a 4-pin valve holder and a short length of wire for winding a two-band coil. The condenser and valve holder may be placed inside a metal box, although such complete shielding may not be needed in every instance. Moreover, with the suggested short length of balanced 300-ohm flat-twin feeder for coupling the booster to the receiver there should be little stray pick-up.

Construction

Details are only given for a combined 28 and 14 mc coil as it is upon these two bands that the peaking of faint DX is likely to be most appreciated. From the diagrams it will

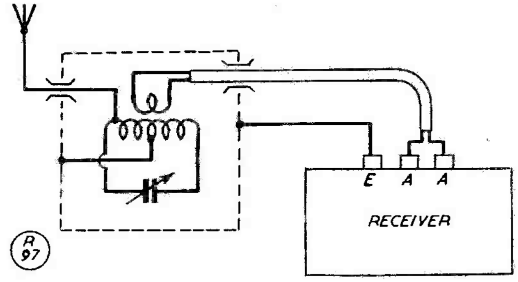


Fig. 1. Method of connecting the external tuned circuit to any usual type of communications receiver fitted with a doublet aerial termination.

be seen that the variable condenser is insulated from the metal box and its vanes are wired to the two filament terminals of the valve holder. The aerial is brought into the box to the anode terminal while the grid terminal is earthed to the box itself and an outside lead taken from the box to the receiver earth terminal. (In the writer's own case a strong absorption effect that occurred just before the 28 mc peak was reached was found to be due to too long an earth wire between box and receiver; the effect disappeared directly a short wide strip of copper foil was used instead). The 150 $\mu\mu$F variable condenser will tune to the 28 and 14 mc bands when placed at about one quarter and threequarter mesh respectively and is used with a coil consisting of six turns of bare 14 gauge wire wound to a diameter of about 1¼ inches and occupying the same length. The ends of the coil are soldered to the filament pins of the valve base, the centre-tap of the coil goes to the grid pin and the aerial tap, which is soldered to the anode pin, is at first left floating. The best position on the coil to which this tap should be made for 28 mc is found later by touching it against successive turns until the maximum increase of signal strength is obtained. Secured in such a position it will be found to be approximately correct for 14 mc also.

Coupling

Turning now to the coupling : The booster is placed close to the receiver and one end of the twin feeder taken to the two aerial terminals normally provided for doublet and other balanced inputs. The other end of the feeder is terminated inside the box in a two-turn loop of 18 gauge wire threaded through sleeving. This loop is pushed down between the centre turns of the coil and there left. To put the booster into operation it is now only necessary to switch the receiver to 28 mc, tune the booster for maximum signal or background and find the best aerial tapping on the coil. After soldering on the tap the booster requires no further attention, the one initial setting of the condenser holding good all across the band in use. To change bands the receiver is switched to 14 mc and the booster retuned for maximum signal or background after which it is left untouched.

Once it is fully realised by the novitiate that quite 75% of a station's performance depends entirely on the transmitting aerial the fullest pains are taken in its construction, erection and matching—so why should not the incoming signal also be given a little extra encouragement when no proper change-over system is in use ?

Though it has not been actually tried, the booster circuit suggested here could no doubt be used equally well on lower-frequency bands. All that is necessary is a coil of appropriate inductance for L1, and probably a turn or two more on L2.

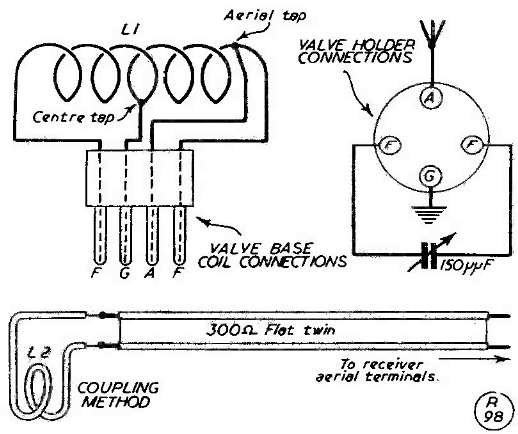


Fig. 2. Circuit and values of the HF signal booster as applied to the 14 and 28 mc bands for any usual type of receiver. The parallel condenser of 150 $\mu\mu$F has two settings, one for each band ; for 14 and 28 mc, coil L1 should be 6 turns of 14g. wound to a diameter of 1¼ins. and about the same length ; L2 is a 2-turn coupling loop in insulated sleeving, inserted into L1. Taps are taken out as explained in the article.

R.E.C.M.F. EXHIBITION

The exhibition organised each year by the Radio and Electronic Component Manufacturers' Federation will take place during the period April 6-8, as usual at Grosvenor House, London, W.1. This is an "invitation-only" show and brings together manufacturers, trade buyers, Service representatives, and scientists from all countries ; it is thus one of the most important shop-windows of the year.

Inductance Measurements Simplified

USING AN OSCILLATOR WITH A RECEIVER

R. A. PARROTT (G3HAL)

This is an ingenious arrangement which, while not being new, should be better known. In brief, it enables the receiver in conjunction with a simple external oscillator to be used for finding the inductance of coils of unknown values. It is a method of measurement which has a practical application at every amateur workbench.—Editor.

THERE have been many articles describing methods and equipment for measuring capacity, and from all sides one seems to be bombarded with the exhortation "Dig out those old surplus condensers and measure 'em!" This is most commendable, but how many old IF cans, oscillator and RF coils, and other types of inductance, both fixed and variable, are lying around in shacks, collecting dust and abuse, because there appears to be no way of measuring them without either buying or building — and calibrating — a high-frequency bridge? And how much time is wasted because a coil wound on a former with an iron-dust core doesn't tune the correct frequency, and the right number of turns has to be found by laborious trial-and-error because it is not known whether the inductance is above or below the calculated value?

This state of affairs need no longer exist! By using the method to be described anyone who has a calibrated receiver, a small condenser of known value, and a few odds and ends of the sort to be found in any junk box, can measure inductance with an accuracy at least equal to that obtainable with a home-made bridge, in less than a tenth of the time that the construction of the bridge would require.

How To Do It

First, a method must be found to make an ordinary tuned circuit oscillate, without having to adjust taps or add feedback windings. Those who already have them made up will find the dynatron or transitron oscillators suitable: people not in this category may find the circuit on the next page useful.

This is a very simple "two-terminal" oscillator, and will make almost anything oscillate, with the possible exception of a crystal. The version of this circuit at G3HAL is built on a chassis about 2″ x 2″ x 1″, with two terminals on one side so that the LC circuit can be hooked on and changed at will. Three leads bring in HT and LT and the unit forms a handy source of RF or AF with the least possible equipment or complication.

Having constructed the oscillator, or dragged from the depths an equivalent piece of equipment, connect to it the coil it is required to measure, with a condenser of 100 to 250 $\mu\mu$F across it. If the coil already has a condenser in parallel—for example, a tuned circuit in an IF can—no external capacity will be required. Oscillation should now be taking place at a frequency determined by the inductance of the coil and all the associated capacities, including valve and wiring capacities.

It is now necessary to find and measure this frequency. Using the calibrated receiver (or an uncalibrated one if an accurate frequency meter is available) search carefully until the note is heard. An absorption wavemeter will give a rough indication and narrow the search: It should be tuned for an increase in oscillator anode current. Note the frequency of zero beat in the receiver and continue searching, noting the frequency of each signal heard from the oscillator. Inspection of these frequencies will then show which are harmonics and which are second-channel responses, and the fundamental can be determined without the risk of error.

When this has been done denote the frequency obtained, f_1. Then add the condenser of known capacity, which should be about 10 per cent. of the value of the condenser used to tune the coil, and preferably ± 5 per cent. tolerance or better. This condenser is designated ΔC. A calibrated variable condenser can, of course, be used instead of two fixed condensers, ΔC being the amount the capacity is *increased*.

The frequency of oscillation will now be reduced a small amount, and should be found on the receiver and noted. It will be designated f_2, and with these three quantities, f_1, f_2 and ΔC, we are now in a position to perform the mathematical process necessary to find the value of the inductance.

Table of Values

The Reference Oscillator

L/C	= Tuned circuit	R2	= 1,500 ohms
C1	= 500 $\mu\mu$F	V1	= Valves such as 6SN7, 6SL7, 12AU7, 12AT7, 6J6, etc.
R1	= 68,000 ohms		

Formula

The formula to use is simple, despite its looks, and is :

$$L = \frac{K(f_1^2 - f_2^2)}{f_1^2 f_2^2 \;\Delta C}$$

where L is in μH, ΔC in $\mu\mu$F, all frequencies in mc and K is a constant = 25,330

Example

Let f_1 be measured as 3·850 mc, ΔC = 10 $\mu\mu$F, and f_2 found to be 3·708 mc.

$$\text{Then } L = \frac{25{,}330\,(3.85^2 - 3.708^2)}{3.85^2 \times 3.708^2 \times 10}\ \mu\text{H}$$

$$= \frac{25{,}330 \times (14.83 - 13.75)}{14.83 \times 13.75 \times 10}$$

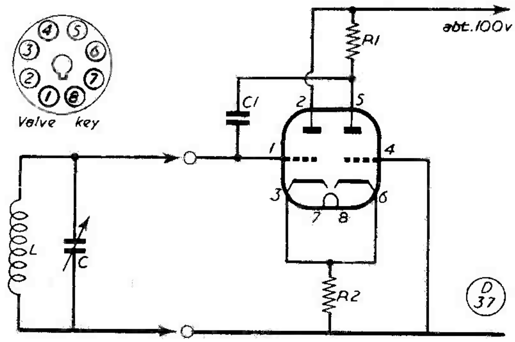
= 13.34 μH *(Using four-figure logs)*

Accuracy

The degree of accuracy to which inductances can be measured depends on *(a)* The accuracy of the frequency measurements, and *(b)* The extent by which the actual value of ΔC varies from the value marked on its case. For highest accuracy the frequency measurements should be made with a good frequency meter, but a reasonably well calibrated receiver will be sufficient for most purposes if the measurements are all made on the same band, *i.e.,* without moving the bandswitch. This is because any errors will generally be in the same direction. In fact, if the frequencies in the example were both 20 kc high the error in the measured value of the inductance would only be about 2 per cent.

In the case of ΔC the error is directly proportional to the inaccuracy of the capacity. The maximum error to be expected from this source when using a condenser of 5 per cent. tolerance would therefore be 5 per cent. and would almost certainly be less than this.

These figures are quite adequate for most amateur work, and it should be noted that by using this method it is the inductance alone which is measured. Most simple bridges compare reactances, which include the distributed capacity of the coil turns, and can lead to quite large errors. The wiring capacities and the valve inter-electrode capacities, as has already



Circuit of the two-terminal oscillator. This will go off with almost any value L, C, and is the basis of the method of measurement suggested in the article. Readings are obtained against the station frequency meter or a calibrated receiver. The unknown inductance is connected as L in this circuit.

APPENDIX

The theory and proof are as follows :

From the basic formula for frequency, $f = \frac{1}{2\pi\sqrt{LC}}$,

we find that $LC = \frac{1}{4\pi^2 . f^2}$, where L is in Henrys, C is in farads and f in cycles per second. In the more usual practical units of μH, $\mu\mu$F and mc,

$$L = \frac{10^6}{4\pi . ^2f^2} \text{ or } \frac{25{,}330}{f^2} = \frac{K}{f^2}$$

Let the frequency of L and C together be f_1, and the frequency of Δ C be f_2

$$\text{Then } LC = \frac{K}{f_1^2} \quad \ldots\ldots\ldots\ (1)$$

$$\text{and } L(C + \Delta C) = \frac{K}{f_2^2}$$

$$\text{or } LC + L\,\Delta C = \frac{K}{f_2^2} \quad \ldots\ldots\ldots\ (2)$$

$$\text{Subtracting: } L\,\Delta C = \frac{K}{f_1^2} - \frac{K}{f_2^2} \quad \ldots (2) \ldots (1)$$

$$= \frac{K(f_1^2 - f_2^2)}{f_1^2\, f_2^2}$$

$$\text{Therefore} \quad L = \frac{K(f_1^2 - f_2^2)}{f_1^2\, f_2^2\ \Delta\, C}$$

been mentioned, are included in the total tuning capacity. This is not used in the calculation of the inductance, and is therefore of no interest. It is for this reason that the value of the main tuning capacity need not be known.

While making no claims for originality, the author feels that this method may not be as well-known as its relative simplicity merits, and that its presentation may fill a long-felt want at many amateur stations.

TACKLING THE RADIO AMATEURS' EXAMINATION

PRACTICAL ADVICE FOR CANDIDATES

A. D. TAYLOR (G8PG)

The 1954 R.A.E. will shortly be upon us, and all those who are taking the Examination would do well to follow the advice in this article, by a contributor who has had much experience in examination work. There is time to make the most of his suggestions.—EDITOR.

In a few weeks' time several hundred candidates will attend at centres all over the country to sit for the City and Guilds Radio Amateurs' Examination. The vast majority of these will have spent much time during the past few months preparing for the examination, either on their own, at their local radio club, or at a technical college. The object of this article is to try and show prospective candidates how best to present their carefully-acquired knowledge in the examination room, how to make the best use of the three hours available and how, as far as individual temperament will allow, to overcome the bogey of "exam. nerves." The suggestions put forward are the result of a number of years' experience in the varied *roles* of examination candidate, lecturer and examiner. They have proved of great value when applied to groups of radio students in a large technical college, seeming particularly helpful to those students to whom examinations were but a dim, schoolday memory.

The subject is dealt with in three sections, one being devoted to the five weeks prior to the examination, one to the equipment which should be taken to the examination room, and the last to the actual examination itself. It is assumed that the student has available as many copies of past papers as possible, the many specimen answers published from time to time in this and other journals, and suitable text books covering radio theory and the G.P.O. licence regulations.

The Vital Five Weeks

By a date five weeks before the examination, any candidate with a reasonable hope of success should normally have absorbed sufficient basic knowledge. The task from then on is for the student rigorously to train himself to put this knowledge on paper quickly, coherently and accurately. Once this art has been mastered (particularly as regards the "stock" questions which inevitably form a fair proportion of this type of paper), the chance of a pass mark is enormously increased. Each day during this period, therefore, the student should try and do at least one question from a past paper, allowing himself twenty minutes in which to complete it. On the next day the answer should be critically checked against the appropriate textbook and any errors or omissions carefully noted. Questions on which the student finds he is really weak should be repeated a few days later, the subject concerned being read up in the meantime. At least once during the period, and preferably twice, the student should spend three hours in the quietest spot he can find, tackling a complete paper as if he were in the examination room. When completed, this should be critically checked for mistakes and omissions.

In answering the practise questions, the aim should be to present the answer in a simple and logical manner which leaves the examiner in no doubt as to what is meant. The correct technical terms should be used where necessary, also recognised abbreviations, but "radioese" should be avoided *at all costs*. Where recognised abbreviations are used, it is often convenient to introduce them first by placing them in brackets after the words they represent, *e.g.* "Fig. 1 shows the circuit of a simple transmitter consisting of a crystal oscillator (CO), frequency doubler (FD) and power amplifier (PA)." From then on the abbreviations alone may be used, as the examiner has been shown quite clearly that the candidate knows what they mean.

When a candidate finds there is something required in an answer which he either does not know or is vague about, bluff should never be resorted to! It is far better to say nothing on a doubtful subject than to embark on half a page of obvious "padding" which the examiner will detect at the first glance.

While this examination is not a test of either handwriting or drawing, a little care should be taken in setting out the answers to questions. As much paper as the candidate may require is provided free, so there is no excuse for cramped answers and postage-stamp sketches, which are a nuisance to those who have to look at them. Drawings (in particular circuit diagrams) should be made as clear and neat as possible. Coloured pencils can often be used to advantage in this respect, sometimes reducing considerably the amount of written work required in an answer. One example of this would be if the action of a full-wave rectifier circuit had to be described. Red arrows can be used to show the direction of electron flow when one anode is conducting, and green arrows the direction when the other anode is conducting, thus simplifying the written explanation. Where a question takes the form of a mathematical problem, each step in the working should be clearly shown, and the final answer should be written in bold figures and underlined so that it stands out. Where the answer is a quantity of a definite unit, *e.g.* "75 mA," care should be taken not to forget the *unit symbol.* For some reason, this is a common omission under the stress of examination conditions.

If the system of study outlined above is carried through, the candidate should, by the eve of the examination, have available in his head a series of concise answers to most of the more likely questions. In particular, attention should be paid to questions in the following categories:—

Requirements for the prevention of BCI and TVI.
Common filter and trap circuits.
Log keeping requirements and the layout of a specimen log sheet.
Frequency measurement requirements.
The action of simple absorption, heterodyne and crystal frequency meters.
The method of making a call.
The method of calculating the input to the power amplifier.
The action of a simple crystal oscillator and VFO and the relative advantages and disadvantages of these two methods of frequency control.
The action of half- and full-wave power supply circuits.
The action of a simple three-stage transmitter.
The action of a three-valve TRF receiver.
The block diagram and action of a superhet receiver.
The action of a simple modulator and the methods of checking for over-modulation.
Polar diagrams, principles and method of feed for a half-wave dipole, a full-wave end-fed aerial, and a simple two-element beam.
Licence regulations covering the use of supply mains and the degree of smoothing required.

These provide a solid foundation upon which the candidate should be able to build a successful paper.

What to Take to the Examination

Do *not* take any text books or radio magazines, as these merely put the invigilator to the trouble of impounding them for the duration of the exam.! While some candidates may wish to use a set of drawing instruments or a slide rule, the vast majority of candidates will find that the following list covers all normal requirements:—

One pen with which the candidate is used to writing.
One small bottle of ink.
Two black pencils.
One red pencil.
One green pencil.
One 6-inch ruler.
One india rubber
One halfpenny.

The last item is for use in drawing the circle around valves in diagrams. It is much easier to use and carry than a pair of compasses! All the paper required by candidates is supplied, so none should be taken.

The Examination

When notification of the time and place of the examination is received, the candidate should make sure that he knows exactly where the examination centre is, and how to get to it. On the day of the examination arrangements should be made to have a *light* meal about an hour before the commencement and to arrive some twenty minutes before the examination is due to start. Having found the examination room, the candidate should then make himself comfortable. Omission of this simple precaution may not merely cause great discomfort but interfere with the quality of work turned in. On returning to the examination room, the candidate should obtain from the invigilator his Examination Number (normally printed on a card) and an official answer book. He should then carefully fill in the yellow form at the front of the answer book, taking great care to see that his examination number is written in the correct place on both parts of the form. Arriving in time to carry out these formalities *before* the official commencing hour allows an extra five or ten minutes for answering the examination questions themselves, so it is well worth while.

At the appointed time the invigilator will open the sealed envelope and issue each candidate with a copy of the question paper. This should be read through slowly and carefully, questions which the candidate feels he can answer being lightly ticked with pencil. The paper should then be read through again, the candidate making quite sure that he fully understands the import of those questions which he is going to attempt.

Once the required number of questions have been selected, a start should be made. Any questions which involve problems should be tackled first while the brain is at its freshest. A careful watch should be kept on the time. An eight-question paper allows 20 minutes per question, *plus* 10 minutes at the beginning for reading through the question paper and 10 minutes at the end for the candidate to check over his answers. No question should be allowed more than 25 minutes unless the candidate finds he has got through earlier questions fast and has time in hand. If at all possible, the answers should be read over and checked before they are finally handed in. When this stage is reached, if the candidate has carried out his preparations carefully, he should leave the room with fair confidence in the final result. Good luck to you all!

DX COMMENTARY

VS2DB

CALLS HEARD, WORKED AND QSL'd

L. H. THOMAS, M.B.E. (G6QB)

THE same queer mixture of good and bad conditions has prevailed on all bands for the past month. One can tune round a band and imagine the whole thing to be useless, and then suddenly a signal will arrest one's attention and may turn out to be a VS6 or a JA2 or something even more interesting.

No one would call the bands reliable, though, and the pundits still insist that we are in for an even lower sunspot number this year than in 1953, making the earliest expectation of better conditions somewhere around the Autumn of 1955!

Let us not dwell on such dolorous subjects, but rather review the odd spots of news that are on the cheerful side. And this month, for a change, we will give the HF bands pride of place and talk about the Top Band later on.

The DX on 21 mc

G5BZ (Croydon) reports working VQ6UU and KV4BB, otherwise nothing of interest. G3CMH (Yeovil) had only one DX contact—on CW with VQ4AQ. He says most activity has been from Africa, with a peak on Sunday mornings, and the band conditions have been really poor.

G2YS (Chester) raised 4S7XG and VK2GW, both between 1000 and 1030 (and doubtless on a Sunday morning, although he doesn't say). G4ZU (Croydon) thought less than nothing of this band; he heard VQ6UU a couple of times, and says that the VS2's have told him that they can receive G's now and again on 21 mc, but get no response to their calls. G3DO (Sutton Coldfield) raised ZS9G on phone for a new one—otherwise nothing to report.

Twenty Metres

Nothing out of the ordinary has been observed on Twenty, although the East-West path is sometimes surprisingly strong around mid-day. One or two outstanding W's (doubtless those with outstanding aerials) brush all the European QRM aside and come busting through in grand style; and, once in a way, the West Coasters will follow suit later in the afternoon.

