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"SPARE TIME FOR BRITAIN"

An announcement in this issue, under the above apt title, that the Royal Naval Volunteer (Wireless) Reserve is beginning a new drive for recruits, emphasises once again the apparent lack of interest on the part of the other two Services in the formation of Wireless Reserves. For the past three years prominent members of the Society—and no doubt many others—have pressed the Air Ministry to resuscitate in some modern and realistic form the Civilian Wireless Reserve. Unofficial conversations have taken place with top-ranking officers in the Directorate of Signals and in Reserve Command. Everyone approached has been sympathetic and appreciative of the part played by wireless reservists during the 1939–45 war, but no one has yet been permitted to say "let us take full advantage of the offer made by these enthusiasts and get cracking."

The formation of a Signals or Radar Reserve would provide opportunities for those who served in the last war to bring themselves up-to-date with the latest designs of Service equipment. Even more important it would enable the keen young technician who has completed his period of National Service to attend refresher courses at training schools where he would be allowed to study new techniques.

It can of course be argued that the Army and Air Force already operate Reserves for those with a flair for Service life. That is true, but these Reserves are not specifically designed to appeal to the technically-minded although no doubt many such have enrolled.

Parades and drills are essential in every Service but the average technician will not be attracted to a Reserve which concentrates prominently on these aspects of Service life. Furthermore if he is carving out a technical career he will seldom be able to devote the requisite number of hours per year to compulsory parade ground training. Tell him that he can spend a couple of weeks annually at a training centre; provide him with opportunities throughout the rest of the year to visit Military or Air Force Stations where he can help to instal and operate new equipment. These things guaranteed, he will be ready to devote a proportion of his time to "square bashing."

Service chiefs do not yet seem to appreciate that there is a steadily increasing demand for technical reserves *of all kinds*—not only in the field of radio. The last war was a battle of wits between the technicians of the opposing forces. Any future conflict will depend even more upon the skill of the technician.

The apparent reluctance of the War Office and Air Ministry to take advantage of the experience gained by radio amateurs who served in the Army and Air Force during the last war, and who are anxious to join a Signals Reserve, is hard to understand. Perhaps there are insuperable difficulties, if so we should like to know how it comes about that the Senior Service is again able to operate a post-war Naval Wireless Reserve. Is it because the Admiralty has a more lively appreciation than either the War Office or the Air Ministry of the value to the community of the radio amateur in times of national emergency?

We commend to all young men the enterprise of My Lords Commissioners of the Admiralty, and we trust that many of them will be able to

"*Spare Time for Britain.*" J.C.

Headquarters Station

Numerous suggestions have been received concerning the operation of GB1RS. The Station Committee (Mr. H. A. M. Clark, G6OT, Mr. F. Charman, G6CJ and the General Secretary) is appreciative of these suggestions and is anxious to provide better services. However new facilities, such as slow Morse practices and normal amateur working, introduce problems—technical, practical and operational—all of which require time for solution. For example, slow Morse transmissions could, at the moment, only be sent as part of the hourly cycle, and at a speed of not less than 12 w.p.m., which is the lowest speed of the G.N.T. transmitter. For slower speeds it will be necessary to devise a reduction gear.

The greatest handicap however is in the matter of accommodation. There is little available space at Headquarters and very few evenings are free of business meetings. The station seeks a suitable "home" and the Committee face the task of staffing it. Offers of help in connection with any of these problems will be welcome.

F.C.

In this issue

LOW-POWER TRANSMITTER FOR 420 Mc/s.

By W. A. SCARR, M.A. (G2WS)*

Introduction

THERE would appear to be considerable divergence of opinion amongst U.H.F. enthusiasts and the more technically minded of the Society's members concerning the type of apparatus which should be used on the 420 Mc/s. band. One school of thought favours, initially, the use of simple and relatively unstable equipment, whilst the second considers that all but highly-selective receivers and crystal-controlled transmitters should be banned from the start. Were the question to be put to the licensed membership as a whole, one can hazard a guess that the majority would carry the day in favour of using simple apparatus.