Sometimes the ZL's will be extremely good in the earlier part of the morning, followed later by the VK's and Asians; but on two days out of three this does not happen. Considering what we know about the sunspot cycle, though, it is surprising how much DX *can* be worked — and fairly consistently at that—on this band. Can it be that we shall all regret it when conditions improve and the QRM *really* gets going?

G6VC (Northfleet) mentions some stuff worked at what he calls "odd times," such as PY7FY (1100), HK1TH (1145) and a gang of VK, JA, OD5, FK8 and suchlike. He tried phone, but the best achievement was FA8CC.

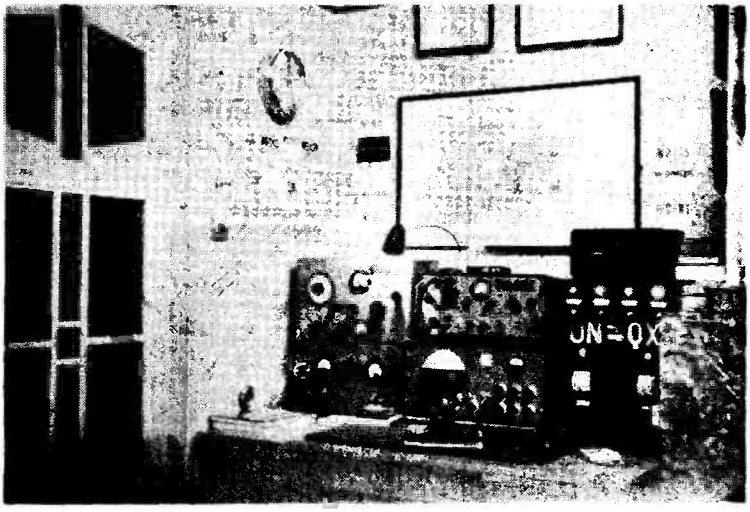
G4ZU unearthed a new one in the shape of MP4QAH on the Island of Hallul, Persian Gulf. Tony, the operator, thinks this should count as a new country, and has asked G4ZU to handle his cards, which he will be doing when the log comes to hand. (He is also handling those from ZB2A). Whether Hallul will eventually prove to be an addition to the list of countries, we don't know; nor do we know whether (if it doesn't do so) it will count as Bahrain, Qatar, Kuwait or what-have-you!

Others worked by G4ZU were VR4AE, LB8YB, VQ6UU, 4W1UU, VK9YY/FK8 (on phone) and F9QV/FC.

G3CMH thought conditions were somewhat better, and bagged VK2VA, VQ4AQ, ZE3JP and some VE's on CW, with MD5DO and VK4TN on phone, the latter at 1010. Heard on CW but not worked were EAØRA and MP4BBE; Gotaways on phone were FR7ZA and ZS3BC.

G5BZ reports contacts with VQ6UU. 4W1UU. VS1FH. VE8OG. MP4BBE and a bunch of VK's. But his operating hours were limited to just about one week-end.

G6QX (Hornchurch) raised OD5AN for a new one on the band, but otherwise was not impressed with conditions. 'QX had the misfortune to lose his long wire in a gale, and his beam also suffered; but he is having a bungalow built on a plot roughly 120-ft. square, so hopes to be doing some good next winter.



Station of ON4QX, Antwerp, who is exclusively CW DX-working on the 14, 21 and 28 mc bands, using ground-plane systems, an 807 PA and an SX-43 receiver with panoramic adaptor. In spite of his DX interests, ON4QX — who, by the way, is a Judge in his professional life — is always on the look-out for G's on Twenty.

TOP BAND COUNTIES LADDER

(Starting Jan. 1, 1952)

Station	Confirmed	Worked
GM3IGW	85	86
GM3EFS	82	83
G6VC	82	82
GI6YW	81	81
G5LH	80	80
GI3HFT	80	80
GM3OM	80	80
G3EIZ	77	78
G2NJ	76	76
G3HIS	74	77
G3ESY	69	69
G3HIW	68	75
G2YS	66	75
G3IVH	66	68
GC3EMI.	65	69
G3GZJ	65	67
G3HTI	63	68
G2AYG	63	64
G3BRL	62	62
G5JM	61	77
G3AKY	61	64
G8TS	60	67
G3CO	60	66
G3LP	60	60
G3CFG	59	62
G3DO	46	54
G3ITY	44	54
G8VG	38	51
G5FA	37	52
G2HKU	36	40
G3JEQ	34	63
G3HYJ	34	53

G6QX is one of many who complain about encroachments on our CW band. His objection is, principally, to the funny noises that occupy it from 14000 to 14050 most mornings—what they are, and where they come from, no one seems to know (but we can have a good guess . . . .). Other flagrant cases we noted during the month were of a 5A3 station (doubtless with a BC-610 at full belt) running phone on 14030, and making a five-minute CQ call at that; and of a UA3 putting phone on a carrier that was no better than T6, and working other UA stations, who were on CW. He was on about 14060 kc, as far as one could find a centre to the disturbance.

We are still waiting for the day when someone will invent a CW receiver that simply does not respond to any kind of phone; then both types can spread out and occupy the entire band. But what a hope!

Forty-Metre Doings

G5BZ continued his very successful skeds with VQ4AQ, and finally concluded them after 30 contacts, with a personal visit from VQ4AQ's XYL. Other contacts on Forty were with VQ2GW, VS9AS and PY2AJK.

G6QX bucked up his score on this band with 3V8AN, EA6AU, VQ3EO and OQØDZ. G3CMH only worked W's and CT2BO, but comments on the "interesting" Russian prefixes now heard on the band, such as UA9, UAØ, UI8, UJ8 and UL7.

G2YS collected ST2AR, VU2EJ and 5A2FA (all in the small hours), as well as VQ4AQ, 4X4FW, MP4BBE and ZD4AE during the evenings.

G4ZU was also busy on the band, adding 30 new countries to his Five-Band score. But they were mostly bread-and-butter stuff, he says, the interesting ones being KV4BB, LB8YB, OQØDZ, SV1SP and a three-way with VQ4AQ and ZS6AJC which started on CW and finished on phone.

GM3IGW (Alloa), one of our keenest Top-Band devotees, broke loose on Forty and raised CT2BO, MD5XZ, ST2AR, ZB2B, ZE3JP, 9S4BF and quite a few others—all on CW. Heard, but not worked, were such plums as FB8XX, LB8YB, VP8AK, 4S7XG, VK6RU and VE8OG (the latter at 1500).

Among the nicer ones known to be active, but not yet heard or worked by anyone who has reported, are HS1D (ex-TA3FAS), VR3D (7017 kc around 0800 GMT) and a new FK8 whose call we don't yet know.

Eighty Metres

Apart from the regular ZL-chasing crowd, no one seems to have been doing much real DX on this band of late. On quite a few mornings during 0700-0800 it would seem that it is easier to work ZL's on Eighty than on any other band, but nothing else of any great interest is around at that time.

G2YS reports working VO3X, VP6CDI, ZBIBF and ZD4AB, all between 0030 and 0430 GMT; G5BZ raised VQ4AQ for a new one on this band.

GM3IGW reports hearing VP6CDI, ZD4AB and ZE3JP, but nothing worked; and G3CMH mentions a "queer one" in the shape of MD5VC on phone. But as he was S8, 'CMH was rather doubtful about him. Other reporters merely mention European QSO's and, in some cases, "bags of W's" during the late evenings and nearly mornings.

In other words, as we said at the beginning, nothing of note.

The Overseas Mail

VQ4CW (Nairobi) has just returned after being in England for six months, and finds a batch of cards waiting for him, reputedly for contacts made during that spell! He wants to make it clear that any contacts with "VQ4CW" between June 1953 and January 1954 were *not* with the genuine one. Let's hope the pirate desists now that the real owner has returned.

VE3ATU, who is the chairman of VE3RCS (Vimy Barracks, Kingston, Ontario) says they would like reports from amateurs and SWL's over here, having just put up a new four-element 20-metre beam. Frequency is normally 14165 kc (phone), and the outstanding G phones are G3BTG, 3EHT and 3EOG. VE3RCS (which is a club station) will "always answer a G station in preference to other calls."

A new arrival in the Canal Zone is SU1MK, who will shortly be operating on 14 and 7 mc, starting on 7015 and 7040 kc with 15 watts input. He will be looking for G's most evenings. SU1MK thanks SU1FX and '1SX for their considerable help in getting him on the air.

DL2UY is ex-G3GPE, and he expects to be active until March 1956. The rig is a CO-PA for Forty (CO-FD for Twenty!) and has raised ZD4AB and TA3AA on the former band, with FQ8AP and VP2GRO on the latter. Ken, the operator, was also MP4BAD and YI1X . . . .

The former op. of ZC5VM is now home, and writes to say that if his QSL's have slipped up anywhere, he may be contacted now and will send off fresh ones:—Sgt. Mills, Beauval, Wise Lane, Borden, Sittingbourne, Kent. He tells us that there are three stations now operating in British North Borneo—ZC5SF, 5VR and 5VS. 5SF and 5VR are both using modified 1154/1155 rigs, mostly on Twenty, both CW and phone. All three can be reached c/o ZC5VS, Aeradio Box 136, Sandaken, British North Borneo.

ZC4JA (Nicosia) wrote in January to say that G's on the Top Band were heard out there as early as 1700 GMT, calls too numerous to mention. He adds that they don't seem to be listening for DX; he has called lots of them without success. By now, of course, we presume that 1700 would be much too early, with something more like 1900 or 1930 as the opening time. ZC4JA has been very surprised at getting his signals into G at all, as his aerial is only 160 ft. long and 20 ft. high.

G3IZJ asks us to tell all his 80-metre CW friends that he is now VP8AZ, operating from Port Lockroy, Grahamland. He hopes to do some work on the LF bands and will be listening during the remainder of the Trans-Atlantic Tests on the *Top Band*.

Concerning the recent mix-up about a YU station who said that he could not work G's . . . . there has been considerable correspondence going to and fro, and it turns out (as we thought) that the whole thing was a misunderstanding. Actually the YU concerned was working other stations and didn't *want* to work G's anyway! Or that's the present story.

4S7XG (Colombo) has been very active on 21, 14 and 7 mc. and pulled his score up quite a bit during BERU, in which he had 116 QSO's. Conditions generally have been very poor, though, and Peter says that 21 mc suffers chiefly from a lack of activity. When a week-end contest comes along, the band is full of signals, although conditions on other bands don't seem to have changed. Peter will be home in August — probably operating G8VG!

SU1SB is another new one in the Canal Zone, and there will be a little delay in QSL'ing, as the cards are not yet printed. But they will come in due course.

ZB1DHF is G3DHF when at home—which is not often, as he

FIVE BAND DX TABLE

POST WAR

Station	Points	3.5 m c	7 m c	14 m c	21 m c	28 m c	Countries	Station	Points	3.5 m c	7 m c	14 m c	21 m c	28 m c	Countries
DL7AA	639	84	146	216	89	104	221	G5FA	406	34	118	150	31	73	166
G6QB	587	52	107	220	73	135	234	G6QX	404	51	96	144	56	57	166
G5BZ	555	60	110	227	93	65	233	G2YS	380	52	68	142	74	44	158
G2VD	493	47	89	178	70	109	187	G2BW	350	24	57	144	82	43	155
G2WW	474	23	70	189	85	107	196	G3GUM	328	31	38	168	90	1	177
G4ZU	462	12	45	200	85	120	207	GM2DBX*	319	21	31	154	32	81	163
G2BJY	459	48	77	141	77	116	179	G8VG	278	35	76	123	18	26	140
G3DO	440	24	46	195	68	107	221	G2DHV	174	20	21	107	11	15	111
G3FXB	439	60	109	172	59	39	174	4S7XG	155	1	27	105	18	4	105

* (Phone)

aviates between 5A2, ST2, MD5, VQ4, VQ5, ZD2 and ZD4! In Malta, the rig is a "Type A Mk. III Transceiver with 5 watts RF into a nondescript piece of wire slung out of the hotel window." Activity on Forty produced 12 countries in a week.

ON4QX (Antwerp) has been a reader since our earliest days, and was licensed in 1936. Since 1952, he has kept to CW working on the DX bands, but is always glad of G contacts, as he is "an old Serviceman with many friends in England." During the occupation of Belgium, the Germans took away not only his equipment, but also the QSL cards and all his records. So ON4QX had to start again "from the bottom," as he puts it.

Top Band DX

There is a huge volume of Top-Band correspondence again this month, so we will divide it and take, first, the real DX doings, including the rather poor showing on the Trans-Atlantic mornings. For some peculiar reason, the days of the organised tests have been just about the least successful for Trans-Atlantic working; many of the weekdays in between have been much better.

Nice stations logged over here, but worked only very infrequently and by the lucky few, have been KV4AA, KV4BB, KP4KD and KZ5DE. All four of them have been heard at times when no W's or VE's were audible. Apparently on this band, as on the others, there are days when "West Indies" conditions are tolerable but the more northerly path is

". . . . No, old man, I am most definitely not using CLAMP modulation . . . ."

closed. VP7NM has also been heard and worked, and VP6EG has been in QSO with W's.

G3HRW (Acle) claims to be the most easterly station in the U.K. to work W's on Top Band! He is only seven miles in from Great Yarmouth, and 6in. above sea level. Between December 30 and the time of writing he had raised K2ANR, W2EQS and W3RGQ; CN2AO and ZC4JA put him into the "four-continents" class. A long wire (to be exact, 1290 feet) has helped a lot.

KP4KD claims G6BQ and EI9J as a couple of "firsts." The position of the "first" between W and GC is somewhat obscure, and the debate continues concerning the respective QSO's of GC2CNC/W2QHH and GC3EML/W1BB. The position is becoming so complicated that we back out of it completely. Our position is that of a reporter, not a learned judge, and we await an agreed statement from the parties concerned.

The following pathetic "*Small Ad.*" has been received: "Keen Top-Band type, on air every Sunday three months 0500 (two exceptions only) plus week-days as and when, with only one VE2 to show for it, offers for sale QTH with bone-dry gravel soil, zero feet a.s.l., well protected from Wx

TOP BAND TRANS-ATLANTIC TESTS 1953-54 SEASON

Remaining Date:
March 14

Times:
0500-0800 GMT

Frequencies:

U.K. Stations: 1830-1870 kc.
W/VE Stations: 1800-1825, 1875-1900, 1900-1925 and 1975-2000 kc. according to location.

and W sigs by steep hill. Consider exchange small hut Holsworthy or Weymouth. Offers to G6LB "!

G3GVA (Calne) sends an interesting log for January 17, but we are keeping all such logs for the complete summary of the Tests, which will appear in a later issue. Suffice it to say that he was hearing W's all the way through 0520 until 0805. Other interesting logs are to hand from G3CED, J. L. Hall (Beckenham) and R. H. Jeakings (Luton), with several bulletins from W1BB and W2QHH.

21 mc MARATHON

(Starting July 1, 1952)

STATION	COUNTRIES
VQ4RF	103
G5BZ	93
G3GUM	91
DL7AA	89
G2WW	85
G4ZU	85
G2BW	82
G2BJY	77
DL2RO	75
G2YS	74
G6QB	73
G3HCU (Phone)	71
G2VD	70
G3DO	68
ZS2AT	65
G3CMH	61
G3TR (Phone)	57
G3FXB	57
C6QX	56
G8OJ	53
ZE3JO	52
G8KP	50
VK2AWU	47
GM2DBX (Phone)	32
G2DPY	32
G5FA	31
G3WP	26
GW3CKB	19
G8VG	18
G2DHV	11
4S7XG	11

The Medium DX, Top Band

One of the blessings of this band (for us in the U.K) is the 10-watt limit. This puts anything over about 300 miles into the DX category, which can induce a pleasing glow in the mildest addict, but is strictly non-habit-forming. So it is nice to hear from HB9JJ, famous for his Liechtenstein expeditions as HE1JJ and HB1JJ/HE, that he proposes to visit Monaco this year for his holiday. He and SM5ARP will jointly operate 3A2BB for three weeks from May 5, and Top-Band operation is definitely scheduled. Two crystals are available, on 1829 and 1994 kc, and HB9JJ says he will use the 1994 frequency for G work. With two operators, the working hours will be generous.

G6VC has raised both ZC4GF and ZC4JA, and has already worked CN2AO, but he can't seem to get across to W or VE yet. G3HRW has bagged ZC4JA, CN2AO and two HB's; G2HKU (Sheerness) also makes it four continents with ZC4JA, as well as working EI9J, HB9CM and OK1HI. The ZC4 contact was made with 3.5 watts. 'HKU also says he heard GD3UB on this band, working PY7AN, but he couldn't hear the PY and thinks it might have been a cross-band contact.

G3JEQ (Great Bookham) makes it clear that DL2PA, suspect by some, is by no means phoney, and has come across with a nice QSL. He comments on the "infectious calling of ZC4JA, after one station's hopeful call," but remarks that it does leave the rest of the band nice and clear! Others also comment on this.

OH3PP seems to be active, and has been reported on the band by G3HTI and others. Maybe the OH boys will be allowed to make a very welcome return to this territory?

G3IVH (Norwich) has undergone a slight change in licensing conditions, as a result of which he has now dropped the "/A" suffix. He worked HB9T in broad daylight (lunch time) on December 20.

WABC and Local Working

G3CFG (Harpenden) tells us that he had never been near the Top Band until early in 1953, when he built himself a rig from the junk-box. Since then he has been exclusively on One-Sixty and says: "I can claim quite sincerely that it has been the most enjoyable period of my Ham Radio experience." He is on the brink of WABC with 62 worked and 59 confirmed.

G3WW (Wimblington, Cambs.) is on Top Band again, and says it is rather nice to be sought after, as a change from being one of *fourteen* active 2-metre stations in his county. He has raised OK1HI but has not yet been up in the mornings for the "real DX."

G2NJ (Peterborough) and G5JM (Buckhurst Hill) both worked a station signing MPQY at about 1530 on January 24. No clues except that the operator said he was "going on watch"—a ship station, obviously.

G3HTI (Cleethorpes) raised GM6JH in Linlithgow, West Lothian, for a new one. The GM has just returned to the air and has no QSL's as yet, but says that if the WABC boys insist he will get some printed!

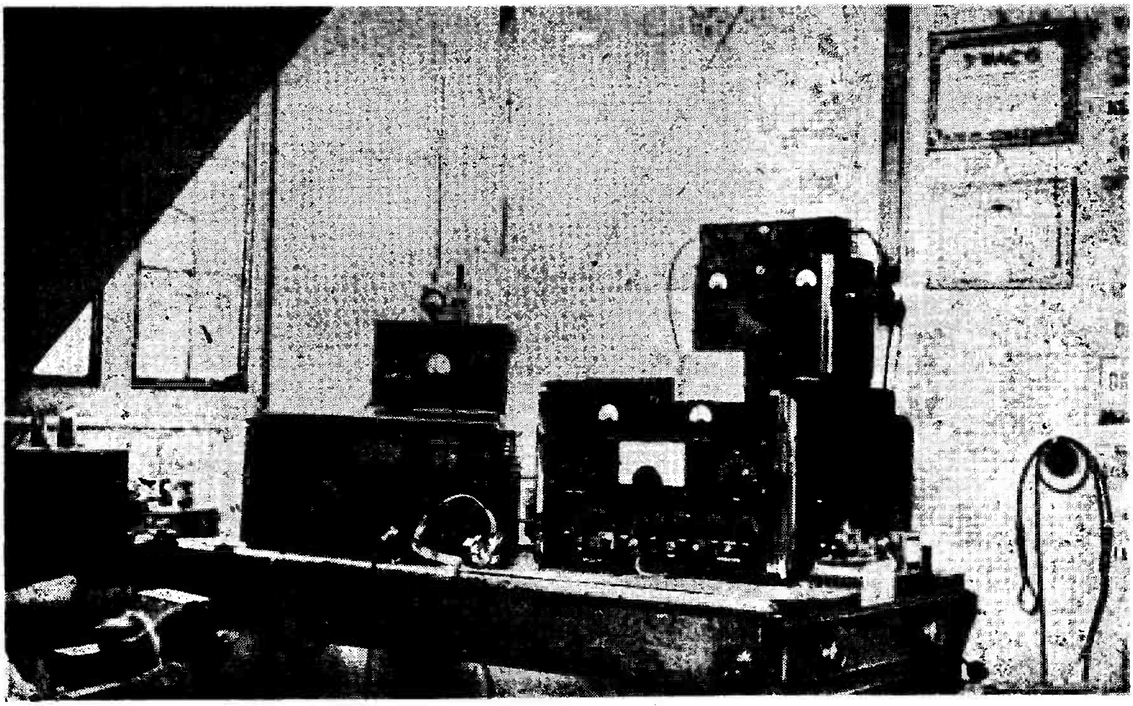
On the subject of QSL's, G3HRW remarks that he sent out over 100 and has had only 35 back, so now he has given it up. His "unconfirmed WABC" runs to over 70 counties—a bit hard.