As things stand, there is much to be said for getting "on the air" on this band, without waiting for the availability of special valves and for the accumulation of the time, money, skill and patience necessary for the design and construction of U.H.F. superheterodyne receivers and crystal-controlled transmitters. No one can deny that these things are possible and desirable, though at present beyond the reach of a large proportion of U.H.F. enthusiasts.

As the present maximum licensed input power is only 25 watts, the energy available must be carefully steered in the right direction by the use of directional aerial arrays if useful work is to be done. There is a fine opportunity for experiment here. With such small power and its concentration in fairly narrow beams, the risk of interference is greatly reduced and judging by the almost complete absence of activity on the band in these first months, it will be a very long time before the problem of interference arises. When

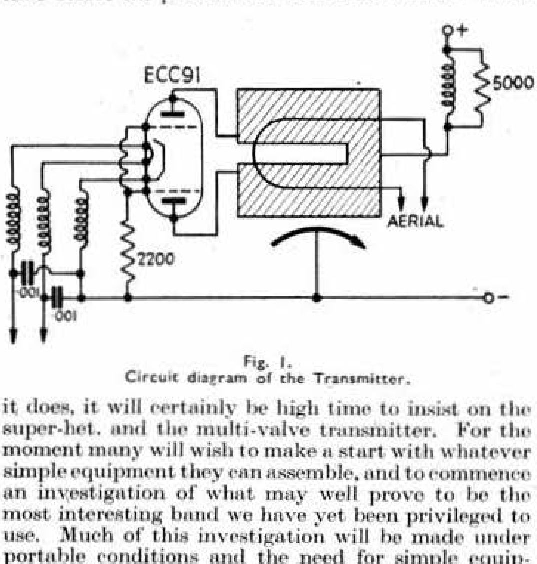
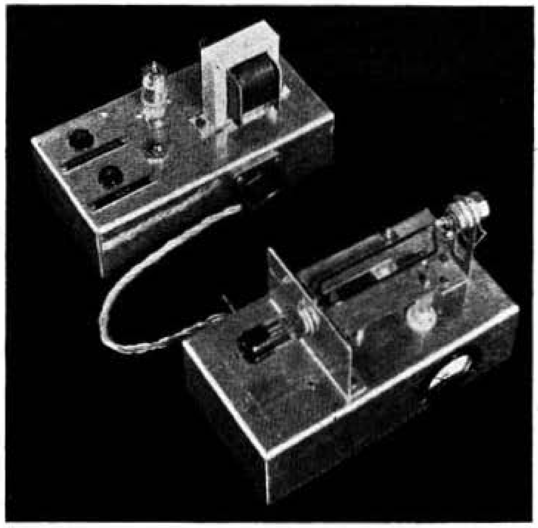


Fig. 1.
Circuit diagram of the Transmitter.

it does, it will certainly be high time to insist on the super-het. and the multi-valve transmitter. For the moment many will wish to make a start with whatever simple equipment they can assemble, and to commence an investigation of what may well prove to be the most interesting band we have yet been privileged to use. Much of this investigation will be made under portable conditions and the need for simple equipment will, therefore, remain even when the home station has been fully equipped with crystal-controlled gear.

As on other bands, every endeavour will naturally be made to secure reasonable stability and to avoid interference with services working on other frequencies. With this end in view, a simple transmitter for local 'phone or M.C.W. work is described in this article.



View of the transmitter and modulator. The equipment has been used with considerable success at the author's home in Shortlands, Kent.

The Transmitter

The transmitter uses a midget double-triode *Mullard* valve, the ECC 91, in a push-pull circuit with strapped grids (Fig. 1). To give frequency stability, the inductance is made from sheet copper and soldered directly to the anode tags of the B7G valve holder. The frequency of oscillation is determined largely by the length of the slot cut in the copper plate (Fig. 2) and this will vary somewhat according to the exact layout of the components. Tests should be made and the slot lengthened gradually until the desired frequency is reached. Final frequency adjustment is made by means of a brass disc, conveniently about 1 in. in diameter, fitted with a screw and supported by a threaded metal tube. This earthed disc can thus be screwed up and down below the slot in the copper plate and, the closer it approaches the plate, the *higher* will be the frequency of the oscillations. In the original model, the top half of an old open-type crystal holder was used. An old neutralising condenser would probably supply what is needed.