G3CO (London, S.E.14) is the latest WABC claimant, GM3FSV (Orkney) having provided him with No. 60. He remarks that the signals from GM3JDR (Wick) are a good indication of the state of the band, and mentions GW3HDH in Brecknock. He also raises the old one about the Isle of Wight, which (sorry!), is definitely one with Hampshire.

G3DO has spent more time on the 1.8 mc band and has collected eleven new counties. He has a lot of blank spaces still in GM and GW.

General Chatter

Those who may feel that we devote excessive space to Top-Band affairs might be interested in this note from W1BB: "Several minor complaints are in from



The main station of G2NS, Southbourne, Bournemouth, which is always kept in a state of readiness; he also has a second, and entirely separate, operating position where things are not so tidy and experimental work can be done without having to worry about haywire.

SWL's and Hams, that *QST*, *CQ* and *SWM* don't give enough space to Top-Band reports, while giving plenty to the DX bands. They believe that *SWM* gives Top Band the best break, and feel that *QST* and *CQ* could do more . . . . "

(Some facts are that it was only in *Short Wave Magazine* that 160 metres first got any regular attention at all; this goes right back to pre-war days. It is because the potentialities of the Top Band have been so fully developed by the planned activity encouraged over the years through this Magazine that other certain periodicals concerned with Amateur Radio now give space to 1.8 mc.—*Ed.*).

G3CO recently spent a pleasant evening with LA6QB and his wife, and asks us to publicise the fact that the LB prefix is the official one for Norwegian portables only; stations on Jan Mayen should not rightly use it. There is always a scramble when an LB prefix is heard. He adds that LB8YB may be genuine, but is certainly not licensed; also that the station signing LB7YB/MM must have been indulging in a little private enterprise, as /MM operation is not allowed by the Norwegian Government.

G2HKU has received his WAE Award with 46 countries and 102 points; this was achieved with a maximum input of 21 watts, but much of it with a rig running on two HT batteries and then a vibrator unit, with powers down to 3 watts.

G6LX, who was out in Monaco last year and operated 3A2AY, passes on the information that the only genuine calls likely to emanate from the Principality now are 3A2AH, 2AJ, 2AM, 2AU, 2AX and 2BA—all residents, and all *phone only*. Any new 3A2 call coming up on CW (with the exception of 3A2BB, already mentioned) should therefore be regarded as suspect.

Four-Band Award

G8KU (Scarborough) asks for elucidation of the rules of the FBA. Others have done the same from time to time, so we will make them quite clear. To qualify, you must have 20 countries, each of which has been worked on four different bands. It doesn't matter *which* bands, but they must be four different ones; and they will not necessarily be the same selection of bands for all the countries. When we originated this award, we envisaged its straightforward application to the four bands 3.5, 7, 14 and 28 mc. Since then, however, 21 mc has been released, and a lot of medium DX has been worked on Top Band, and they could not be excluded. The effect has been that this award is now much easier than we ever intended it should be, and we are seriously thinking of closing it down and making, instead, a Five-Band Award covering the bands from 10 to 80 metres only.

DX Strays

TI9AA, if you hear him, will be DI9AA on Cocos Island, but the latest news is that he has a breakdown with the gear . . . . The VQ7NZK/VQ9NZK expedition has, we believe, been postponed again; but Jim of ST2UU promises another break from those parts before long, if his patience holds out and the pack behave themselves . . . . CEØ operation from Easter Island was covered last month, and the conditions still hold good . . . . FB8XX is on Kerguelen Island, and has already been making himself heard. He is on 7 mc as well as 14 mc.

KV4AA supplies the following mouth-watering information about DX in the Caribbean (locals to him!): Stations taking part in a daily 80-metre phone net include VP2VA (British Virgin Islands); VP2KG and 2KM (St. Kitts); VP2MC and 2MY (Montserrat); VP2DA and 2DL (Dominica); VP2AL and 2AJ (Antigua); VP2LA (St. Lucia); VP2SH (St. Vincent); VP2GX (Grenada); and a crowd of KV4's and KP4's. Now why doesn't Dick use his influence to get some of these types cracking with phone *and* CW on the DX bands? Have a look on 3865 kc at 1100 GMT, any day, and you'll find them all there (if you're a miracle man!)

Other nice calls being bandied about, but not heard by anyone over here, are VR6AC (7030), VQ8AB (7030), ZD8AW and/or ZD8EW (14 mc). The one and only station on Macquarie is using the call VK1AC instead of VK1CI, as mentioned before. He is VK3ACI.

That seems to be about the size of this month's news, so we will hope for an improvement in the bands with the coming of Spring. We might even risk the old crack about the sap rising early in the morning—it might be worth it by the end of March.

Deadline for all next month's news in first post on **Friday, March 19,** and for the month following will be *April 16*. Address everything to "DX Commentary," *Short Wave Magazine,* 55 Victoria Street, London, S.W.1. Until next month, we will say 73 and Good Hunting.

GW5FN, Rhiwbina, Cardiff, has been on the air since 1928, having first signed G5FN at Gillingham, Kent. The transmitter is totally enclosed in an R.1132 cabinet, and runs a pair of PT15's at 150 watts, the VFO is a Clapp 6AG7-6J5-6V6, and the whole outfit is fully TVI-proofed. Receivers are a BC-348 and an AR88, and the main aerial is a Windom.

ANTARCTIC DX STATION

VK1EG, MacROBERTSON LAND

R. B. JONES (VK3BG)

SOON to be active on 20 and 40 metre CW and phone will be VK1EG, on MacRobertson Land, the Australian sector of the Antarctic Continent, 1500 miles from the South Pole.

Bill Storer, radio operator to Australia's first permanent base on the Antarctic continent, can rightly claim that he is "rare" DX.

With the party he left Australia on the Danish polar ship, *Kista Dan,* under charter to the Australian Government, on January 4. He is located a little south of Lat. 70°, where the temperature rarely exceeds freezing point and drops to as low as minus 15° F. His equipment is a modified AT5, a war disposals transmitter used by the Royal Australian Air Force. It runs a pair of 807's in the final and is modulated by another pair of 807's. His receiver is a Hammarlund, and the aerial, probably a dipole, will be erected between some of the 70-foot steel poles (able to withstand 100-mile-an-hour gales and blizzards) to be used for the rhombic beam system for the commercial traffic to the Australian mainland.

Despite its isolation — it is ice-bound for 10 months of the year — MacRobertson Land is little further from the big cities of eastern Australia than, say, London is from Athens. His nearest amateur neighbours will be other VK1's at Heard Island, which is about 2500 miles south-west of Perth and 500 miles north of MacRobertson Land.

Bill Storer has taken with him a QSL which will be a prize to any amateur station or short-wave listener's wall. It shows the relationship of his base to the two sub-Antarctic VK1 bases at Heard and Macquarie Islands and the southern coast of Australia. It is in three colours—green, red, and black. On the back are the details of equipment, reports and so on.

G's fortunate enough to contact VK1EG—and he should not be difficult to work when the band is

Bill Storer, who will be signing VK1EG from MacRobertson Land in the Australian Antarctic during the the next twelve months.

open—will find him a man of knowledge on the Antarctic. He has visited all the Australian VK1 bases on a tour of duty.

With him will be nine others—eight Australians and a French observer. One of the Australians, Lem Macey, technical superintendent, was VK3OY with the pioneer party which landed at Heard Island in December, 1947. As yet he has not taken out a VK1 call. Should time permit, other members of the party will operate from VK1EG. They will have much to tell the world of Amateur Radio of the strange fascinations of this last continent, rich in minerals, possibly including uranium.

VK1EG's operation on the amateur bands will be dictated by the time he has available between his commercial traffic to the Australian mainland, domestic traffic and meteorological information. He expects to be on the air by about mid-March. Naturally, his prime interest will be the Australian mainland—where he has operated VK2EG for many years—but he will be looking for European contacts. His own ambition is to make DXCC during his 12 months on MacRobertson Land. Incidentally, among his various duties is that of acting as local postmaster—so he will be handling his QSL cards in two capacities! [*over*

Macquarie Island as it is to those who sojourn there. A small settlement on an isthmus between two bumps of high ground. The pinpoint is 54° 45′ South, 158° 35′ East, which puts it about 1,000 miles south of Hobart, Tasmania. Administration of these distant territories is under the Antarctic Division of the Australian Department of External Affairs.

It is difficult until things get under way to determine ionospheric conditions on 20 and 40 metres to Europe and the Northern Hemisphere generally. Signals passing through or originating in northern or southern polar regions are often affected by severe disturbances caused by ionospheric and magnetic storms which are frequent in these latitudes. Often these disturbances cause irregular reflection. MacRobertson Land may be just in or outside the southern auroral zone, which does not confine itself to within one circle of latitude. So only time will tell how the signals from VK1EG will reach the rest of the world.

Even emergency traffic would be quite possible by use of the amateur bands. Ice-bound for 10 months of the year and subject to blackouts on various frequencies, Bill Storer may have to use Twenty or Forty should emergency strike this isolated British outpost.

And remember, VK1EG is a first-class commercial operator. He can swing the key with the best of us.

"The Mobile Handbook"

THIS is a new addition to our range of publications which will be of considerable interest and real practical value to all who are in any way concerned with the design, construction or operation of mobile radio equipment on the HF bands.

Though written from the point of view of the American amateur—who is permitted mobile operation on all bands with any power he is able to generate—the principles and general treatment are, of course, equally applicable to any sort of mobile or /P installation in the frequency area 28 to 1.7 mc (10 to 160 metres).

A great deal of the information, circuitry and methods given in *The Radio Amateurs' Mobile Handbook* has come from American manufacturers of mobile radio equipment. There are valuable chapters on car electrical systems, power supplies, installation, control circuits and noise suppression, internal and external. Most of the constructional material—on converters, receivers, modulators, transmitters and aerial systems—is essentially practical and based upon on-the-road experience with the equipment described. Indeed, the author made his own first mobile contact in 1934. On the receiver side, there are descriptions of simple converters for use with an existing car radio set of the usual type (used as an IF/AF amplifier) as well as of a complete receiver designed from first to last for mobile operation on the HF bands, and claimed to represent the ultimate in the present state of the art.

The transmitter designs range from comparatively low-power (12 and 28 watt) installations for two or three bands, up to a big 300-watt job powered from an auxiliary engine-driven generator. The transmitters described are matched by suitable modulators, it being assumed that the objective is RS-59 phone working all round while on the move. The obvious problem of aerials, particularly for the lower frequency bands, is dealt with in detail, and many ingenious ideas are put forward for obtaining effective radiation off car-borne aerial systems of various kinds.

Naturally, the circuits, design data and constructional information given can also be applied to normal home-station installations, particularly if a compact layout is in view—hence, the book is of interest to the general reader and well worth its place on any radio man's bookshelf. From the point of view of the British amateur operator or professional engineer, it will suggest the answer to any /P problem where the aim is to instal equipment for the HF communication bands in car, boat or caravan.

Layout, illustration and presentation are neat and clean and, for British readers, there is some interesting and informative advertising which shows how far the Americans have got in the field of mobile radio —not that it is yet possible to buy any of their equipment over here!

The Radio Amateurs' Mobile Handbook, by William I. Orr, W6SAI, published by the proprietors of *CQ*, 192pp., 6½-ins. by 9½-ins., with 244 diagrams, tables and photographic illustrations, under 46 main headings. Obtainable from stock, price 17s. 6d. post free, of the Publications Dept., Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

INDEX — VOLUME XI

Every copy of this issue of SHORT WAVE MAGAZINE went out with an extensive and carefully compiled Index to Volume XI—as a loose insert, and free of charge. A study of this Index shows the extraordinary range of interest and activity covered in the Magazine during the last twelve months. Any reader who does not find the Index in his copy of this issue can have one on application with a *stamped addressed envelope.*

CARDS IN THE BOX

If your call-sign appears below, it is because we are holding cards for you at our QSL Bureau, and have no forwarding address. Please send a large stamped addressed envelope, with name and call-sign, to BCM/QSL, London, W.C.1, and the cards will be forwarded on the next G clearance. If publication of your call-sign/address is also desired, that should be mentioned at the same time; it will then appear in our "New QTH" feature and in the *Radio Amateur Call Book,* the American publication which is still the only directory to the amateur stations of the whole world.

G2AGB, 3IZS, 3JDW, 3JFI, 3JJV, 3JTT, 8PT, GC3BDB, GM3CGH, GW3ZU

TRUTH AND FICTION

SPROG'S* GUIDE TO THE BANDS

(To be taken with a Pinch of Salt)

J. G. MILLINGTON (G3JGM)

HOLDING probably the first G3J — call issued, anyone can see that we must have bags of operating experience, the fruits of which we hasten to serve up to fellow-sprogs whose experience is not quite so vast! Since most of the manuals are definitely misleading, the following notes should give a truer bearing on matters. Let us begin with the real meaning of the RST code, set out below:

R1	—	*This is a private QSO. We didn't ask you to call in.*
R2	—	*If you will send at 30 w.p.m. . . . !*
R3	—	*I have no actual objection to a QSO with you.*
R4	—	*I can read your call and my RST report.*
R5	—	*Jolly fine QRS, OM. Mni tnx !*
S1	—	*73 es bcnu.*
S2	—	*What, you again !*
S3	—	*Ur tx needs an ant.*
S4	—	*O.K., but make it short.*
S5	—	*Of course, I may have too much selectivity in.*
S6	—	*You only gave me S7.*
S7	—	*S9 really, but who wouldn't be with your power ?*
S8	—	*Thought I'd give you a 9, didn't you ?*
S9	—	*You have bent my S meter needle.*
T9x	—	*I shall be visiting ur QTH shortly.*
T9	—	*Same as R5 q.v.*
T9c	—	*I have an fb VFO for sale.*
T8	—	*You may nw take umbrage !*
T8c	—	*I do not wish to work you.*

There are no other T signals, whatever the books may say, but other important signals are:

FB	—	*Could you please lend me . . . ?*
OM	—	*Either we have never worked before, or I hve forgotten ur name.*
OB, OC	—	*Vy tnx ur fb rpt.*
73	—	*I want another QSO nw.*
88	—	*If u were /T, I might mean this.*
QRZ	—	*I am sick of sending CQ.*
R	—	*If u think I bothered to take all that gen on ur rig . . . . !*
K	—	*My wrist is getting tired now.*
QRQ	—	*I had two DX QSO's while u were sending ur call.*
QRX	—	*XYL QRM.*
QRM	—	*Pse QRS.*
QSL	—	*The walls of my shack are peeling.*
CUAGN	—	*I wonder !*
FONE	—	*I am tired of sending QRS to u.*
Wx	—	*Almost QRU.*
Hi	—	*I hpe my last remark did not offend u.*

With the exception of the oblique stroke, which is obligatory in certain call-signs, there is only one punctuation sign known to ham radio, *viz.*, the long break (dah-dit-dit-dit-dah). This is used when trying to think of something to say next. Three consecutive long breaks at the beginning of a QSO signify that the operator keeps a card index, and if followed by "GE OM," you can be sure you haven't worked him before. Intelligent interpretation of this technique may save you the trouble of keeping an index yourself. Three long breaks at the end of a QSO, however, will be followed by "So 73 OM es bcnu," etc., and are a signal to start looking round the band. Some crafty operators, however, finish their final with TSE, and expect a couple of E's back in return. If they don't get them, they rightly infer that you weren't listening, and won't work you again. A stand-by receiver is needed to defeat this kind of thing!

Old Timers sometimes say that the most successful operators are those who choose one band and stick to it. In view of this, a brief summary of the characteristics of each band may be of value, especially for frequency checks.

160 metres :	Unmodulated carriers continuously running, spaced about every 10 kc and spasmodically modulated with unintelligible gibberish believed to be about shoals of kippers.
80 metres :	Modulated carriers running continuously with intelligible gibberish. Several hundred CW signals at every degree on the dial.
40 metres :	Super-QRO stations giving interesting output statistics of factories in Omsk, Tomsk and Plonksk. Brass bands and talks about communal tractors.
20 metres :	FB DX all the time. Except when you are able to operate. At such times, a rushing noise like a ball tap system, or the plaintive kilowatts of DL/W's calling to their mates.
14 metres :	They say it *has* been open !
10 metres :	The peace which sunspots have brought to a tired band, with a noise like frying eggs in the great silence.
2 metres :	Motor ignition, trolley buses and vacuum cleaners, all S9 plus at this QTH.
70 cms :	One QSO per annum.

Disgruntled indeed would be the keen ham who could not find ample scope with so wide a choice, and such unfortunate ones will be confronted with the dreadful prospect of six months' QRT to build an SSB rig, and then having either no QSO's at all ("Something seems wrong with your modulation, Old Man"), or being confined to 80-metre phone. Maybe those operators who were working below 1800 kc during the last Top Band contest knew what they were doing after all!

* (*Sprog :* R.A.F. term for "Beginner.")

EARLY QRP DX RECORD

Arising from recent discussion in SHORT WAVE MAGAZINE about amateur exploits in the early days, it is worth mentioning that as long ago as 1926 the French station F8OL, of Mendon (Seine-et-Oise) made WAC ("Worked All Continents") with an input of *one watt.* Those who know would probably agree that it was actually easier to do it then than it would be now, due largely to the QRM conditions prevailing today and the fact that in the mid-1920's sunspot activity seemed to be exceptionally favourable. Nevertheless, it was an outstanding achievement by any standard, especially when it is remembered that in those days our gear consisted of SEO transmitters and 0-V-1 receivers.

Horn Beam for VHF

SOME DESIGN CONSIDERATIONS

W. SCHREUER (VK2AWU)

There are all sorts of aerial arrays possible for the VHF bands. Here is a beam which, if designed for two metres, can be used effectively on 70 centimetres as well, without any change —and with a bigger gain on 430 mc, since the gain increases as the frequency goes up.— Editor.

A FEW years ago the writer contemplated operation on the 144 mc band, and consideration was given to an efficient radiating system. The frequency appeared sufficiently high to permit the use of a wide-band (low Q) radiator, and the use of a pyramidal horn at first appeared possible. Further examination, however, showed up the difficulty of feeding such a device, as the use of waveguides at 144 mc is obviously out of the question. For various reasons operation on two metres had to be postponed indefinitely and the problem was shelved.

Modified Horn with Direct Excitation

An article [1] by D. O. Morgan recently provided new interest in the problem. Morgan points out that as only one particular plane of polarization is of interest, only two triangular areas of a pyramidal horn need be enclosed by conducting sheet or wire mesh. When these conducting sheets are insulated from each other, direct excitation at the apex of the horn by a transmission line is possible.

In a normal pyramidal horn, all four triangular areas are covered with conducting sheet or wire mesh, but when *horizontal* polarization alone is of interest—as in amateur VHF work —only the *vertical* triangular areas need be so covered. The rectangular aperture of the horn is always in a vertical plane and the system is uni-directional, away from the apex. A 60° horn, *i.e.*, one in which all linear dimensions are equal, is most suitable from mechanical considerations and, furthermore, possesses a convenient radiation resistance. Fig. 1 shows such an arrangement. It must be noted that the two conducting areas are insulated from each other, therefore the horizontal members of the aperture must be of timber or other non-conducting material. Only the 60° horn, with linear dimension D as shown in Fig. 1, will be considered.

Bandwidth and Gain

The pyramidal horn is a high-pass device. Its cut-off frequency corresponds to $D = \frac{\lambda}{2}$, and it will work up to infinitely high frequencies, the gain increasing 6 dB every time the frequency is doubled. The power gain [2] relative to a half wave dipole at frequencies higher than cut-off is given by

$$\frac{8.4\ A^2}{\lambda^2}$$

where A is the area of the aperture or mouth of the horn. For the modified 60° horn this becomes

$$\text{Power Gain} = 8.4\ D^2$$

where the linear dimension D is expressed in wavelengths.

When D = 1 the power gain is 8·4 or approx. 9 dB. A horn with $D = 1\frac{1}{2}$ and gain of 12 dB on the two-metre band, will have $D = 4\frac{1}{2}$ and a gain of 12 + 9 = 21 dB on the 70 cm band.

Radiation Resistance

This varies somewhat near the cut-off frequency, having a maximum value of 480 ohms when D = 0·75 . Between D = 1 and D = ∞ the radiation resistance falls very gradually from 420 to 380 ohms. Also at D = 1 and larger, the reactance at the feed point, *i.e.*, the apex, becomes insignificant. The table in Fig. 2 summarizes the behaviour of the feed point. A transmission line of 400 ohms is easily constructed; it is, however, doubtful whether the mismatch caused by the use of a commercial 300-ohm line is of any consequence.

Practical Considerations

The gain figure of an aerial system, though useful, does not specify the polar diagram.

D in wavelengths	Resistance at Feed Point in ohms	Reactance at Feed Point in ohms	Gain dB
0.5	400	300	3
0.75	480	100	6
1	420	60	9
1.5	400	30	12
2	390	10	15
∞	380	0	∞

Fig. 2. Theoretical characteristics of a 60° Horn Beam.

Direct comparison between the modified horn and other types of aerials is not easy without specifying a number of factors. It can, however, be stated with confidence that a given horn aerial will have a wider horizontal pattern and a lower angle of radiation than a single multi-element Yagi beam having the same gain figure. A horn with D = λ is probably equivalent in performance to a well-designed uni-directional "2 over 2."