As it was not thought necessary to cover the whole band, the oscillator was made to work at approximately 420 Mc/s. with the disc right down. Screwing it up to within 1/10 inch of the copper plate raised the frequency to about 440 Mc/s. In every test, the frequency should be measured *with the aerial coupling loop in position and with the transmitting aerial attached*. It is of the greatest importance to have a good frequency meter available and always to measure the frequency under exact operating conditions.

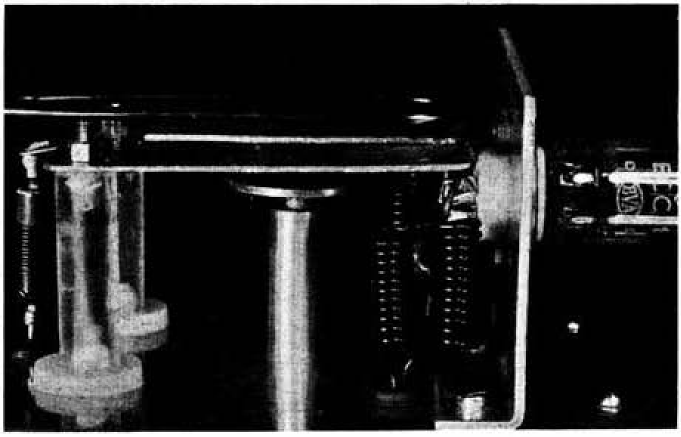
Little more need be said about the construction of the transmitter, which will be clear from the photographs. The chassis measures 7in. × 3½in. The R.F.

* 8 Beckenham Grove, Shortlands, Kent.

chokes consist of about 9½in. of enamelled copper wire. Five-pin *Belling Lee* sockets were used for all power connections.

The Modulator

As the transmitter is designed to work with an input of not more than 4 watts, a single button-base valve is all that is required for modulation and the *Mullard* EL 91 midget output pentode is suitable in every way. No difficulty should be experienced in constructing the modulator (Fig. 3), which uses a choke rather than a transformer as the former is cheaper and more easily obtainable. A small 20-Henry choke made by *Elstone Electronics Ltd.*, was used in the original modulator.



Part of the Transmitter showing tuning disc. In the original model this comprised the top half of an old open-type crystal holder. The copper plate (Fig. 2) can be clearly seen.

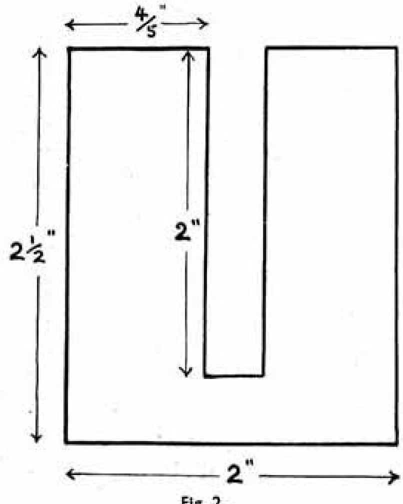


Fig. 2.
Dimensions of copper inductance. The frequency of oscillation is determined largely by the length of the slot.

The metal chassis is the same size as that used for the transmitter and the two might well be fitted into a small case or on to a frame for portable operation.

Provision is made for M.C.W. by feed-back from the plate of the EL 91 into the primary of the microphone transformer. A single-pole double-throw toggle switch effects the change-over and the M.C.W. note may be varied if necessary by altering the capacity of the condenser C2. When using M.C.W., the microphone must either be left in circuit or its terminals shorted by using a closed-circuit jack. Current for the single-button carbon microphone is obtained from the H.T. source through a resistance R2 of 22,000 ohms.

Operation

A well-regulated voltage supply of not more than 180 volts should be used and the voltage actually reaching the anode of the ECC 91 should not exceed 150 volts.

In spite of its very small power, the transmitter will be found capable of covering considerable distances if used in conjunction with a highly-directional aerial system. At these frequencies, power is relatively unimportant but the concentration of the available energy in a narrow beam is of the highest importance.

It is intended, of course, that the transmitter shall be used in conjunction with broadly-tuned receivers of the super-regenerative type. This much maligned type of instrument is the most effective U.H.F. receiving device where simplicity of design and portability are of first importance. There is a need for experimental work on the super-regenerative receiver for frequencies above 400 Mc/s. and it is to be hoped that members will be encouraged to work along these lines during the coming months.

In conclusion, the writer would like to acknowledge indebtedness to Mr. F. Charman (G6CJ) for suggestions and advice, and would be glad to hear in due course from members who build the transmitter.

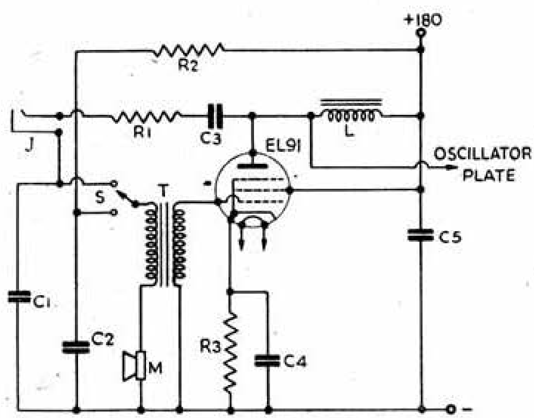


Fig. 3.

Modulator for Low-power 420 Mc/s. Transmitter.

C1, C3	.5 uF	S	S.P.D.T. switch.
C2	1 uF.	J	Jack for key.
C4	25 uF (electrolytic)	M	Microphone.
C5	4 uF.	T	Microphone transformer.
R1, R2	22,000 ohms.	L	L.F. choke (20 Henries).
R3	680 ohms.		

TEST OSCILLATOR FOR THE TWO METRE BAND

By J. St. C. T. RUDDOCK, B.A. (G8TS)

NOW that the 144 Mc/s. band is open to amateurs, much thought, time and patience will be expended upon designing transmitting and receiving gear for use on these new frequencies. Perhaps the most fundamental requirement will be a piece of equipment for determining when the appropriate portion of the spectrum is being covered. An absorption wavemeter to provide these facilities was described in the May, 1948, issue of the BULLETIN, but the use of such a device has severe limitations since no definite indication of resonance is available. The use of a low-power oscillator is probably the best answer to the problem. Such a unit can be constructed quite easily, and, if proper care is taken, it will become as faithful a friend as the old type of wavemeter used on the lower frequencies.

The inclusion of a meter in the grid circuit enables the device to be used to indicate resonance in tuned circuits. It thus becomes a "grid-dip" meter, permitting the following measurements and observations to be made:

(1) The resonant frequencies of R.F. and oscillator stages of receivers with I.F.'s up to 12 Mc/s., and of transmitter doubler and P.A. stages with power switched off.
(2) The calibration of absorption wavemeters.
(3) The determination of dipole resonant frequencies.

To a limited extent the device can be used as a comparative check of receiver sensitivity. It is also useful as an R.F. source, for checking the back-to-front ratio, the forward gain and the frequency bandwidth of beam aerial arrays.

Circuit

In Fig. 1, it will be seen that the oscillator consists of one valve, five condensers, two resistors and one inductance, forming a Colpitts circuit in which both ends of the tuning condenser, C2, are above earth potential. C1 is a band-setting condenser, which, along with the two-turn coil, allows a tuning range of

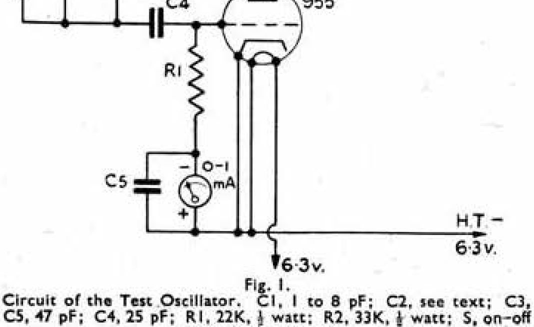


Fig. 1.
Circuit of the Test Oscillator. C1, 1 to 8 pF; C2, see text; C3, C5, 47 pF; C4, 25 pF; R1, 22K, ½ watt; R2, 33K, ½ watt; S, on–off switch; L, see text.