The outstanding advantages of the modified horn aerial are the simplicity of the feed requirements, complete absence of need for critical adjustment and the possibility of multi-band operation with a "flat" transmission line. A horn initially constructed for the two-metre band will give an additional gain of 9 dB when used on 70 cm. On the other hand, when only moderate gain figures are desired on one band, the horn is structurally more complicated than the usual sharply tuned aerials, though the reverse is probably true when high gain figures are sought.

Vertically stacking two modified horns is a distinct possibility for lowering the angle of radiation without sharpening the horizontal pattern. The axis-to-axis spacing of a stacked pair of horns should be odd multiples of half a wavelength and in practice cannot be less than 3λ when D is larger than $\frac{\lambda}{2}$. But owing to the relationship between the 2 m and 70 cm bands, a stacked arrangement will be useful on both frequencies. The radiation resistance is affected only to a very minor extent by stacking, so that the obvious combination of 300 and 150 ohm transmission lines results in a practically "flat" multiband system.

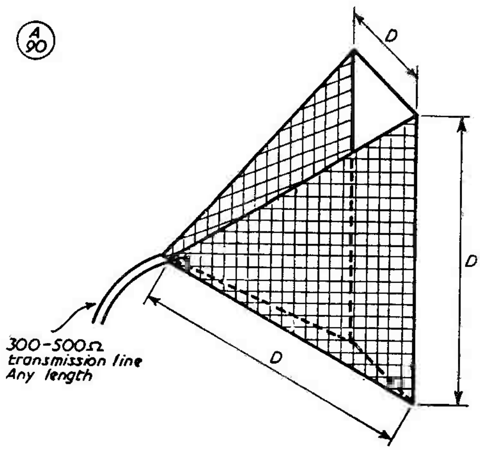


Fig. 1. The modified 60° Horn Beam. The vertical triangular areas are covered with wire mesh and are insulated from each other. A beam of this sort can be fed with 300-ohm line, and if built for two metres, can be used "third-harmonically" on 430 mc without any alteration, the gain increasing as the frequency goes up. The feeder connection is made to the mesh sections.

Conclusion

This article is based solely on theoretical considerations, no practical results being available. This is hardly desirable, but is it felt the subject may be of sufficient interest to the VHF experimenter, being a somewhat unusual approach to the VHF aerial problem.

References

(1) "Horn Antennae for Television" by Dean O. Morgan, *Electronics* (USA), October 1951.

(2) *Radio Engineers' Handbook*, 1st edition, by F. E. Terman, page 826.

AMATEUR HISTORY — WHAT NEXT?

Arising from the controversy with the BBC and Sir Noel Ashbridge on matters discussed in our last two issues, we would first of all like to thank all those who have written expressing their firm approval of the line we have taken and their complete agreement with the views we put forward. Many of these correspondents have naturally asked "What happens next?" The answer is that it is now high time an authentic History of Amateur Radio was written, with dates and facts, so as to support any future arguments that may arise on the same subject. Accordingly, we have suggested to the Radio Society of Great Britain that something in the nature of an "Agreed Statement of the Facts" should be prepared for joint publication, this to be widely circulated for the information of all concerned. The broad facts are as given on pp.727-728 of the February issue of SHORT WAVE MAGAZINE, but this calls for considerable filling out as to details, such as dates of first DX contacts on the various bands, periods by which world-wide working has been achieved, comparative commercial development at those times, and so on. It may as well be admitted here and now that by about 1937 amateurs had lost their long lead on the HF bands, and with the coming of the 1939 War and the tremendous impetus it gave to radio research and development, anything contributed by amateurs in the early days was completely submerged—lost and forgotten. But the wheel has turned full circle, for once again we see the importance of the amateur contribution in the field of VHF communication. Every commercial or Service VHF system is designed, installed and operated on the fundamental conception of line-of-sight working. It is the amateurs alone who can show that for a significant part of the time —whether considered as a week, a month or a year— communication well outside line-of-sight ranges can be relied upon.

Two-Band VHF Receiver

TWO-METRE AND 70-CENTIMETRE RECEPTION WITH COMMON IF/AF AMPLIFIER

PART I

R. F. WESTON (G2BVW)

In this article, to appear in two parts, the author describes in full detail the design of his two-channel VHF receiver. This is completely self-contained, in that by suitable switching arrangements and proper choice of IF tuning range and local oscillator injection frequencies, it gives reception over either the 144 or 430 mc bands. The design, basically, is a suitable converter or "RF front end" for each band, with an oscillator-multiplier chain common to both, feeding into an IF/AF amplifier section built to modern communication receiver standards. A VHF receiver on these lines is not, perhaps, everybody's meat, particularly at those stations where VHF working is not the only interest. But the ideas put forward by our contributor and the points he makes will be of great interest to all readers who are engaged upon VHF receiver construction of any sort. —Editor.

IN the opinion of the writer, we must at some stage in our development of and operation on the VHF bands come to realise that if we use converters on two metres and 70 cm only, then that thing which we call a receiver is actually a whole conglomeration of separate pieces of equipment joined by a multiplicity of supply leads. In such a receiver set-up we tend to duplicate stages unnecessarily, *e.g.*, "head amplifiers," crystal multiplier stages, and so forth, and apart from the items involved, the lethal potential of the whole can be quite high unless everything is properly earthed down.

Further consideration of the use of separate converters shows that unless a fairly versatile type of construction is used it is necessary to build new local oscillators or crystal multiplier chains nearly every time a new converter is made and experimentation is curtailed through the complexity of the job. The answer to this would, one supposes, be the use of a separate oscillator system, but this only adds another piece of equipment ! If we are not careful we finish up (as the writer did) with eight separate pieces of gear, *viz.*, one 2-metre converter, two converters for 70 cm, two oscillator chains for the converters, power supply, power supply switching unit and the station receiver into which everything was fed !

With the above problems underlined many times by continuous experimental efforts to produce different and better 2-metre and 70 cm converters, the writer came to the conclusion that the only real answer was in the construction of a receiver into which all permanent equipment was built and the experimental parts made detachable. For example, the entire IF system, the local oscillators and power supplies built in permanently with sufficient room left in the right places for detachable front ends (RF and FC stages).

It is felt that the decision to leave the front ends detachable is a good one, especially for 70 cm work, for new techniques and ideas are continually coming up and their value can only be assessed by personal trial, preferably with identical ancillary equipment used in all tests and measurements.

The receiver to be described eliminates any duplication of stages, it provides for reception of a band of frequencies in the 30 mc region *plus* the frequencies for which "front ends" are added, it is one piece of equipment, and can be made 100% safe to handle.

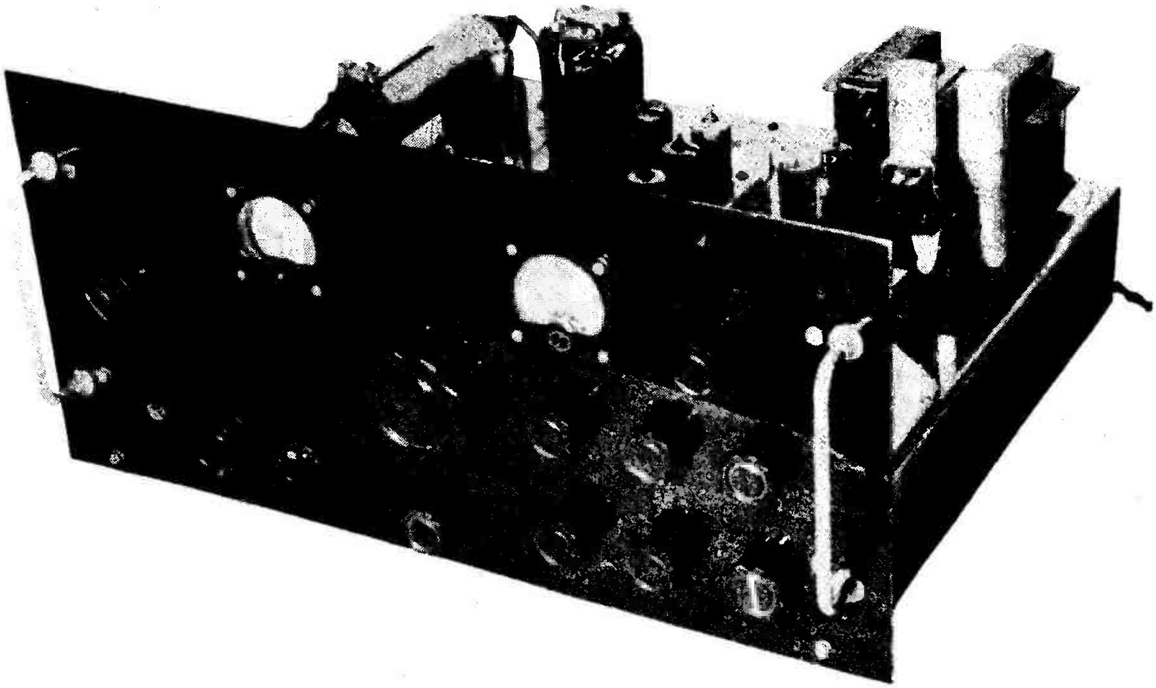
No originality is claimed for any particular part of the job ; in fact, the "LF" part is a near-copy of the AR88, although any other good receiver circuit arrangement can be used.

General Receiver Considerations

The design of a receiver that would do all that was required of it, plus providing local oscillator facilities while still leaving room on this same chassis for two front ends, seemed at first to be a very tall order, especially when one realises that its performance must be as good as, and preferably better than, the main station receiver.

Two separate courses of action would, it was thought, solve the problem : Either the AR88 could be mounted in a relay rack with an additional panel under the tuning controls so that a chassis mounted on it could carry the converters and extra power supplies, or an attempt could be made to build a new receiver specially designed for the job and preferably a copy of the AR88, but *not* weighing 112 lbs. !

At this stage of planning a 2 x 3 ft. chassis



General appearance of the G2BVW two-channel VHF receiver, designed for the 144 and 430 mc bands. A block layout appears in Fig. 1., and an interior view of the receiver was shown on p.304 of the July 1953 issue.

or a relay rack seemed to be the order of things and the project was nearly abandoned.

Further consideration of the receiver, however, simplified things considerably as it was realised that selectivity need not be better than 3 kc, therefore a crystal filter need not be used, and that if the first IF's were suitably chosen then only one wave band need be covered.

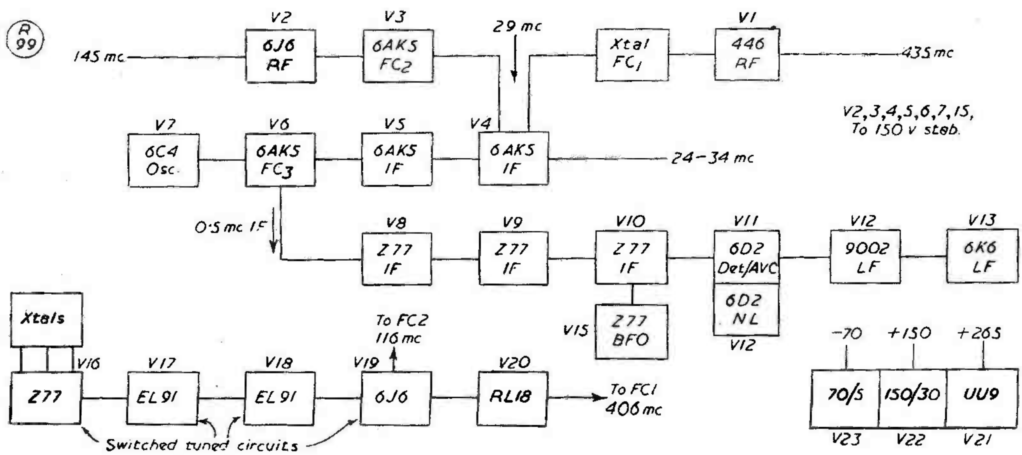


Fig. 1. Block schematic of the electrical layout of the G2BVW 144/430 mc VHF receiver. The treatment is such that it can be built in sections. There are two separate converters : V2, V3, for the 144 mc band ; and V1, Xtal mixer, for 430 mc. Each of these can be operated with the same crystal oscillator-multiplier chain V16-V20, switched to give the required injection frequency to produce a 29 mc IF in both cases, into the main receiver section V4-V14. By using a common IF of 29 mc, the same IF area 24-34 mc can be tuned on the main receiver to give coverage on either band. (*Note: In this diagram the last two stages of the main receiver should be marked V13 and V14 respectively*).

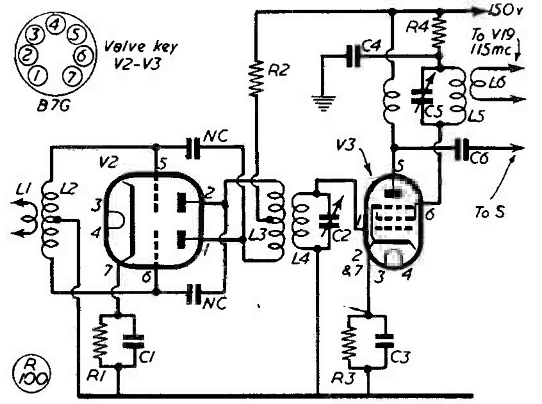


Fig. 2. Two-metre converter section of the G2BVW receiver. Valves are 6J6 for V2 and EF95 (or 6AK5) for V3.

Table of Values

Fig. 2. The Two-metre Converter Section

C1, C3, C4, C6 = 500 µµF	R3 = 220 ohms
C2, C5 = 5-30 µµF	R4 = 10,000 ohms
R1 = 70 ohms.	V2 = 6J6
R2 = 4,700 ohms	V3 = 6AK5

eliminating band switching and the coil pack. The use of all-miniature valves where possible and miniaturised IFT's further reduced the size. It was then realised that if a final tunable IF of about 20 to 30 mc was chosen the tuning condenser need only be very small—in fact, one twin condenser from the old Type 27 converter is possible. It was later found best to use two of these condensers in order to reduce coupling between stages and to provide more condenser sections, each condenser was split-statored in order to obtain the desired value.

The next question to be decided was that of the actual valve line-up. In the interests of overall gain and selectivity it was decided to keep the two RF stages of the AR88 and its three 455 kc IF stages. The other features of the AR88—its noise limiter and RF gain control system, and their associated switching, the S-meter and tone control—were considered very good and useful at VHF, so it was decided to retain them.

The valves decided on were as follows: For the two RF stages (20 to 30 mc) 6AK5's; these offered the best signal-to-noise ratios obtainable without resort to special circuits. (It is intended to modify these RF stages to a cascode arrangement at a later date.)

For the frequency changer it was decided to try 6AK5, 9003, 9001 and Z77 and similar types in order to ascertain the best performance. For the local oscillator a 6C4 was chosen. 6F12's and Z77's were proposed for the 455 kc IF stages, followed by two 6D2's, a 9002 and a 6F6 output stage.

Voltage stabilisation called for the rating of a VR 150/30 and this was used; for the rectifier a UU9, but a 6X5 will do quite well. This type of rectifier enables the use of only one filament winding on the transformer and simplifies the problem of possible portable operation with the receiver.

The IFT's 20-30 mc and 455 kc were next considered. It was decided that for the 20-30 mc tunable section, the 1" dia. x 2" long cans and coil formers from a surplus altimeter would be used. They obviously had to be rewound, but this proved to be a fairly easy matter. For the 455 kc transformers there are quite a number of very good makes on the market at a reasonable price; the dimensions of those chosen are 1" x 1" x 2" approx. Normal type intervalve transformers are all that is needed.

For the power transformer, two separate units have been provided, one for HT supply and one for 6·3 volt heaters, the reason being again that of possible supply from batteries. The HT transformer has a vibrator winding in addition to the mains winding. For solely AC use any transformer of 265—0—265 at 90 mA with suitable heater windings will suffice.

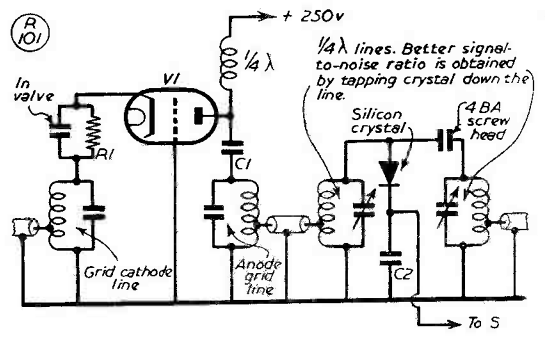


Fig. 3. The 70-centimetre front end for the VHF receiver. V1 is a GL446A ground-grid triode, with a silicon-crystal mixer used in a quarter-wave line input/output circuit. The input and output are actually tapped down the line in each case to get a better signal-to-noise ratio. The detail for the construction of the 430 mc RF and mixer stages will be given in the second part of the article, with all coil values.

Table of Values

Fig. 3. The 70-Centimetre Converter

C1 = 30 µµF	R1 = 220 ohms.
C2 = 10 µµF	V1 = GL446A

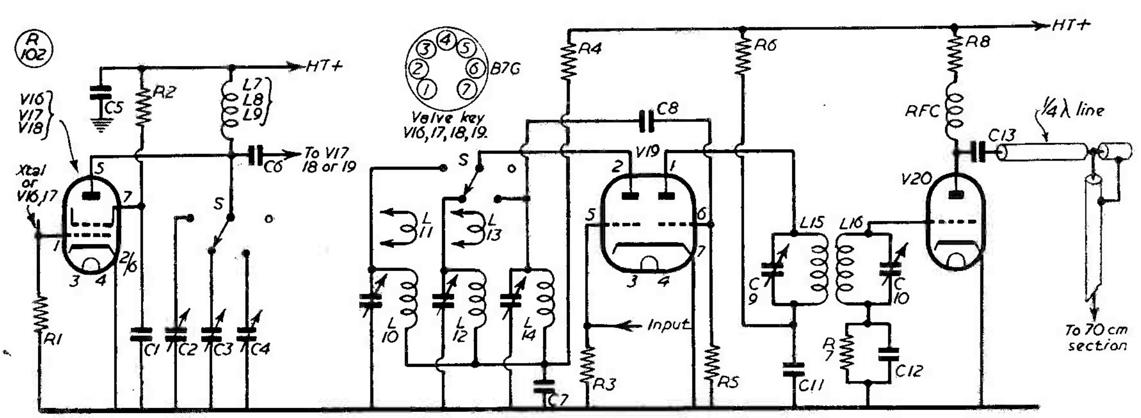


Fig. 4. The crystal oscillator-multiplier section, in which the circuitry of V16 represents the three stages V16-V18 (see Fig. 1.) Stages V19, V20 produce the injection frequency for the 430 mc converter; the injection at 116 mc for two metres is taken off V19. Two different crystals are used (see text) to arrive at the correct output frequencies without beats in either band or in the IF tuning range.

Receiver Layout

For a layout of the components it was initially decided that a chassis of relay rack fitting, 16″ deep x 3″ high with a 9″ panel would accommodate all components and leave room for the two VHF " front ends " required. The material chosen for the chassis and panel was 14 gauge aluminium; this because of its strength and " workability " and it has proved fairly satisfactory.

It was decided to fit the tunable IF on a separate chassis detachable from the main one and mounted on it in a central front position. It was found that the oscillator chain would fit easily into the left hand side of the chassis, while the second IF, audio and power supply arrangements would come in on the right hand side. The exact layout is indicated dimensionally on the drawing.—(*See* Part II to follow.)

The central location of the first IF system positions the grid of the first IF valve 6½″ from the rear of the chassis and in its longitundinal centre. The centre underside and the centre to rear left underside are clear to allow the installation of converters.

Details of Construction and Circuit

(*a*) ***The Crystal Oscillator Chain.*** For frequency changer injection at around 116 and 406 mc it is the writer's opinion that while good stable SEO circuits *can* be produced they are on the whole more difficult to design and build for stability and a good T9 note than a crystal multiplier chain. The problem of designing a crystal multiplier chain largely centres around the RF frequency range to be covered, the desired IF frequency range to be tuned, and lastly, but perhaps the most important, what crystals have you that do not land a harmonic in the middle of the RF band *or the tunable IF band*? When considering crystal selection the average amateur will undoubtedly be swayed one way or another depending on whether he has a stock of miscellaneous ex-WD crystals or whether he can just go out and buy whatever he wants.

In either case it is quite a simple matter to find out if a crystal is suitable or not or to determine what you want if you proceed as follows: Write down the crystal frequency at the left hand side of a piece of paper then proceed upwards and away (30°) from it progressively multiplying by 2 up to 400 *plus* mc. Next proceed downwards and away (30°) multiplying by 3 up to 400 plus mc. You can then fill in the intermediate stages.