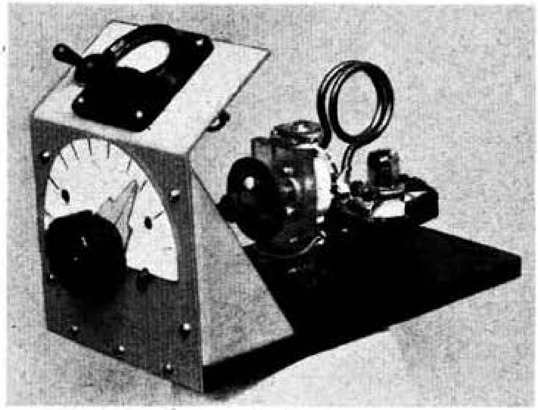


Fig. 2.
The completed Test Oscillator for the Two-Metre Band.

132 to 150 Mc/s. to be covered by C2. C3 is included in order to remove D.C. voltage from the coil.

The valve used in the original model was an acorn type 955, mounted as shown in Fig. 2. Other types, including the 6C4, 9002 and 6J6, have been tried with equal success. The inclusion of C5 was found to be necessary to by-pass R.F. from the leads between R1 and the grid-current meter. The L.T. and H.T. supplies come from a separate source, the switch S1 being included in the positive lead of the latter.

Construction

Figs. 2 and 3 show the finished unit, which has a 5-ply wooden base, 6½in. × 4in., and a metal front panel with brackets carrying the dial assembly, meter and H.T. switch. Details of this panel are given in Fig. 4, the top portion being bent over at an angle of 45° in order to facilitate reading of the meter. C1, C2 and L are mounted on the trolitol bracket which is also detailed in Fig. 4, and the complete assembly is 3½ in. from the front panel. A length of ¼in. diameter rod and a coupler constitute the drive between C2 and the *Plessey* type epicyclic gear on the panel. An ivorine scale and perspex pointer provide for the addition, at a later stage, of calibration markings. Each component can be easily identified in the photographs.

The tuning inductance, L, has two turns of 10 S.W.G. silver-plated copper wire, wound with an internal diameter of 1⅛in. and with ⅛in. spacing between the turns. C2 is a *Polar* type trimmer condenser with spindle extension and with the number of plates cut down to one fixed and one moving, spaced approximately one plate thickness.

Operation

With the heater connected to a 6·3 volts source, and with 250 volts H.T. applied, the grid meter should indicate approximately 0·7 mA., and the H.T. consumption should be about 4·3 mA. When the voltage is reduced to 150 volts, the consumption falls to 2·4 mA. and the grid current to 0·36 mA. The latter has always been found to be a usable figure, even when types of valve other than the 955 were used, giving a slightly lower value of grid current.

Any circuit resonant in the band 130 to 150 Mc/s., when held near the coil, should cause the meter to dip. In order to prevent " pulling " of the oscillator frequency, the coupling must be as loose as possible, causing a barely perceptible movement of the needle when resonance is reached. The three power supply leads should be long enough to permit holding the oscillator unit close to the transmitter or receiver circuits whose tuning ranges are being investigated.

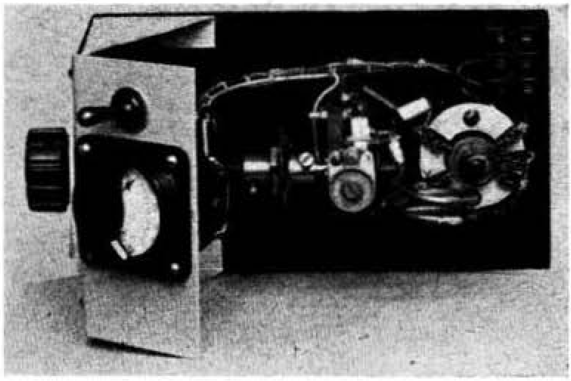


Fig. 3.
Top view of the Oscillator, looking down on the coil and the 955 Acorn.

Calibration

There are four suggested methods of calibrating the oscillator, each depending upon the test equipment available.

(1) *Using a calibrated receiver covering the frequencies between* 130 *and* 150 *Mc/s.*

This is the simplest and easiest method, if a suitable receiver is available. The *Hallicrafter* type *S27* receiver can be used between 130 and 143 Mc/s., but its dial calibration must not be depended upon. Stray pick-up only is necessary to give a definite S-meter reading, but precautions must be taken not to confuse the image reading with the true reading.

(2) *Using a transmitter or oscillator having an output between* 130 *and* 150 *Mc/s.*

The transmitter doubler or P.A. tank circuit, when adjusted for minimum dip and with the H.T. switched off, can be used as a source of calibration, the circuit simply acting as an absorption wavemeter when the oscillator coil is held near the P.A. tank circuit. Thus, if several crystals are available, giving output frequencies inside the band in question, calibration points are readily afforded. A calibrated oscillator can be used in a similar manner.

(3) *Using a signal generator giving either fundamental or harmonic output between* 130 *and* 150 *Mc/s.*

A pair of high-resistance headphones are connected in series with the H.T. line, and a single-turn coupling loop connected to the signal generator output is held near to the oscillator coil. Upon tuning the oscillator condenser a beat note will be heard when the oscillator and the signal generator are at the same or harmonically related frequencies. For example, the signal generator may be working between 65 and 75 Mc/s., and the oscillator on a frequency between 130 and 150 Mc/s. The L.F. modulation of the signal generator will be of assistance in this operation, and several settings, using different frequencies, complete the calibration. Method (2), with H.T. applied to the driven valve, can be used in a similar manner.

(4) *Using Lecher Lines.*

For those with no calibrated test equipment at all, there is no alternative but to use the Lecher wire principle for the calibration of the oscillator. The frequency of an R.F. generator can be determined by measuring the distance between loops and nodes in a uniform line loosely coupled to it. This is due to the fact that these loops and nodes are always an electrical half wavelength apart, so long as the velocity factor of the line is unity. Lines having the latter requirement can be constructed with very close spacing and supported at each end, the whole being clear of any surrounding objects by a distance at least as great as that between the lines.

When a shorting strap is placed on the lines at a point at which the electrical length of the whole

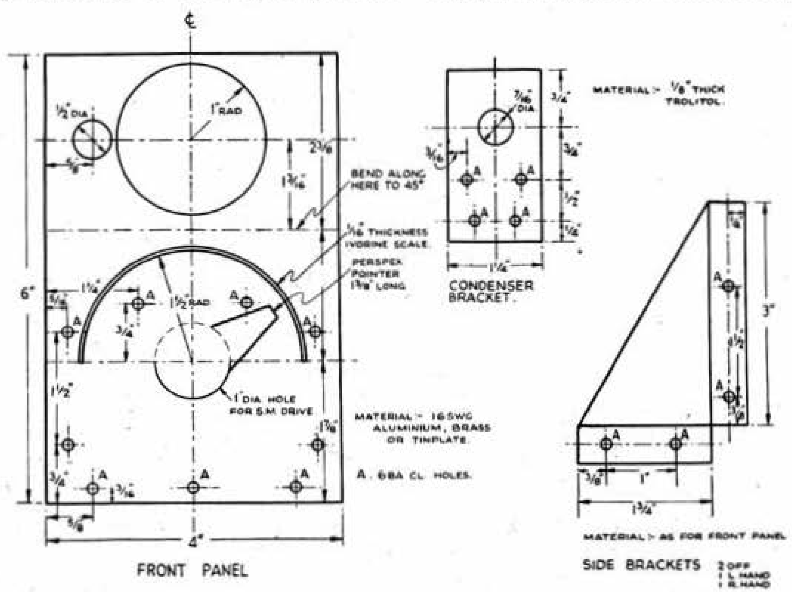


Fig. 4.
Dimensions of the front panel, the condenser bracket and the side brackets.