Take, say, the first figure (3 ×) down from the fundamental and proceed upwards and away, multiplying by 2. Fill in the whole triangle up to the 400 plus mc in this manner and you have all the frequencies that can be obtained from that crystal by times 2, 3 and 4. The other frequencies can be filled in if so desired merely by adding or subtracting the fundamental from any given figure on the

Table of Values

Fig. 4. The Crystal-Oscillator Multiplier

C1, C5	= 0.05 µF	R1	= 100,000 ohms
C2, C3, C4	= 5-45 µµF	R2	= 10,000 ohms
C6, C11, C12	= 100 µµF	R3, R5, R7	= 47,000 ohms
C7	= 200 µµF	R4, R6	= 15,000 ohms
C8	= 20 µµF	R8	= 20,000 ohms
C9, C10	= 3-8 µµF, concentric	V16	= Z77
C13	= 10 µµF	V17, V18	= EL91
		V19	= 6J6
		V20	= RL18

chart. From the above it will be seen that if a frequency of 406 mc is required it is a simple matter to reverse the process and to divide instead of multiplying, so giving all the crystal frequencies that will double, triple or quadruple to 406 mc. The above processes should enable anyone to make the most of any crystals available or to determine exactly what is wanted. A further consideration when choosing crystals is that if harmonics are to be considered in the tuning range then the minimum crystal frequency usable is just greater than the tuning range, *e.g.*, for a band 8 mc wide, an 8-plus mc crystal, and the nearest harmonics on each side of the band can easily be determined.

As previously stated, it had been decided to use a tunable IF in the order of 20-30 mc, and on examining all available crystals by the method outlined above it was found that a 6·35 mc crystal when slightly ground would give a frequency of 116 mc, making the IF 28 to 30 mc for the two-metre band. For the 435 mc band it is at present only really necessary to tune 432 to 438 mc (which is the Zone Plan area), and to obtain the same tunable IF with a centre frequency of 29 mc, an FC injection frequency of 406 mc is needed. The figure of 406 was analysed as already explained, and an 8·4 mc crystal ground up to give the required frequency.

Examination of the major harmonics of the two crystals showed that in both cases the tunable IF and the RF bands were free of obvious interference. The exact frequencies finally evolved were 6·3888 and 8·4350 mc respectively.

(To be continued.)

NEW EDDYSTONE CATALOGUE

This is now available, and is a neat 28-page booklet listing the very wide range of Eddystone radio parts and accessories, including receiving and transmitting variable condensers for HF and VHF, in many capacities and ratings; RF chokes of several different types; coil formers and bases in various sizes, including the new polystyrene VHF type; knobs, dials and scales, slow motion and direct drive, including the outstanding new No. 843, with a 4-in. diameter scale and a 10:1 reduction ratio, giving absolutely positive control through a totally-enclosed ball-bearing epicyclic motion; insulators for different purposes in several shapes and sizes; aerial accessories; and numerous other items, such as filter and vibrator units, receiver mounting blocks, a calibrated S-meter for the S.640, 740 and 750 receivers, a nice range of equipment racks, cabinets and fittings; IF, BFO and FM discriminator units; couplers, small tools, and miscellaneous items. This catalogue is of direct interest to every radio man, professional or amateur, whether a constructor or interested only in radio technique. Copies are available at one shilling each, on application to: Stratton & Co., Ltd., Eddystone Works, Alvechurch Road, West Heath, Birmingham 31, or from Webb's Radio, 14 Soho Street, Oxford Street, London, W.1.

CORRECTION — "KEEPING BACK HARMONICS"

In this excellent article in our February issue, the expression $R.10^6$ in formula (2) on p.722 should read 10^6. In formula (4) on p.723, the square root sign should enclose the whole expression. It is sometimes difficult to avoid such mistakes in mathematical settings, even if the original text is blameless.

TRANSISTORS ON HF

G3CCA (Leicester) now has a transistor transmitter using four GET-1 germanium triodes in parallel-push-pull, CW only at present, for the 3.5 and 7 mc bands. He hopes shortly to have a Trans-Atlantic contact on this all-transistor transmitter, on which we shall be publishing details in due course.

ELECTRONIC CONTRACT FOR BRITAIN

Three well-known British firms—B.T.H., Ferranti and G.E.C.—will share in a contract worth about £2½ million placed by the Hazeltine Electronics Corporation of New York. This order is for electronic equipment and associated test gear for the U.S. Navy operating under N.A.T.O. Additional contracts worth several million pounds are expected to be placed shortly, and will provide work for some years to come.

FRENCH RADIO EXHIBITION

If you are wanting a good excuse to go to Paris, a big Radio Exhibition is being held at the Parc des Expositions, Porte-de-Versailles, Paris 15e, during the period March 12-16, 10 a.m. to 6.30 p.m. daily. Special facilities are offered to overseas visitors in the form of a 20% fare reduction on French travel, with "advantageous conditions," arranged through the Havas Exprinter agency, for those staying from one to five days. Application for particulars can be made to: S.N.I.R., 23 rue de Lubeck, Paris 16e—and probably the big London travel agencies would be able to supply information as to the special facilities. According to the Exhibition prospectus, some 50,000 foreign visitors are expected, and there are to be technical meetings and lectures apart from the Exhibition proper.

VHF BANDS

A. J. DEVON

Dull Conditions, Low Activity—
More Receiver Reflections—
Contest for 430 mc Stations—
Reports, Notes and News—

THE last month certainly struck a record-low for both conditions and activity. Nevertheless, there is always something to be heard on two metres, and such daily schedules as G2NM-G2YB, G5BD - GM3EGW, G8OU-GW8UH, G2HCG-G3FAN and G3HBW-G3YH are still being kept regularly, even if the paths are more difficult than during normal conditions.

For those who may want to listen for these stations, their times are (approximately): G3HBW-G3YH, 0715; G2NM-G2YB, 1830; G2HCG-G3FAN, around 1915 onwards; G8OU-GW8UH, around 2245 onwards; and G5BD-GM3EGW, 2315 onwards. In spite of the poor conditions, the latter schedule has been extraordinarily successful having regard to the fact that the G5BD-GM3EGW path is 240 miles; contact is made with better than 50% regularity, and over one period during the last month, a QSO was possible six nights out of seven.

There may, of course, be other regular long-haul schedules which have not been notified, or which we have not heard. And since at this time of year schedule-keeping is by far the most important of the activities open to the regular VHF operator, we would like to know about any others, with the distance and the degree of reliability attained. In spite of flat conditions, there is still a fair level of evening activity, and stations not often reported in these columns are heard working one another most nights, any time from 1800 onwards.

The mail this month has been understandably scanty, and mostly concerned with rebuilding, new construction or repairing gale damage. And the quest for better, new or improved converters goes on unceasingly.

On this theme, everyone who has tried it has found that providing variable tuning for the RF and/or mixer stage is a Good Thing. There is no doubt that using a condenser-tuned air-spaced inductance gives a worthwhile improvement in comparison with slug-tuned coils. Strictly, slug tuning should be reserved for spot-frequency working—that is, where the receiver is required to work on one frequency only, for which it can be peaked up on the slugs and thereafter left set. But what we want to do on two metres is to cover a band of frequencies—true, the two megacycles at 144-146 mc represent only a very small percentage change in tuning, but the fact is that a midget condenser, even across a slug-tuned coil, will show a marked peaking effect on signals anywhere in the band, especially on the mixer side. The RF stage does not usually respond so well, due, of course, to its much heavier loading by the aerial; it is often too tightly coupled, anyway!

Of course, there is the usual trick-and-snag about tuning the front end stages. An RF-mixer combination which is quite docile with slug-tuned coils will probably burst into wild life when the RF and mixer circuits are brought into resonance, due to self-oscillation in the TPTG mode. This will almost certainly happen, even with a pentode RF valve, unless screening is exceptionally good and the RF stage accurately neutralised. The line of least resistance is to tune the mixer only—then, a pentode RF stage with proper screening and slug-tuning on its grid side will usually remain quiet. But the very fact that it cannot be peaked up without bursting into oscillation merely proves how much is being lost by slug-tuning.

One important factor which also complicates the issue is that of noise—RF circuits tuned on the nose bring up the noise, which leads easily on to the suggestion that many converters are so quiet because the RF stages are not really resonating in the band! The *only* way to set up such circuits properly—in the absence of a local who is prepared to run his carrier for you for long periods, as a sort of signal generator—is by the use of a stable, accurately calibrated grid dip oscillator with a good open tuning scale. The most valuable piece of VHF equipment possessed by your A.J.D. is such a GDO; it tunes 118-150 mc with a 180° slow-motion dial and is fitted with probe coupling. With it, one can not only set up the RF circuits, but it also enables injection frequencies to be accurately located; in fact, it is stable enough to provide injection at any of the usual frequencies when converter experiments are in hand.

It may be of interest just to add that in some recent tests with converters it was found that one tuned RF stage into a tuned mixer gave slightly better signal levels (on inside and outside signals) than another converter having two slug-tuned RF stages and a slug-tuned mixer, with the latter peaked mid-band and the RF stages slightly staggered. The noise was about the same with both, and for comparison purposes the same IF and common IF/AF amplifier were used, with the same valve types in both converters—6AK5 RF and 6AG5 mixer. In practice, it was found difficult to prevent self-oscillation of the RF stage, and the two-RF job with slug tuning was a good deal more convenient to operate!

The findings appear to be that in

simple converters a good general design would be a CC oscr-mult, with a tuned mixer (6AK5 or 6AG5) and two staggered, slug-tuned RF stages, using 6AK5's. The keen fiddlers might say that a neutralised-triode RF stage, with a separate tuning control for peaking up on the aerial side, would be better—and they would probably be right.

The foregoing discussion is not intended to read any lessons to the experienced VHF operator, who will know it all and a good deal more besides. But the points made here (with what was said in this space last month) may be of interest and practical value to those who are either newcomers to the VHF bands or still are not happy about their converters. And the Old Timers may note that the fundamental principles involved are exactly the same as those which had to be kept in mind with our TRF receivers of 25 years ago!

G3BNC, Southsea, getting on with a new piece of VHF gear while keeping an ear open on the two-metre band. He says he sent us this because we illustrate "so many neat and tidy stations"!

The Cheltenham Meeting

At the time of writing, many acceptances have been received for the gathering to take place at the Belle Vue Hotel on Saturday, March 13—*see* panel p.747 last month for details. The event will be reported in our next issue with, it is hoped, some photographs.

It may be possible, even at this late stage, to take a few more in. If you have not booked and now wish to be there, write G2AJ or G3FRY *immediately*. It will be no use turning up on the night without a ticket, even if you come with the money in your hand, because it is all a matter of catering and accommodation arrangements.

Station Reports

The 20-odd reports received this month all tell the same tale—not much doing, but still busy improving the gear and waiting for the first openings. These may be any time now, if last year's experience is anything to go by!

On the constructional side, GM3DIQ (Stevenston, Ayr) reports that he now has a converter lined up as follows: Cascaded-Cascode 12AT7 - 12AT7 - 12AT7 mixer — 12AT7 push-pull oscillator — 6AK5 head amplifier. We are consumed with envy and admiration! Clarke reports 12 GM's and GI5AJ worked, with eight more GM's known to be active. The new GM3DIQ transmitter runs 12AT7 72 mc—12AT7 144 mc—832—829B.

G2FJR (Sutton Bridge, Lincs.) reports 15 stations worked or heard in the month to February 6, with conditions good at midday on January 22, when he was well over the top with G5TZ/A 'way down in the Isle of Wight. For Norfolk, stations regularly active are G2DJM and G3DOV.

G3HBW (Wembley, Middx.) is building for more power on 430 mc with a QQVO6/40—a problem here is an aerial feeder line that will take it on 70 centimetres, and skeleton coax is now being tried.

G3CUZ (Leek, Staffs.) has been having beam trouble, and relates some hair-raising adventures with a bent mast and a wrecked beam after the Great Gale on January 15; he is now building a 4/4/4 with a spring-loaded 300-ohm feed line.

The Welsh stations active during the period January 15 to February 11 were GW3EHN, GW3EJM/A (who has worked G8OU). GW3ENC, GW8UH and GW8SU.

On the 70-centimetre band, G6YU (Coventry) has considerably improved his converter and increased the transmitter output; he is now a consistent RS-57 with G2BVW at 30 miles. G2FNW (Melton Mowbray) has a new 16-element stack for 430 mc—but keeps to an indoor dipole for Two, as he prefers 70 cm contacts.

Warming the Beam

G2HCG (Northampton) had some interesting—and, to those working him, amusing—experiences with his two-metre beam during the Great Freeze. Water had got into the matching system and, as it froze, upset the characteristics to such an extent as to reduce signal strength seriously both ways, even on locals. When he went over to transmit, the ice melted and his signal gradually crept up on the S-meter at the receiving end; conversely, if his contact kept on too long on an over, the matching section gradually froze again, and the signal at G2HCG went steadily down! This believe-it-or-not story, which shows, incidentally, how accurately the G2HGC beam is matched, is *absolutely true*. It was found that five minutes was about the maximum allowable time on a receiving over, after which G2HCG had to transmit to unfreeze the beam again! (The fault has now been rectified by fitting a new matching section, impervious to moisture). And in case it should be thought that this experience betokens the use of some colossal power at G2HCG, let it be said that a mere 50 watts will warm up tubing quite appreciably, as anyone who has ever used a resonant-line tank circuit made of dural tube will know.

G2BVW (Leicester) has a new 32-element stack for 430 mc, but not yet up to its full planned height of 60 feet; at the lower level of 25 feet it shows a "tremendous improvement" in comparison with the 6/6 at full height.

From G3CO (London, S.E.14) we have an interesting note about VHF activity in Norway, he having recently been over to LA. He met LA8QB, who said that on 430 mc there is nobody on over there. On two metres, there are nine known-active calls, together with a few spasmodic types who make occasional appearances, and some stations are also thought to be on in the far north of Norway —nice for the GM's. What we do know is that the regular LA's are all good ones, on the look-out for EDX.

G8VN (Rugby), like G2FJR, mentions January 22 as a good date with him, and in the evening G8OU and G5TZ/A were very strong signals. His total of stations heard and worked for the month to February 1st was 28.

Table for 430 mc

Gerry Jeapes of G2XV (Cambridge) makes two suggestions, both of which we propose to adopt: The first is an all-time counties worked table for 70 centimetres (his own total is now 13 counties), and the other is for a 430 mc Contest, to be laid on fairly soon; this is being looked into, and will be discussed further in our next.

In the meantime, will *all* 430 mc operators please let us have their total of counties worked to date, with stations. From this, we shall be able to see what the starting figure should be—at the moment, it looks like five, but let us know all you have worked first of all. If sufficient claims are received, this new Table can take off in the next issue.

VHF Meeting in Scotland

GM3DIQ writes to say that a "West of Scotland VHF Group" has been formed, with a dinner meeting to be held in Glasgow on Wednesday, March 24 (*venue* not settled at the time of writing). All who can make it are asked to get into touch with GM3DIQ direct (QTHR) and "the damage will be 10/6 per skull" for the evening. We hope this venture is a success, and look forward to having a report on it in due course.

Calls Heard and The Tables

The few calls h/w lists received do not justify the space this month, as they report mainly local contacts. At the same time, your A.J.D. does not want it to be thought that we are no longer interested in calls lists for the Activity Report—far from it. But those who do not see theirs in print this time will understand that unless we have at least a dozen, the compilation of that section of "VHF Bands" is hardly worth while. We certainly look forward to many and ample lists for the Activity Report when the curtain goes up again, and would ask all correspondents to send one in whenever they write to "VHF Bands."

For much the same sort of reasons, there are no Tables this month. The dozen or so claims received have been noted for inclusion in the next appearance of the Achievement Tables, which will be as soon as the "volume of business" warrants it. Until then, the Editor's instructions to A.J.D. are to keep it short and to the point . . . well, blow us down, don't we always? (*No.*—Ed.).

VHFCC Elections

Having shown the necessary proofs, new members of the VHF Century Club are: G8VN, Rugby, No. 163; DL1LS, Heidelberg, No. 164. The break-down of their cards is as follows: G8VN put in 55 cards for two-metre contacts, and 46 for QSO's on the old five-metre band; call-signs among the latter show that some at least of the old 58 mc practitioners have never appeared on two metres.

The 100 QSL's sent by DL1LS showed that he has worked only three G stations, his others being nine F's, four HB's, two PA's and the balance DL's.

Straying Brethren ?

You've heard of G3WW and G5ML, haven't you? And, of course, you know them as keen and active VHF operators, don't you? Well, here's something—(come up close) your A.J.D. has heard them both knocking off the *oblasts* on 160 metres! They'll be creeping into comrade L.H.T.'s tables before long. (*Why shouldn't they have a blast on One-Sixty while it's so cold on Two?*—Ed.).

Dead-Line Date

The publication date of this issue gives a little more time this month—for the April issue the dead-line is **Monday, March 22,** certain Address all your VHF news, views, ideas, claims and suggestions to: A. J. Devon, "V.H.F. Bands," *Short Wave Magazine*, 55 Victoria Street, London, S.W.1. Get your 430 mc gear ready and don't forget to put in a counties-worked claim. With you again on April 9, all being well.

RADIO AMATEURS' EXAMINATION

We have just been informed by the City and Guilds of London Institute that the entry date for the May 1954 R.A.E. was March 1st. Intending candidates who may not have sent their names forward in time should apply forthwith to the secretary of their nearest Technical College.

VHF WEATHER AND DX RESULTS

PERIOD JANUARY 11 TO FEBRUARY 11

NOTES BY HB9PQ ON TRANS-ALP WORKING

A. H. HOOPER (G3EGB)

Future contributions under this heading will take a rather different form, with more graphical presentation and surveys over different paths. The article below deals mainly with observations and conclusions offered by HB9PQ as a result of his collaboration with HB1IV on Mount Pilatus over a long period. These conclusions are very interesting in that they prove that even from a site at more than 7,000 feet a.s.l. propagation conditions must be right for really long-distance VHF working.—EDITOR.

ANOTHER poor month but illuminating, for it brought our first anticyclonic conditions of the Winter. Conditions, moreover, which exhibited the highly desirable property of dry and (relatively) warm air sinking from aloft towards ground level. It is this condition of *subsidence* that at other times of the year accounts for the more widespread EDX. Although an extensive refractive index discontinuity developed from time to time, the physical limitation imposed by the low temperatures we experienced resulted in the layer being very weak—from the radio point of view. From a study of the results of radio soundings published in *The Daily Aerological Record* of the Meteorological Office, London, conditions peaked on the evening of January 23, and are thought to have been good enough for G and EDX. January 25 and February 3/4 also appeared good enough for limited working to the East.

Since good anticyclonic conditions with subsiding air can fail to produce results, it is intended to treat the physical limitations in detail at a later date. For the time being, it is an approximate guide that a radio refractive index discontinuity can have any value from zero up to a maximum determined by the air temperature. With increasing temperature the maximum value increases rapidly. For example, arbitrarily taking the maximum possible value at freezing point (32°F) as unity and allowing for the usual decrease of temperature with height, the Table below sets out MSL temperatures corresponding to certain ratios of the maximum possible discontinuity value.

Maximum possible RRI discontinuity (ratio)	1	2	3	4	5	6
MSL temperature °F	32	48	59	66	72	77

Thus, when the temperature (it should be measured at about 1500 GMT) is 66°F, RRI discontinuities can range from zero up to 4 times the limiting value for freezing point. The Table does *not* tell us, for a given temperature, what magnitude of RRI discontinuity is likely, but merely which magnitudes are impossible, and we can see that in Winter the best of reflecting layers is relatively weak.

The first and last EDX spells of 1953 (March 1 and November 31), although at times of year associated on average with cooler temperatures, occurred with temperatures in the order of 48°F. For the spell in January of this year mid-afternoon values of about 32°F were experienced.

It may be that here is a pointer that can be used, during the change-over from Autumn-to-Winter and Winter-to-Spring conditions, to indicate when, other conditions being satisfied, EDX is nevertheless unlikely. We can be testing this now.

Research in HB

The direct results of HB9IV's occasional operation from Mount Pilatus are well known. Recently some indirect results, achieved after four years' work by HB9PQ, became known. The latter, who is a meteorologist, has been kind enough to send a summary of his efforts, and hopes that it will be of interest. It was he who made a successful long-range selection of the date for the later visit to Mount Pilatus on October 17. His summary follows:

"In 1949 I began to interest myself with the extension possibilities of VHF, and I undertook some research relative to the dependence on general and some local weather situations, especially of Foehn and local thermic streams. To begin with, I could only use the European VHF contests, in which I participated as an observer in co-operation with HB9IV on his famous VHF-DX-QTH, on Mount Pilatus (7300 ft. a.s.l.). It was necessary to collect all the results carefully, the positive and the negative ones, and to compare them conscientiously with the actual weather situation, as disclosed in the weather maps over several years.

It is generally known in Amateur Radio circles that the extension of VHF in large and stable high-pressure centres is relatively very good, and that the distances reached are great. But in which part and direction of the high-pressure district is very uncertain. Also it is known that sometimes a two-metre station can be reached on the other side of the Alps with the beam directed in a straight line to the QTH, but *why* was unknown. A very interesting fact emerged during the European contest of 1950. In the early afternoon we could work from HB1IV an Italian station some miles south of Milan, with the beam pointing directly south against rock walls 12,000 feet high and over. By observation of the cloud formation over the Alps, I could establish that a very strong inversion had been built up from about 12,000 to 15,000 feet, possibly in connection with a light Foehn situation. So we learned that inversions were forming a layer which were acting as reflectors. And so my first researches began with comparisons of air pressure and temperature layers.

Proceeding from the assumption that long distances could be reached from and to a high-pressure centre, the contest of 5 July 1952 and 12 September 1953 brought us a certain disappointment. In 1952 the furthest distance obtained was only 250 miles, and in 1953 only 300 miles. What was the reason? A warm front with a very slight weather influence was situated across the transmitting direction, and it seemed to stop completely the extension in this direction. This was a 1952 supposition that was confirmed in 1953, when, in a similar situation, no station could be worked beyond the warm front (*see* Fig. 1). At this time about 35 stations in England were 'mobilized.'

A further very interesting fact emerged from the results of the contest of September 22-23, 1951. All worked stations between 120 and 250 miles away were practically situated in between the isobars of 1025 and 1015 mb, and were in a direction nearly parallel to these isobars (Fig. 2).

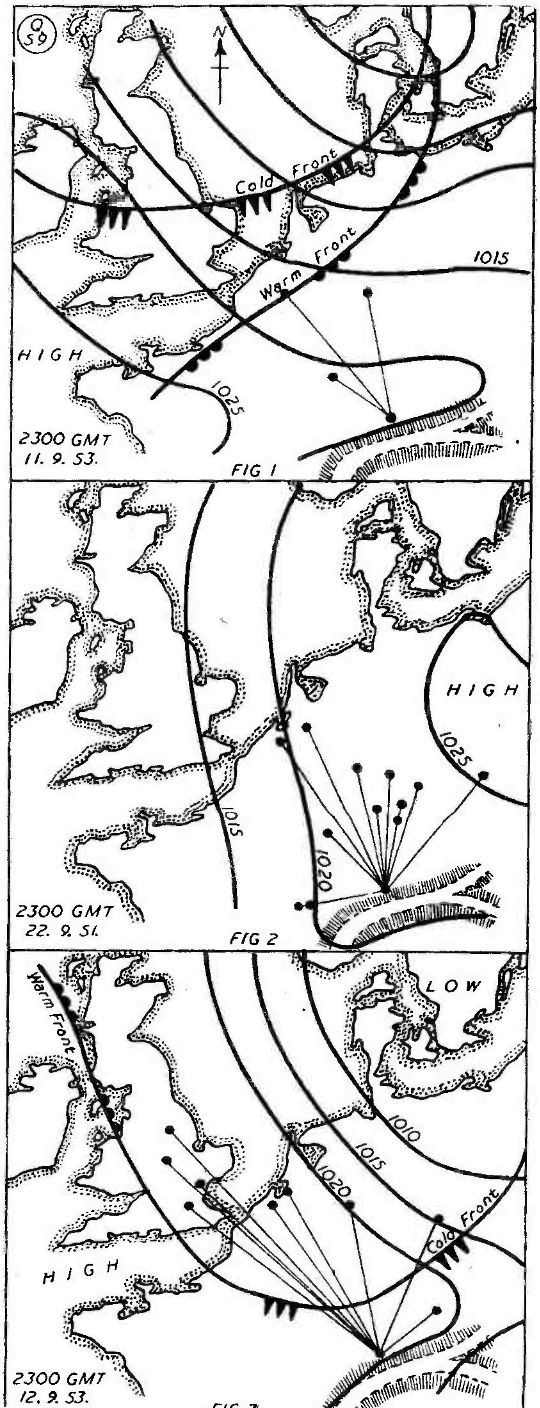
All the results of these observations I had employed to work out a forecast relative to the weather - and - extension - situation for HB9IV's "private contest" on the Mount Pilatus. Hoping for a good forecast, I gave to HB9IV extension in between the isobars of 1025 and 1015 mb and parallel to them. The success was very good indeed, the first HB-G, HB-GW and HB-PA contacts, with a maximum obtained distance of approximately 670 miles to G5YV in Leeds.

The weather-map at Fig 3 shows the situation between 1845 and 2250 GMT on the big day. Most of the worked stations were situated in a direction parallel to the isobars and in between 1020 and 1022 mb, but practically only in the north-east part of England—nevertheless, the stations in the west and north-west were listening, too. *The warm front extending from a low-pressure centre situated west of Iceland stopped all extension to the western part of England and to Ireland.* After midnight GMT GW2ADZ was worked (about 615 miles), when the warm front was displaced a little more westward and was situated now between England and Ireland. The front had an active influence on the weather and stopped all further extension in this direction.

Contrary to the idea of extension parallel to isobars, three DL's situated more in a north to north-east direction, but practically in between 1025 and 1015 mb, were worked. The main direction of these three stations lies at right angles to the oncoming cold front. A similar situation was met on July 7, 1952, when the direction of two stations worked was nearly at right angles to a polar cold front advancing from the north-east.

An interesting and important observation was made on September 6 and 7, 1952. A shallow low was lying over France with a front running west to east. Strong instability with cumulus cloud developing was implied. During the time of the strongest cumulus development, from about 1000 to 1500 local time, the band on both days was practically dead.

To conclude my explanation, I will summarise the



Figs. 1-3 above show how active "warm fronts" can screen off VHF DX working, and how the direction of DX working from HB tends to lie parallel to the isobars (lines of equal barometric pressure). HB1IV was on Mount Pilatus in September 1951 (Fig. 2.) but on that occasion did not get into the U.K.

main points which are important to judge two-metre conditions:

To obtain good results relative to distance and report, it is necessary to be situated on a flank of a broad zone of high pressure, but the pressure gradient should not be too flat. Maximum distances could be obtained if the working stations are in between the isobars of 1025 and 1015 mb and the main transmitting directions are practically parallel to the isobars.

Close to these conditions in deciding the issue of obtaining great distances is a stable and equal distribution of temperature layers up to very high altitudes.

For obtaining moderate distances but with very good reports, the conditions in a direction at right angles to a cold front are also favourable.

Warm fronts, situated across the intended transmitting direction, can hold back completely an extension in this direction, if the warm front is active.

With instability occurring, generally we can obtain only very short distances, the band being dead. Such situations are easily revealed by the presence of cumulus formations.

In mountainous countries it is favourable to be over the low inversions, which undergo diurnal fluctuation, because these low inversion layers are too irregular to give a good steady reflection. That is the reason we have chosen Mt. Pilatus as our research QTH."

Comment

It is, of course, not possible to give a detailed account of HB9PQ's work in the available space, and only three of the many charts he has prepared in support of his conclusions are reproduced. The Alps and adjacent mountain ranges form the southern boundary of the European area; they drastically modify the weather characteristics in their vicinity and are a long way inland. The British Isles are relatively low-lying and have a sea exposure. One wonders, then, whether rules valid for HB can apply to G, and the DX spells of 1953 have been examined with this in mind. It was found that we were on the flank of a broad zone of high pressure on five occasions, and that working was mainly between and parallel to the 1015 and 1025 mb isobars also on five occasions, out of a total of 10. This suggests that for the British Isles in 1953 these criteria did not fit as frequently as for HB. The question of propagation at right angles to a cold front could not be properly tested, as for us such "fronts" tend, in fact, to be quickly-moving affairs which would yield only snap spells. The rules regarding warm fronts and instability are in complete agreement with our own experience and fit in well with our ideas of the origin and development of refractive index discontinuities.

A most important point is the achievement of HB/I working. It is interesting to note that a suitably strong inversion and moisture lapse can develop in a Foehn situation. (This is the forced ascent of air up over a barrier lying across its path). Now our major DX has been achieved *via* a "reflecting" layer formed by air sinking earthward in an anticyclone. Although the two effects are of different origin, one wonders whether they could, by occurring together, unite into one vast reflecting layer. The question is one we can look at in detail another time. No doubt HB9PQ will have more to say on this one!

American Angle

Coming across an article by W2BAV in *QST* for October 1949 on the prediction of VHF conditions, the writer studied it carefully to see how far we have progressed since it was written. Although we now know that for the U.K., at least, prediction by the presence of anticyclones is not enough, it was intriguing to note that most of the DX referred to by W2BAV occurred with a barometric pressure of 1017 mb or greater. This compares well with the figure of 1019 that applied for G through 1953. So there we are—no VHF DX spells with pressures of *less* than 1015 mb in HB, 1017 mb in W and 1019 mb in G: A surprising measure of international agreement! A pity that pressure alone does not give a pointer to conditions.

The permission of the Director, Meteorological Office, London, to make use of information gained from the official publications mentioned is gratefully acknowledged.

Broad Band Amplification

DESIGN DATA FOR GAIN AND BANDWIDTH

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(DECCA RADAR, LTD.)

Though this is essentially a theoretical article of direct interest to the receiver design engineer, the principles discussed and the formulæ given can equally well be applied to the design of frequency multipliers and buffer amplifiers at the higher frequencies.—Editor.

FOR amateur communication on the low frequency bands, the present trend is to narrower receiver bandwidths: but the advent of amateur television and pulse communication brings with it a need for receivers of wide bandwidth. In general, the overall receiver bandwidth is determined by that of the intermediate frequency amplifier, and this article is an attempt at showing some of the methods by which wide bandwidths may be obtained, and to give formulæ, without proofs, for the design of such amplifiers. It would be as well at the outset to state that by " wide " bandwidth is meant a pass-band, to the points 3 dB down on the response curve, of greater than 2 mc, and possibly as much as 20 mc. These bandwidths will normally be obtained at an IF between 15 and 100 mc. It should also be stated that the techniques to be described are not limited only to IF amplifiers, but may also be applied to straight receiver RF stages and to wide-band frequency multipliers of buffer amplifiers.

Valves

A brief consideration of valves is first necessary. In this particular application, it is most important to choose the right valve. Any valve has a certain value of mutual conductance, gm, and of input and output capacitances, C1 and C2 respectively ; these parameters, being determined by the geometry of the valve, are not under the control of the circuit designer. It may be shown that, for any valve, the product of gain and bandwidth is a constant, *i.e.*:

$$GB = K \qquad (1)$$

The constant K is, of course, different for different types of valve. The gain-bandwidth product, GB, may be improved by choice of circuit, as is shown later ; but it is clearly an advantage to start with a valve possessing a high GB factor. Fig. 1 shows a simple inter-valve circuit, consisting of coil L, a damping resistor R, and coupling condenser C. Capacitances C1 and C2 are respectively the input capacitance of V2 and the output capacitance of V1. The coupling capacitor has an impedance which is negligible at the IF ; L is designed to resonate with C1 + C2 at the desired IF, and at this frequency, the dynamic impedance of the resonant circuit will be high compared with R. Then the gain from the grid of V1 to that of V2 is given by

$$G = g_m R \qquad (2)$$

and the bandwidth of the stage by

$$B = \frac{1}{2\pi R\,(C1 + C2)} \qquad (3)$$

Thus the GB factor for the stage is

$$GB = \frac{g_m}{2\pi\,(C1 + C2)} \qquad (4)$$

If, as is usually the case, V1 and V2 are the same valve type, this last expression gives a figure of merit for a valve used for this purpose ; clearly, to maximise GB, gm should be as high as possible, and the valve capacitances as low as possible. This figure is often expressed in megacycles, and the modern all-glass high slope pentode has a GB factor in the region of 60 to 80 mc. This implies that, for a GB factor of 60 mc, a gain of 2 with a bandwidth of 30 mc may be obtained or, alternatively, a gain of 10 with a bandwidth of 6 mc. It should be observed that for actual design work, the value of C1 and C2 used must be increased over that obtained from valve data sheets: in such data, the input capacity stated is the cold capacitance, which is increased by 1 – 3 $\mu\mu$F when current is flowing through the valve. An allowance must also be made for valveholder capacity, and for strays in the circuit ; a total increase of about 5 $\mu\mu$F in input capacitance, and about 2 $\mu\mu$F in output capacitance is reasonable. It was stated above that R is the damping resistor, and governs the gain of the stage ; at high IF (60 mc and above) it is possible that the valve input resistance, due to transit-time effects, may be low enough to be comparable with R ; in such a case, the value of R must be increased to allow for this extra damping in parallel with it. Valve manufacturers usually quote the input resistance at some frequency in the region of 50 mc, and this may be converted to the resistance at the chosen IF by noting that it is inversely proportional to the square of the frequency

$$R_{IF} = R_o \left(\frac{f}{f_o}\right)^2 \qquad (5)$$

where f and R_{IF} are the selected IF and the resistance at that frequency, and fo and Ro are the manufacturer's stated frequency and damping. With valves such as the EF95, the input damping at 60 mc is about 16,000 ohms, which is high compared with R in all but very narrow bandwidth cases.

Having chosen a valve with a high GB factor, and decided on the IF, overall bandwidth and gain required, consideration must

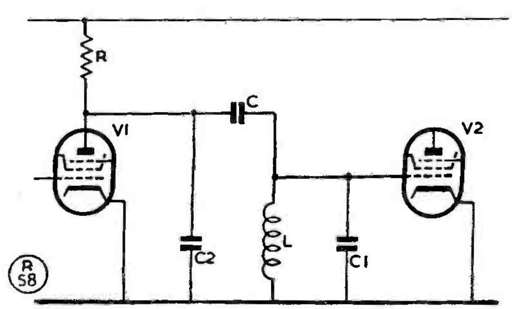

Fig. 1. Coupling circuit.

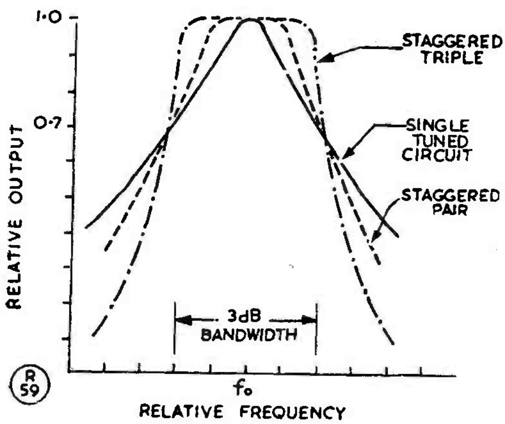

Fig. 2. Selectivity curves.

be given to the actual circuit possibilities. Another look at the expression for the GB factor above reveals that an increase in C1 or C2 will reduce this factor so that trimmer condensers will not normally be required. The tuning coils are resonated with the existing capacitances which are held as low as possible by careful layout to reduce strays. If a tuning adjustment is desired to ease the alignment process, the coils are made adjustable, either by the use of movable cores, or by movement of turns.

Isochronous Tuning

The first coupling circuit to be examined is that of Fig. 1, which has already been referred to. An amplifier made up using such circuits, all tuned to the mid-frequency of the desired pass-band, is known as an isochronous-tuning amplifier. Its principal advantages are its simplicity and lack of criticality in the matter of exact tuning and damping ; its principal disadvantage is its inefficiency when maximum gain and bandwidth, considered over the whole amplifier, are to be realised. This inefficiency arises as a result of the selectivity curve of this single-tuned circuit : cascading such circuits results in a very rapid decrease in overall bandwidth. If circuits with individual bandwidths of 10 mc are cascaded, two stages will have an overall bandwidth of 6·4 mc, three of 5 mc, and so on. The expression relating overall bandwidth to individual stage bandwidth is (approximately)

$$B_o = \frac{B_1}{1.2\sqrt{n}} \quad \ldots\ldots\ldots\ldots (6)$$

where Bo is the overall bandwidth, B_1 individual stage bandwidth and n the number of cascaded stages. For high-gain, wide band amplifiers, this rapid decrease of bandwidth makes the circuit very uneconomical and often impossible to use. The design equations are completed by the earlier statements that

$$B_1 = \frac{1}{2\pi R\ Ct} \quad \ldots\ldots\ldots\ldots (3)$$

$$G_1 = g_m R \quad \ldots\ldots\ldots\ldots (2)$$

and

$$G_o = (G_1)^n \quad \ldots\ldots\ldots\ldots (7)$$

where R = damping resistor, Ct = total capacitance (output + input + strays), G1 = individual stage gain, and Go = overall gain.

Stagger Tuning

It was noted that the main fault with isochronous tuning was the rapid fall of bandwidth as more stages are cascaded, this being due to the smooth, shallow selectivity curve of the single tuned circuit, and it may readily be appreciated that more vertical sides to the selectivity curve would result in less bandwidth shrinkage. In fact, if a rectangular selectivity curve could be obtained, there would be no loss of bandwidth as a result of cascading. One method of obtaining steeper sides to the selectivity curve is the use of stagger-tuning. The coupling circuit for this looks the same as in Fig. 1, but successive stages in the amplifier are tuned to different frequencies. Discussion here is limited to the case of staggered pairs and triples. In the former case, each two stages in the amplifier are considered as a pair, one stage being tuned to one side and the other stage to the other side of the mid-frequency : the two curves taken together give a pass-band with a flat top and steeper sides than that of the single-tuned circuit (Fig. 2). For a staggered triple, the selectivity curve is synthesised in three stages, two of which are tuned to opposite sides of the mid-frequency, and the third to the mid-frequency, giving a curve with sides still steeper than that of the pair. The process

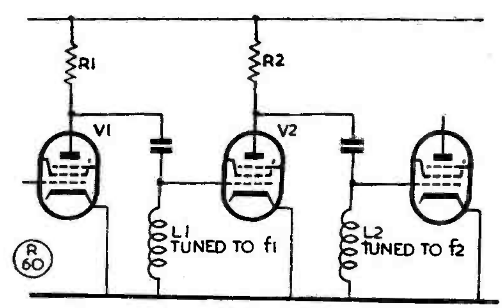

Fig. 3. Circuits in staggered pair.

may be carried on with quadruples and quintuples, each giving a sharper curve than its predecessor, but the price to be paid for the better performance is the need for very accurate tuning and damping of the individual stages. The reason for the steeper sides is easily seen when it is considered that the more circuits that are taken to synthesise the pass-band, the narrower each circuit needs to be, and so the more abrupt is the fall in each circuit.

The design of these circuits tends to be rather complex for wide bandwidths, but for bandwidths up to about 0·3 of the centre frequency, considerable simplification is possible, and as this represents a 10 mc bandwidth at 30 mc, it is probably about the top limit for amateur needs. Proceeding as for the isochronous case, the narrowing of bandwidth is given by

$$B_o = \frac{B_2}{1.1 \sqrt[4]{\frac{n}{2}}} \text{ approx. for pairs} \quad \ldots (8)$$

and by

$$B_o = \frac{B_3}{1.06 \sqrt[6]{\frac{n}{3}}} \text{ approx. for triples} \quad \ldots (9)$$

Since n is the number of stages, $\frac{n}{2}$ and $\frac{n}{3}$ represent the number of pairs and triples respectively. B_2 is the bandwidth per pair, and B_3 the bandwidth per triple. A staggered pair is made up of two circuits, one tuned to

$$f_1 = f_o - 0.35 B_2 \quad \ldots \ldots (10)$$

and the other to

$$f_2 = f_o - 0.35 B_2 \quad \ldots \ldots (11)$$

where f_o is the mid-frequency. The individual circuit bandwidths are

$$B_a = \frac{1}{2} . \frac{B_2}{f_o} . f_1 \quad \ldots \ldots (12)$$

and

$$B_b = \frac{1}{2} . \frac{B_2}{f_o} . f_2 \quad \ldots \ldots (13)$$

From these expressions and that for bandwidth $(B = \frac{1}{2 \pi R Ct})$ the circuits may be designed (Fig. 3).

For a staggered triple, the offset circuits are tuned to

$$f_1 = f_o - 0.43 B_3 \quad \ldots \ldots (14)$$

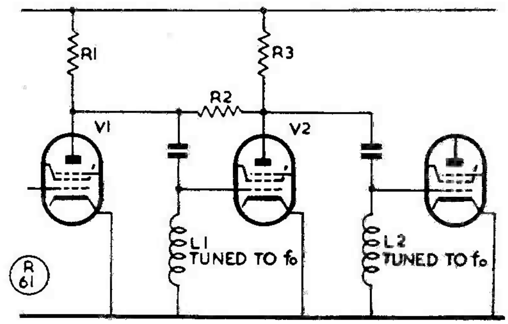

Fig. 4. Circuit for a feed-back pair.

and

$$f_2 = f_o - 0.43 B_3 \quad \ldots \ldots (15)$$

and have bandwidths of

$$B_a = \frac{1}{2} . \frac{B_3}{f_o} . f_1 \quad \ldots \ldots (16)$$

$$B_b = \frac{1}{2} . \frac{B_3}{f_o} . f_2 \quad \ldots \ldots (17)$$

respectively. The centred circuit has a bandwidth of B_3 and is, of course, tuned to f_o.

In a staggered system, each stage has a different gain, given by gmR, and the overall gain may be computed by adding the gains (in dB) of the individual stages at the mid-frequency. Alternatively, use may be made of the fact that, for a staggered system, the GB factor is the same as that of one single-tuned stage of the same bandwidth. Thus, for a pair with a bandwidth of x mc, the mean gain per stage is the same as that of a single stage of x mc bandwidth: then the overall gain of the pair is the same as that of two cascaded isochronous stages, but (see above) the bandwidth of the pair is x mc, while that of the isochronous pair is only $0{\cdot}64x$ mc. The overall gain of the staggered pair or triple is then the square or cube of the mean stage gain respectively.