line is an exact number of electrical half-waves, the line will act as a high-Q parallel resonant circuit, and so will have the same effect upon the oscillator as would an absorption wavemeter. Owing to the high Q of the unloaded oscillator circuit, very loose coupling between it and the Lecher line is necessary, usually not more than a single-turn coupling loop. The total length of the line should be approximately one wavelength, which, at 144 Mc/s., is about seven feet.

wavelength in metres can be found by multiplying this distance (in inches) by ·0508. The frequency (in megacycles) can be obtained by dividing the distance into 5907. In both cases, the line velocity is regarded as unity.

The accuracy of the Lecher wire principle of frequency measurement, with normal reading accuracies and using very loose couplings between line and oscillator, can be of the order of from 0·1 per cent. to 1 per cent.

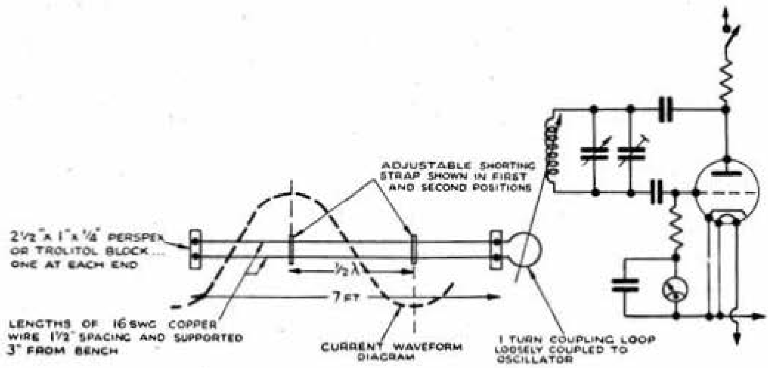


Fig. 5. Using Lecher Lines to determine the frequency of the oscillator. The lines are mounted on a wooden board or supported, clear of walls, etc., by wire strainers.

Fig. 5 explains in detail the constituent parts of a typical set-up. The strap should be moved along from the open end until a dip on the meter is noticed, the loop coupling being reduced to give a sharp deflection. This point is marked, and the strap moved towards the oscillator until a second dip is noticed. This point is again marked, and the distance between it and the first measured. The

In practice, many uses can be found for this test oscillator. There are two points about its use, however, which call for special mention. Firstly, reliable results and measurements can be obtained *only with the coupling as loose as possible* between the oscillator and the circuit which is being measured. Secondly, it is *not* suitable as a frequency standard satisfying G.P.O. requirements.

SPARE TIME FOR BRITAIN

NAVAL WIRELESS RESERVE NEEDS RECRUITS

THE Royal Naval Volunteer Wireless Reserve was reconstituted in 1947 as a unit of Officers and Men specialised in Wireless Communication within the framework of the R.N.V.R.

The conditions of service are substantially the same to-day as given in the May, 1947, issue of the R.S.G.B. BULLETIN, but summarising it may be said that engagement is for five years during which period 16 hours' attendance per quarter at the local training centres, and 28 days with the Fleet or in a Naval Signal School, is obligatory.

Broadly the categories for enrolment are:— (*a*) Telegraphists; (*b*) Radio Electricians.

A high degree of selection is employed, however, for entry as Radio Electricians.

Training

Training is carried out at local coastal R.N.V.R bases around the United Kingdom and at special fully-equipped centres set-up exclusively for R.N.V.(W.)R. training. In addition, Reservists who have attained a prescribed standard of efficiency in the Telegraphist Branch are issued with a complete transmitting and receiving station for use in their own homes. This usually comprises an HRO–MX type receiver with a complete set of general coverage coils, a 35-watt crystal controlled C.W. transmitter—6V6 C.O., 807 Doubler P.A.—and a comprehensive kit of tools, equipment and maintenance spares.