Negative Feedback

Another method of achieving the steep-sided selectivity curve which is desirable to minimise bandwidth shrinkage is the use of negative feedback. A common way of applying this is to divide the amplifier up into pairs as was done for staggered pairs, and introduce negative feedback across each pair as in Fig. 4. The selectivity curve obtained is the same as that for a staggered pair, and so the bandwidth shrinkage is the same, but the negative feedback pair has its tuned circuits all aligned to

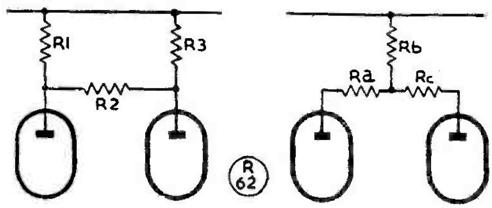

Fig. 5. Circuit transformation, as discussed in the text.

f_0. This represents a simplification, but there are disadvantages. One of these is that gain control can only be applied to the first stage of each pair, as the second is within the feedback loop. A second drawback is that stray capacitance across the feedback resistor R2 modifies the response curve as it makes the feedback dependent on frequency. The effect of this capacitance may be reduced by transforming the circuit formed by the damping resistors R1, R3 and the feedback resistor R2 of Fig. 4 into the equivalent circuit of Fig. 5. The design equations for the feedback pair of Fig. 4 are:

$$R1 = R3 = \frac{2g_m}{2\pi C_t B_4 (\sqrt{2}g_m - 2\pi C_t B_4)} \qquad (18)$$

and

$$R2 = \frac{2g_m}{(2\pi C_t B_4)^2} \qquad (19)$$

where R1 and R3 are the damping resistors, R2 the feedback resistor and B_4 the pair bandwidth. The conversion from Fig. 4 to Fig. 5 may be done by use of the formulæ

$$R_A = R_C = \frac{R_1 R_2}{2 R_1 + R_2} \qquad (20)$$

$$R_B = \frac{R_1^2}{2 R_1 + R_2} \qquad (21)$$

Transformer Coupling

None of the circuits so far discussed has given an instrinsic improvement in the coupling circuit gain-bandwidth factor, for the improvement noted has been an overall one resulting from the better selectivity curve. The final circuit to be considered here does give such an improvement, however; this is the use of a transformer for inter-stage coupling, as in Fig. 6. For simplicity, the only case to be noted is that of a transformer, the windings of which are critically coupled, the primary and secondary Q-factors being equal. It is well-known that as the coupling between windings of a transformer is increased, the response curve of the transformer becomes broader, until, at critical coupling, the response curve is at its widest for a single-peaked response; with tighter coupling than this, the response curve shows two peaks, one each side of the mid-frequency. The gain-bandwidth factor improvement from the use of transformers is $\sqrt{2}$ (compared with the single-tuned circuit). The bandwidth shrinkage for transformer coupled stages in cascade is given by

$$B_0 = \frac{B_5}{1.1 \sqrt[4]{n}} \text{ approx.} \qquad (22)$$

where B_5 is the bandwidth of one transformer-coupled stage. The required coupling between windings is given by

$$k = \frac{B_5}{\sqrt{2}.f_0} \qquad (23)$$

and the Q-factors of the primary and secondary by

$$Q1 = Q2 = \frac{1}{k} = \frac{\sqrt{2}.f_0}{B_5} \qquad (24)$$

from which the required damping resistors are obtained by use of

$$R1 = \frac{Q1}{2\pi f_0 . C1} \qquad (25a)$$

and

$$R2 = \frac{Q2}{2\pi f_0 . C2} \qquad (25b)$$

C1 being the output capacitance + strays of V1 and C2 the input capacitance + strays of V2. The gain per stage is then

$$G = \frac{g_m \sqrt{R1 . R2}}{2} \qquad (26)$$

The better GB factor of this circuit might make it appear overwhelmingly superior to the other circuits. In practice, most of the

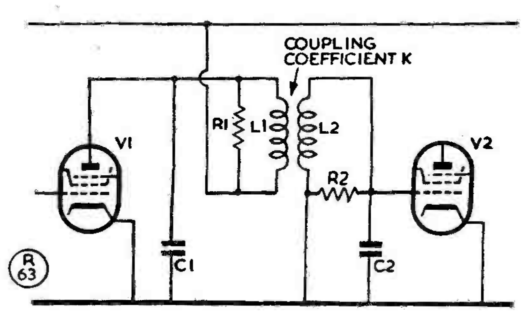

Fig. 6. Transformer inter-stage coupling; values and the significance of the coefficient K are discussed in the text.

superiority is lost due to the increase in stray capacitance from the more complicated transformer. It is not an easy circuit to align correctly, needing a lot of cut-and-try, but, once set up, is not very critical as far as small changes in capacitance are concerned.

Examples of Design

Examples will be shown of the design of an IF amplifier to illustrate the use of the equations given. Assume that the amplifier requires a gain of 80 dB and a bandwidth of 5 mc at 30 mc mid-frequency, and that the valve to be used has a total capacitance in circuit (input) of 9 $\mu\mu$F, total output capacitance of 5 $\mu\mu$F and gm of 5 ma/v.

These values give a GB factor for the valve + strays of

$$\text{from (4)} \quad \frac{5.10^3}{2\pi.14} = 57 \text{ mc.}$$

(A) Isochronous Amplifier

A guess is first necessary at the number of stages required. Try 8 stages. Then from (6) individual stage bandwidth

$$B_1 = 1.2.B_0.\sqrt{n} = 1.2.5.\sqrt{8} = 17 \text{ mc.}$$

From above $GB_1 = 57$ mc,

$$\text{so } G_1 = \frac{57}{17} = 3.3 = 10.5 \text{ dB.}$$

and overall gain

$$G_0 = nG_1 (\text{dB}) = 84 \text{ dB.}$$

Thus 8 stages is the right number.

The damping resistor is obtained from (3) in which C_t is now 14 $\mu\mu$F

so R1 = 670 ohms.

The tuning coil inductance is

$$L = \frac{1}{4\pi^2 f_0^2 C_t} = 2 \text{ micro Henry.}$$

(B) Staggered Amplifier

Again a guess is needed. Try 2 pairs (4 stages). Then, from (8)

$$B_2 = 1.1.5.4\sqrt{2} = 6.6 \text{ mc.}$$

$$\text{Then mean gain per stage} = \frac{GB}{B_2} = 8.5 = 18.7 \text{ dB.}$$

And overall gain = 74.8 dB.

This is 5 dB low but may be acceptable.

The pairs are then designed. One stage is tuned to

from (10) $f_1 = f_0 - 0.35\,(6.6) = 32.3$ mc.

and the other to $f_2 = 27.7$ mc.

The bandwidth of the first stage is, from (12),

$$B_a = \frac{6.6\,.\,32.3}{\sqrt{2}\,.\,30} = 5\text{mc.}$$

and that of the second stage similarly

$B_b = 4.28$ mc.

From these bandwidths, the damping resistors are

from (3) R1 = 2300 ohms.
and R2 = 2650 ohms.

And the inductances, L1 and L2 are

$$L1 = \frac{10^6}{4\pi^2 (32.3)^2\, 14} = 1.74 \text{ micro Henry.}$$

and similarly

L2 = 2.36 micro Henry.

(C) Transformer-Coupled Amplifier

Assume 4 stages. From (22).

$B_5 = 7.8$ mc.

From (23) $k = 0.183$.

$$\text{And } Q1 = Q2 = \frac{1}{k} = 5.5.$$

From (25a) in which C1 = 5 $\mu\mu$F
R1 = 5850 ohms.
And in (25b) C2 = 9 $\mu\mu$F
R2 = 3250 ohms.

$$\text{And the gain per stage} = \frac{5\,.\sqrt{5.85\,.\,3.25}}{2} = 10.8 = 21 \text{ dB}$$

So, overall gain = 84 dB.

And approximate inductances are (as before)
L (primary) = 5.65 micro Henry.
L (Secondary) = 3.14 micro Henry.

These three examples show how an amplifier may be designed to meet a given requirement, and, incidentally, make clear how uneconomical is the isochronous amplifier.

To align these amplifiers, it is nescessary to use a signal generator, and care must be taken to eradicate any traces of feedback in the amplifier by using adequate decoupling on valve electrodes and supply lines. If this is done, there is no reason why the theoretically calculated gains and bandwidths should not be reached in practice; amplifiers may thus be designed for the specific job in hand.

The author's acknowledgments are due to Messrs. Decca Radar, Ltd., for permission tc publish this article.

NEW QTH's

This space is available for the publication of the addresses of all holders of new U.K. callsigns, as issued, or changes of address of transmitters already licensed. All addresses published here are reprinted in the quarterly issue of the "RADIO AMATEUR CALL BOOK" in preparation. QTH's are inserted as they are received, up to the limit of the space allowance each month. Please write clearly and address on a separate slip to QTH Section.

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G6VD, W. M. Vendy *(ex-ZE3JS)*, Horizon Cottage, Trenance, Mawgan Porth, Newquay, Cornwall.

Random Jottings by the Old Timer

PITY the writers of science-fiction stories! All credit to their fluency of thought and depth of imagination, but very few can possibly have the real scientific knowledge to make their tales credible in every detail. We have recently been delving into the little matter of radio communication out among the galaxies and find some extraordinary difficulties being given extraordinary solutions. Our hero of the (extra-galactic) flying squad, having made a landing on Centaurus III (gravity roughly 3,500 G) wants to radio instructions about the method of getting his new supply of fuel, and, possibly, his return ticket. But the poor chap is, at the lowest estimate, one light-year away from his nearest neighbour in space. To simple-minded folk like us, brought up to believe that radio waves travel at roughly the speed of light, that means that his "Over to You" is followed by two years of silence before the QSO continues. This might be a very good thing for some of our Sunday-morning phone, but is hard on our hero.

COMING OR GOING ?

Another thing that intrigues us is the complications that might be caused by the Doppler effect. The earth-bound stations may know the exact QRG of the space-wanderer when he is stationary, but if he calls them up when travelling at a speed near that of light, it seems that they might have an awful lot of searching to do before they found his signals. And how would they know where to QSY, themselves, so that the frequency he listened on would present him with their own signals? Truly the extra-galactic traveller is beset by major difficulties; even if he travels at the speed of light (which we still regard as moderately fast, old fogies that we are), he will still require 4,000 years to get to some of the necessary spots to give "new ones" to the aspiring members of the DX Million Club. And as we are told that most of the *real* DX spots in the universe are receding from us at the speed of light, he would never catch up on them, anyway!

CONTESTS AND LADDERS

There would be some slight difficulty about assessing claims for the WAHB (Worked All Heavenly Bodies) Ladder if the judges had to wait more than 4,000 years for some of the QSL's to arrive, but no doubt a system of handing down credits from generation to generation would be reliable enough. (Birth certificates should, however, be sent by *registered* post). The biggest blow would be the proof of the widely-held theory that the entire universe is unpeopled, except for our own planet. Then the extra-planetary DX could only be worked at all by relying on the good nature of such travellers as CEØAA, EA9DD, G2RO, VQ6UU and the many others whose expeditions have made the radio conquest of this Earth possible. The matter of financing their longer expeditions, and arranging for their successive progeny, during the journey, to be taught the science of radio in time to make the next QSO, might also present some practical difficulties. But who shall say that such things would be beyond the resources of the keen amateur?

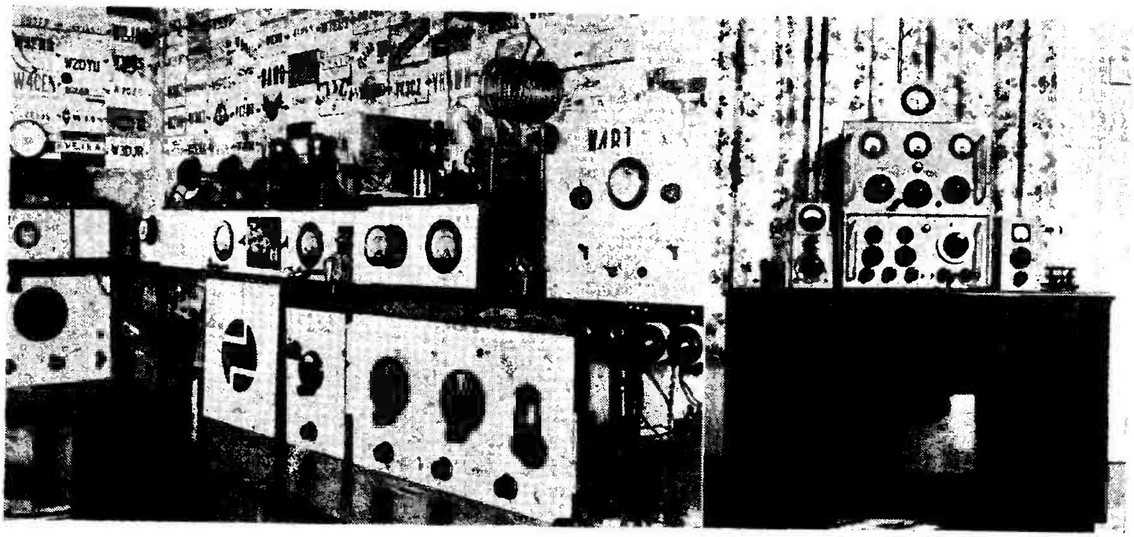
SHIPS THAT PASS

To return to more mundane matters—and how dull they seem, after a dose of science-fiction—we often wonder whether it is true that Amateur Radio has deteriorated since the early days. Certainly it has taken a turn for the worse in one way, and that is the making of real friends over the air. In spite of the "handles," how many call-signs mean more to you than just the label on a station? How many people on the air do you really *know*? There are, we know, plenty of amateurs who do run regular schedules with other stations; there are some who derive far more pleasure from repeated contacts with a friend, near or far, than from any amount of chasing DX. On the whole, though, the vast majority of QSO's on our bands must be of the hit-and-run variety. Exchange RST, ask for a card, and dash on . . . . that is the *tempo* demanded by most. And if the same station calls one again within a week, one is disappointed because he has already been "polished off." Surely, in a rational world, one would be *pleased* to find a station that one knew already.

HUMAN TOUCH

We should like to see a lot more of the personal touch infused into our hobby as a whole. Why should not the CW man who works a VK, a ZL or a VQ4 get to know as much about him as he does about his neighbour on 80-metre phone? Admittedly there are an awful lot of stations in the world, but you don't have to work them *all*—or do you? One thing is certain—speaking from personal experience—and that is that repeated contacts with the same station inevitably lead to the kind of radio-friendship that is all too rare nowadays. And what dull things QSL cards really are. They could easily tell one what the other chap does for a living, whether he is married and has a family, roughly how old he is, and what sort of a town it is that he lives in. But many amateurs would resent these incursions into their privacy and would actually prefer to remain just a call-sign on the night air. We are not indulging in any comdemnations or criticisms here, but we wonder, all the same—is this right?

The Other Man's Station — G2PN



IT is not often that we can show a photograph of an Old Timer station "as was" with a picture of it "as is." But here we see G2PN — owned and operated by A. Pollard, 31 Donkin Terrace, North Shields, Northumberland—as it was in 1937-39, with the modernised table-top rig as it is today in the picture to the right.

The subject of our story this time was first licensed as 6WK as long ago as 1923—no G prefix in those days, just the plain call-sign. Active until 1928, when, what with getting married and setting up house, his interest in Amateur Radio waned somewhat till, early in 1933, he visited G5QY of Newcastle. All the old urges flared up again, and in August 1933 G2PN came on the air—and has kept active ever since.

By 1935, the station filled a whole room, with a miscellaneous collection of gear to cover all bands from 1.7 to 56 mc. With the resumption in 1946, G2PN — like so many other stations — had to be completely rebuilt, and this time into a much smaller space, as a growing son had taken over the original radio room. Activity was somewhat curtailed thereby, the only bands worked during the period 1946-51 being 14 and 28 mc, with an occasional burst on the 160-metre band.

In 1951, came another big reorganisation, and the present layout, as pictured above, took shape to occupy a corner of the dining-room; naturally, for this it had to meet domestic approval. And readers will agree that G2PN now presents the stream-lined appearance that fully justifies such approval.

The transmitter covers the CW portion of 3.5 mc with ten switched crystal frequencies, but is VFO-controlled for 14 and 21 mc, running 60-140 watts depending upon the band in use. The transmitter sits above the receiver, with all power packs in the wide cupboards of the desk, and log books and so forth in the centre drawer.

In spite of being pinched for aerial space—the longest wire that can be erected permanently is but 33 feet—the DX tally now stands at 208 countries worked in all Zones, with cards held for several of the DX certificates.

As G2PN himself remarks, this brief description of his station and the results achieved may inspire others who, like himself, "are relegated to a corner of the dining-room which must be kept tidy," to overcome such a severe handicap with a layout on similar lines.

THE MONTH WITH THE CLUBS

By *"Club Secretary"*

(Dead-line for Next Issue : MARCH 19)

OBSERVANT readers will already have noticed a difference in the *format* of this feature. For no less than eight years, in this post-war series, we have been reporting the news, as sent in by Clubs and Societies, on the basis of a paragraph to each. Factual reporting has been the order of the day, even if rendered a little difficult by the fact that some Club scribes send in merely a bald statement of the dates of forthcoming meetings, whereas others fill a couple of pages with general chat about what goes on.

In future, for various reasons (all of them, we hope, good !) we propose to report a little less objectively and to weave the various Club reports into a general story representative of What the Clubs are Doing.

At the end of this, for clarity and easy reference, we propose to place those reports which merely give the dates of forthcoming meetings and such-like news. So we ask Club Secretaries to note, here and now, that we would appreciate it very much if their reports would stick to one of two forms : either (*a*) Some general notes on what has been happening at their meetings, who is who in the Club, and what proposals they have for their future welfare, or (*b*) Just a plain, concise statement of meeting-place and two or three past or forthcoming dates. All Club Secretaries are invited to make full use of this space, which is of course free — and the more interesting Club reports can be made, the more useful will be this feature. And we are always glad to have photographs, too, which are paid for on appearance.

Transistors in the News

There is no doubt that a great amount of amateur activity in the future will be bound up with very low-power work, using transistors for transmission. The subject will therefore become one of prime importance for the go-ahead type of Club, and lecturers who know their stuff about transistors are bound to be in great demand.

The ball has been set rolling, and the subject has already been attacked by two Clubs, ***Leicester*** and ***Southend***. At ***Leicester*** Mr. C. L. Wright, B.A., B.Sc., G3CCA (whose articles are to appear in SHORT WAVE MAGAZINE in due course), talked to a large gathering on February 1st. He gave an explanation of the theory of semi-conductors, and the relationship between valve and transistor. Part II of this lecture is to be given on March 1st and the following meeting, March 15 at the Holly Bush Hotel, Belgrave Gate, Leicester, will be a members' night for general discussions.

At ***Southend*** a big crowd gathered on February 5 to hear about Transistors from Mr. J. Missen, B.Sc., of the G.E.C. Research Laboratories. He covered such aspects of the subject as a transistor characteristic tracer, a broadcast receiver, a junction transistor oscillator, a portable transmitter, a relaxation oscillator and a photo-transistor.

One of the points made was that although transistors are unaffected by time or pressure, temperature does affect them. Further research, it is hoped, will overcome this disadvantage.

Films and Film Strips

There is no better way of illustrating a lecture (in the absence of a brilliant lecturer) than the film strip. These methods have become very popular among those Clubs who cannot often rely on the services of outside speakers. Every month we read of their use, as also of some straight films — among the luckier Clubs with a projector available.

A film strip on Valve Characteristics was seen by ***West Lancs.*** during January ; and during March ***Clifton*** are to see a film on Plastics. ***Lancaster's*** recent film strip show covered (or partially covered !) the subject of Television.

It seems to us that the tape-recorded lecture is another facility which could be used to great advantage by small or remote Clubs ; the only one to mention it this month is ***Salisbury***, who are opening the 1954 programme with a tape lecture loaned by the R.S.G.B. This will be followed by various instructional films at the meetings right up to the start of the summer programme.

Annual General Meetings

The season of AGM's, if there is one, really extends from October until April — but there seems to have been a spate of them in January and early February. The ***RAF Amateur Radio Society*** holds its own event at RAF, Locking, on March 27 at 2.30 p.m., with tea arranged and visitors welcome.

Salisbury held theirs in January and had a slight move-round of officers. G3IVP, former Secretary, is now Treasurer, and the new Secretary's name appears in the usual panel. At ***Southend*** a satisfactory report was presented by the Treasurer, Mr. E. H. Bridges, who has held that post *for* 34 *years* ! An interesting innovation was the listing of a batch of volunteers who were willing to be co-opted on the Committee when their particular knowledge was required for any purpose.

Officers were also elected at ***Romford***, where the membership is on the 30 mark. New members will be welcomed any Tuesday evening at R.A.F.A. House, 18 Carlton Road, Romford. At ***Warrington***, also, the new officers were elected : an Annual Dinner and Dance was also held.

Spen Valley's Annual Dinner saw the assembly of 54 members, friends and XYL's, and the guest speaker was W2DTJ, a radio operator in a B.29 Super Fortress " weather ship," who is stationed at Burtonwood.

The AGM at ***Chester*** was also held recently, but the Annual Dinner does not take place until Friday, April 2. G2YS, a founder member of this Club, is shortly moving QTH again, and will be taking up a new post in Filey. The Club will miss him. Before going to Chester, G2YS rendered outstanding service at Coventry and is most experienced on all Club matters.

'Way out in ***Malta*** a Hamfest was held by the Malta A.R.S., and this one was " strictly a stag party." With masterly understatement the report says that the conversation " tended to centre round Ham Radio." It further states that the time of finishing was uncertain, but many members were not on the air on the Sunday morning !

At the ***Derby*** AGM, the Treasurer reported a very sound financial position (assets over £75) and stated that the present membership of 72 was the highest on record. A move is being made to incorporate in the present Club's title the name of the Derby Wireless Club (1911), which claims to be the first Wireless Club in the world !

All roads in the area were snow-bound when ***Portsmouth*** held their AGM, but there was a good attendance just the same, and the officers were duly elected and the G8BU Shield and an Award of Merit presented respectively to Mr. Wheeler and G3CXJ.

There were some 30 members present at the ***Norwich*** AGM, at which the Chairman and all the officers were re-elected for another term of office. And at the ***Gravesend*** AGM, G3JBT and G3FST were put up for Chairman and President respectively.

No Meetings !

There are in existence several Clubs and Societies which are bound together by a common interest rather than by the boundaries of a town or district. Such Clubs cannot hold regular gatherings, but meet through their monthly publication and, of course, on the air.

One such is the ***QRP Research Society***, with its monthly journal " QRP " and its inevitable meetings of members on the amateur bands. GC2CNC, a well-known member, recently worked a W2 on the Top Band with an input of only 4.4 watts ; turning to the other extreme, he worked F8OK for the first contact between France and the Channel Islands, this time on two metres. Beginning on April 1 is a monthly 2-metre listening contest, by which it is hoped to promote further interest within the Club on VHF work.

The ***Tops CW Club*** is another which normally meets only on the air, but the Second Annual Midlands " Topsfest " is being held on April 24 at the Black Horse Hotel, Thompson Avenue, Wolverhampton. This gathering opens at 3 p.m. and proceeds (with refreshments) until late in the evening. Tickets are obtainable from the Organising Secretary, G3ABG, 58 Union Street, Bridgtown, Cannock. They cost 2s. for the meeting only, or 5s. for " the whole treatment," including tea.

Stoke-on-Trent took part in MCC with G3GBU, the team being, left to right : SWL Rowley, G3EOX, G3IDQ, G3UD, G3DML and G3HVI. The gear consisted of an HRO receiver and an ex-Army 12 Set. Though Stoke-on-Trent did not get a high place in the Contest, they did enjoy themselves.

Notes in Brief

CANNOCK CHASE : Next meeting March 4, and most members will be at the " Topsfest " in Wolverhampton on April 24.

CHESTER : Meetings on March 9 (Talk by G3ITY), March 16 (Auction Sale), March 23 (G3ATZ on Receivers) and March 30.

CLIFTON : Meetings every Friday at 225 New Cross Road, London, S.E.14. Visitors assured of a warm welcome.

LEICESTER : Meetings on March 15 (Members' Night for general discussion) and March 29)G2BVW on VHF Equipment).

MIDLAND : Meetings on the third Tuesday, 7 p.m. at the Imperial Hotel, Temple Street, Birmingham. Forthcoming subjects include Projection TV. Instruments, and UHF/VHF Transmitters.

ROMFORD : On March 30, G5RV on TVI and Transmitter Design. At R.A.F.A. House, 18 Carlton Road, Romford.

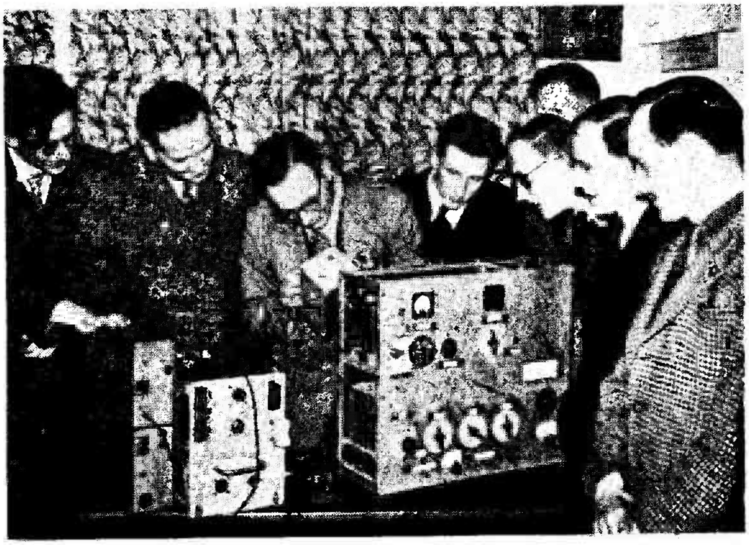
SPEN VALLEY : Meetings on March 10 and 24 ; subject for the latter date is Crystal Microphones and Pick-ups (Rothermel, Ltd.).

TORBAY : The AGM, followed by a Junk Sale, will be held on April 17.

WARRINGTON : Visitors welcomed to all meetings, held at the King's Head Hotel, Winwick Street, at 7.30 p.m., on the first and third Tuesdays of the month.

WEST LANCS.: Meetings every Tuesday, 8 p.m., over Gordon's Sweet Shop, St. John's Road, Waterloo, Liverpool. New members and visitors warmly welcomed.

BRIGHTON : Meetings every Tuesday, and the committee would like to see better attendances this year.



At a recent meeting of the Hull & District Radio Society, with G3FKK checking their band-switched transmitter with an absorption wavemeter. In this club there are a number of keen SWL's, in various stages of progress towards getting their licences.

BRENTWOOD : Future meetings will be held every Monday at 8 p.m., in the Model Engineers' Hall, Primrose Hill, Brentwood.

NORWICH : Next dates are March 5 and 19, and April 2 — visitors will be made welcome.

HARROW : Coming events — March 12 (Basic Theory), March 26 (Oscilloscopes), March 5 and 19 (Practical Nights). At the latter meetings the Club station G3EFX will be on the air on 80 metres.

GRAVESEND : Meets on Thursdays, 7.30 p.m., at a new QTH — Scouts' Den, London Road, Rosherville.

LEEDS : Meetings on Wednesday evenings at the Swarthmore Educational Centre, 3 Woodhouse Square, Leeds 3. March 17 — Visit to the Radiotherapy Department, Leeds General Infirmary ; March 31 — Talk on Realistic Sound Reproduction, by Dr. K. A. Exley.

PORTSMOUTH : Meets on Tuesdays, 7.30 p.m., in the Signals Club Room, R.M. Barracks, Eastney. Visit to Portsmouth telephone exchange on March 16.

SOUTH MANCHESTER : Coming events ; March 12, Talk by G2ALN ; March 26, Discussion on Rules of D-F Tests, and on the construction of D-F receivers, by G6DN and G3HZM.

ACTON, BRENTFORD AND CHISWICK : Meets Tuesday evenings, 7.0 to 10.0 p.m., at the A.E.U. Rooms, 66 High Road, Chiswick, W.4. Talks scheduled are by G6LX and G3VA on "DXpeditions" and the "History of Amateur Radio," while future activities include visits and /P operation.

Deadline for next month's reports :
First post on Friday, March 19,
addressed "Club Secretary,"
Short Wave Magazine,
55 Victoria Street, London, S.W.1.

NAMES AND ADDRESSES OF SECRETARIES REPORTING IN THIS ISSUE

ACTON, BRENTFORD and CHISWICK : R. G. Hindes, G3IGM, 51 Rusthall Avenue, Bedford Park, W.4.
BRENTWOOD : J. S. Thornton, G3FQQ, 18 Western Road, Billericay, Essex.
BRIGHTON : T. J. Huggett, 15 Waverley Crescent, Brighton 6.
CANNOCK CHASE : C. J. Morris, G3ABG, 58 Union Street, Bridgtown, Cannock.
CHESTER : N. Richardson, 23 St. Mary's Road, Dodleston, Chester.
CLIFTON : C. H. Bullivant, G3DIC, 25 St. Fillans Road, London, S.E.6.
DERBY : F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover, Derby.
GRAVESEND : R. J. Appleton, 23 Laurel Avenue, Gravesend.
HARROW : S. C. J. Phillips, 131 Belmont Road, Harrow, Weald.
LANCASTER : A. O. Ellefsen, G3FJO, 10 Seymour Avenue, Heysham.
LEICESTER : W. N. Wibberley, 21 Pauline Avenue, Belgrave, Leicester.
LEEDS : B. A. Payne, 454 Kirkstall Road, Leeds 4.
MALTA : J. Spafford, ZB1BZ, Argus House, Paceville, St. Julians, Malta.
MIDLAND : D. Hall, 144 Hill Village Road, Sutton Coldfield.
NORWICH : D. Youngs, 53 Salisbury Road, Norwich.
PORTSMOUTH : L. Rooms, G8BU, 51 Locksway Road, Milton, Portsmouth.
QRP : J. Whitehead, 92 Ryden's Avenue, Walton-on-Thames, Surrey.
R.A.F. : R. F. Weston, G6PZ, R.A.F., Locking, Somerset.
SALISBURY : H. G. Futcher, 171 Castle Road, Salisbury.
SOUTHEND : J. H. Barrance, M.B.E., G3BUJ, 49 Swanage Road, Southend
SOUTH MANCHESTER : M. Barnsley, G3HZM, 17 Cross Street, Bradford, Manchester 11.
SPEN VALLEY : N. Pride, 100 Raikes Lane, Birstall, Leeds.
TORBAY : L. D. Webber, G3GDW, 43 Lime Tree Walk, Newton Abbot.
WARRINGTON : G. H. Flood, 32 Capesthorne Road, Orford, Warrington.
WEST LANCS. : S. Turner, 5 Balfe Street, Seaforth, Liverpool 21.

THE CABLE SHIP "ALERT"

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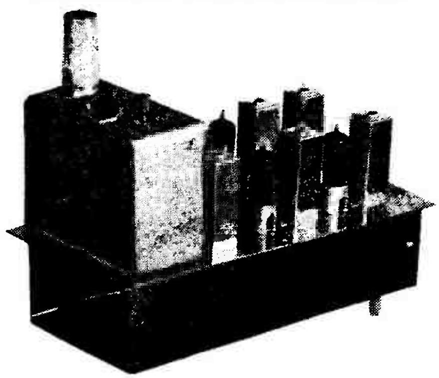

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URGENTLY WANTED: MANUALS OR INSTRUCTION BOOKS, DATA, ETC., ON AMERICAN OR BRITISH ARMY, NAVY OR AIR FORCE RADIO AND ELECTRICAL EQUIPMENT.—HARRIS, 93 WARDOUR STREET, W.1. (*TEL.: GERRARD 2504*).

WANTED: 70 to 100 mc Receiver at reasonable price.—Harris, The Huon, Bournemouth.

NC-200 NATIONAL RECEIVER, £37 10s.; Hammarlund Super Pro with Hammarlund power supply, £45; Telediphone Dual Recorder, continuous operation, £22; MG-149F Converter, £14; Lowther 12-watt Amplifier, £17; DST-100 Receiver, £30; ET-4332 Cabinet, £15; 5ft. 6in. Rack, 35/-; McElroy Morse Recorder, less valves, £3 10s.—BRS.12959, 15 Grosvenor Crescent Mews, S.W.1.

EDDYSTONE 680, unmodified; one owner; £40. Box 1366, Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

FOR SALE: 1154 with original power/packs, £12 10s.; 1355, 35/-; RAF 1190 Transmitter (mass of QRO gear), £15; Bendix Radio Compass, £5.—85, London Road, Kearsney, Kent.

HALLICRAFTER SX25, 11 valves, with manual; 550 kc to 42 mc; Xtal filter, S-meter, £13.—Ackroyd, 3 Wilson Road, Parkstone, Dorset.

WANTED: B2 Power/pack.—Particulars and price to: Box 1368 (all replies answered), Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

TWO 150 mA METERS, 8/- each; 100 kc crystal with base, 14/-; UM1, £1 2s. 6d.; 500-500 transformer, 17/6; 0-600 volt meter with metal case, unwired, 15/-; eliminator (needs smoothing condenser), 10/-; 750-750 transformer, 17/6; 5v. 1.5a. rectifier trans. for above, 5/-; doz. R.A.F. 5a. switches, 5/6; four 750v. 4 mF block condensers, 1/6 each; 10 battery valves, 10/-; telephone handset, 5/-; 3 chokes, 3 speaker trans., 12v. mains trans., 10/- lot; two 6L6, 6/- each; two 6J7, 3/6 each; one 6A8G, 5/-; five two-gang 0005 mF, 6 misc. variable condenser, 10/-; 100 mica and paper condensers (50 new), 7/6; Muirhead slow-motion drive, 5/-; 62 RSGB *Bulletins*, 48 *Short Wave Magazine*, 45 *Practical Wireless*, 18 *Wireless World*, 15/- (post extra); 0"-3" depth micrometer, 10/-.—Box 1367, Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

EDDYSTONE 740, absolutely as new, few hours' use only; £30 or near offer.—G5TZ, Newport, Isle of Wight. (*Newport 2504* any time).

BC 348-0 (RCA) internal mains supply, 12-volt dynamotor attached, as new, phones, £16 o.n.o.—Box 1370, Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

SMALL ADVERTISEMENTS, READERS—*continued*

TRANSMITTER. 40-watt 80, 40, 20, 15, 10 metres, bandswitched; Phone/CW Table Topper by Q-Max, excellent condition, with handbook; cost £75; size 19" x 10" x 9½"; only microphone and key external; £50, carriage paid U.K.; inspection invited.—Flt.-Lt. Lockyer, R.A.F. Debden, Saffron Walden, Essex.

BRAND-NEW, unused, R.109 8v. Communications Superhet, 1.8-8 mc, AVC, BFO, speaker, spare valves, vibrator; recently purchased at £5 5s. 0d.; bargain, £3 10s. 0d.—R. Pottle, 120 Norwich Road, Costessey, Norwich.

B36 MARCONI 9-valve Receiver, 1-20 mc, bandspread and 100 kc crystal calibrator added, £10. —G3AZT, 34 Westfield Road, Rugby.

EDDYSTONE 640, good condition; instruction book; also Class-D wavemeter; offers?—163 Queen Mary's Road, Coventry.

FOR SALE: CR100 Radio Receiver, complete with separate 3-ohm loudspeaker, good condition; view in East London; £25 or offers.—Box 1369, Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

G73 Sig. Gen./Wavemeter with xtal calibrator, 100 kc to 25 mc in 6 bands, with calibration booklet; also Canadian 13-valve Comm. Rx, 1.5 to 30 mc, with enclosed spkr.; above perfect condition; sell or exchange for Tx equipment.—Gronant Villa, Abbey Drive, Gronant, Prestatyn.

HRO-Mx (National) Directional Loop, 6-volt pack, speaker, two coils 180-430 kc, 0.9 - 2.05 mc; prepared for yacht, never used. What offers?—Box 1371, Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

WANTED: QQVO640 or 320. State price.—G8PX, 1 Lovelace Road, Oxford.

813 RACK Tx, grey enamelled finish, TZ40 modulator, speech amp., ATU, VFO, wide band doublers 10, 20, 40, 80 metres; relay switched, single control; £20. Home-brewed Double Super, two RF's, switched all amateur bands to 30 mc, S-meter, enclosed speaker, less case, £8. Top Band Phone Tx, enclosed, complete, £6 10s. 0d.—G3FYJ, Starkholmes, Matlock, Derbys.

FOR SALE: Brand-new R.103/A Rx, 160, 80, 40 metres; AC mains or 6 volt; £20 o.n.o. Radiovision "Hambander" Rx and Selector, matched speaker; had very little use; £25 o.n.o. New Rx, R.1132/A and Mark 3 P/Pack; £12 the pair. New Rx R.3118, 16-valve; AC mains; £8. Brand-new 11-band Pye broadcast Rx, table model; p/u and gram., magic eye, etc.; £40 o.n.o. Small portable signal tracer, with battery; hardly used; £5.—A. Harmsworth, High Coxlease, Lyndhurst, Hampshire.

VALVE BARGAINS (all at 3/6, guaranteed): 6N7, 6AC7, 2A3, 1625, 12A6. At 5/-: VT501, 6AK5, 6J6, VR150, 807, EL35. At 6/-: 6AG7, 5R4GY, 5U4, 5Z4, 6B8, 6SA7, 6SN7. WANTED: 813's; would consider exchanges. WANTED: AR88, any condition, S27, BC221, or exchange HRO bandspread coils and twenty pounds for AR88.—Box 1375, Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

AR88LF, S-meter, handbook; excellent performance; £42. Xtal controlled, G2IQ 2-metre converter, £3. Two-metre Transmitter, EF50-CV1510-832-829B, £5. UM3, £3. Transformer 1000-0-1000 volt, 250 milliamps, 30/-. Choke, 10/-. Valves: 813, 25/-; Amperex 211G, with holder, 12/6; TZ40, 6/-; 807, 5/-. All items carriage paid. —G5HB, 1 South Street, Watchfield, Nr. Swindon, Wilts.

SMALL ADVERTISEMENTS, READERS—*continued*

WANTED: Class-D Wavemeter, unmodified or AC mains; good condition.—G. W. Hawksworth, 12 Powell Street, Heckmondwike, Yorkshire.

WANTED: Class-D Wavemeter in good working condition. — Details and price (all letters answered): Watts, 76 Boilean Road, Ealing, London, W.5.

WANTED: Table-top or enclosed rack bandswitched phone Transmitter, preferably 150-watt, TVI-proof and professional.—G6AS, 120 Grange Road, Olton, Birmingham 27.

TRANSMITTER: Grey metal screened cabinet, 22″ x 20″ x 31″; Wilcox-Gay VFO, 6V6, 6L6, P/Pull 807's, 60w. Phone (supermodulation), 100w. CW; triple heavy-duty power supplies. VCR138 'scope monitor; low harmonic output; FB condition; coils 14 and 28 mc. Delivery 30 miles radius. £25 o.n.o. — G2BVN, 51 Pettitts Lane, Romford, Essex.

EDDYSTONE S640 Stabilized Oscillator, 6BA6 RF stage, re-aligned, complete with S-meter and matching speaker, £17. Radiocraft 2-stage preselectod, 1.7 to 30 mc, £5.—J. P. Pracy, 2 Talford Grove, W. Didsbury, Manchester 20. *(Phone: Didsbury 3678).*

Q-MAX. Q510X Receiver, 180° bandspread 160-80-40-20-15-10 metres, S-meter, Xtal filter, etc; working on all bands but requires slight attention. Nearest £22, or exchange BC221 in good condition.—Baker, 2 Vale View, Swinderby, Lincs.

WANTED: Any *QST* before November 1923; *Radio*, June 1933 to December 1935; *R/9*, September 1932 to June 1935, and August 1935; *CQ*, January, March, April, June, July 1945, and November 1945 to February 1946. — G3IDG, 95 Ramsden Road, London, S.W.12.

WANTED by SWL: One or more General Coverage Coils for HRO Senior; good condition essential.—Please state price and coverage. Box 1374, Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

WILCOX GAY VFO. FB condition, modified output; £4, or exchange good bug key.—G3BII, Harrias Cottage, Hedgerley Lane, Beaconsfield, Bucks.

WANTED: Receiver, coverage all HF bands. Willing collect London or Northants areas. Must be good condition and have bandspread.—VQ5AU, c/o Short Wave Magazine, Ltd., 55 Victoria Street, London, S.W.1.

522 RX, 30/-; 1155, £6; RF27, 30/-; CAY 471SA, 20/-; TU6B, 10/-; W66 wavemeter, 3-15 mc, 15/-; 750-0-750v., 6v., 4v., £2; 500-350-0-350-500v. and 2 chokes, 30/-; 3KV, 2V, 2V, 5V., 10/6; 1:1, 2:1, 3:1 60 watts, 10/-. Valves, crystals.—Enquiries: G3CTO, 47 Warwick Avenue, Slough.

G4LF SELLING-UP: 100-watt Tx in 6ft. rack; AR88, VFO, D104 mike, 40ft. poles, valves, xtals, etc.; £65 or near offer for quick sale. Buyer collects.—Turton, 428 Binley Road, Coventry. *(Walsgrave 2494).*

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5Z4	8/6	6SG7	7/6	75	8/6	9D2	4/-	PEN25	6/6
6A7G	8/6	6SH7M	7/6	78	8/6	15D2	10/-	PEN46	7/6
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Containing 4-EF50, 2-SP61, 2-EA50, 1-EB34, 2-single-gang .0005 tuning condensers. W/W volume/controls, switches, condensers and resistors. Size 12in. x 9in. x 5in. New condition, **35/-**, carr. 3/-.

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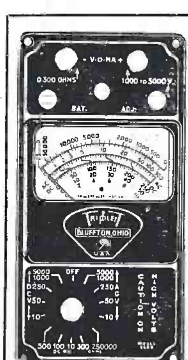

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