A number of frequencies within the band 3–6 Mc/s. have been allocated to the Reserve. These frequencies are used by a network of stations covering the British Isles which operate traffic handling schedules of a Service nature. Exercise working also takes place.

Transmitters of higher power are fitted (or are being fitted) in the R.N.V.(W.)R. Training Centres for long distance communication by C.W. or Telephony. These transmitters, of modern design and construction are rated from 150 to 400 watts R.F. *Marconi* CR100/7, HRO and AR88 communication receivers are in use.

Regular instruction in Morse Code is given and the aim is for new entries, beginning with no knowledge of the Code at all, to work up eventually to the full naval speed of 22 w.p.m. under expert instruction. This is by no means as formidable as might at first sight appear. Touch Typewriting is also taught to all Reservists, the principal aim being that the Telegraphist will, after a period of regular and thorough training, be able to take down messages direct on the typewriter in the manner which has been used by amateur and commercial operators in the U.S.A. for some years.

British Naval W./T. procedure, which is now very much akin to commercial procedure, is taught by degrees.

Recruits Needed

Whilst expert telegraphists and touch typists and those with previous service in the Wireless Branches of the Services are welcomed, recruits without previous experience, who pass the necessary formalities, are given careful consideration and a training no less thorough than their more advanced colleagues.

Bounty and training expenses are paid to Reservists.

Full details may be obtained from the Admiral Commanding Reserves, Admiralty, St. James's Park, S.W.1, or the London District Officer—Lieutenant-Commander V. R. T. Rogers, R.N.V.(W.)R. South West Tower, Admiralty, Whitehall, S.W.1.

Why not spare time for Britain?

EFFICIENCY SYSTEMS OF AMPLITUDE MODULATION

Suppressor—Grid Leak—Screen Grid—Grid Bias—Cathode

By L. M. GUNNELL, G8HB*

AN R.F. amplifier may be amplitude modulated either by keeping the efficiency constant and varying the input, or by keeping the input constant and varying the efficiency. The constant efficiency systems include the various methods of anode control, whilst the variable efficiency systems include those outlined below. With anode modulation high efficiencies are realised—of the order of 75 per cent.—but a large amount of audio power is needed if reasonably full modulation is to be obtained. On the other hand the variable efficiency systems have the advantage of needing only a small amount of audio power, but the efficiencies obtainable are low—from 30 to 50 per cent. This is because, during modulation, the efficiency must be varied between zero and the optimum, with the idling efficiency set half-way between the two. Thus, if the maximum that can be obtained for a particular amplifier is 75 per cent., the theoretical efficiency must not exceed 37·5 per cent. for full modulation.

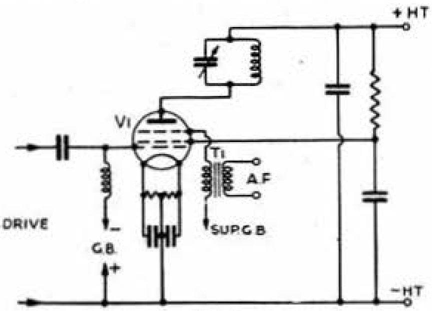


Fig. 1.
Suppressor Grid Modulation. The valve is an R.F. power pentode, such as the PT15.

Under certain circumstances, however, some of the systems are capable of working at efficiencies of 50 per cent. A practical example will show exactly what this means. With 100 watts input (*i.e.* total D.C. power input to the P.A. anodes), and anode modulation, 75 watts of R.F. output can be obtained, but 50 watts of A.F. power are required for full modulation. (For transmission of speech rather less than this is needed, but it is assumed that the carrier is to be modulated by a sine wave). With grid bias modulation and the same input, the output is 50 watts, but only about 5 watts of A.F. power are required. From the foregoing it is apparent that some of the efficiency systems are capable of giving results comparable with those normally associated only with anode modulation.

The initial adjustment of efficiency systems is difficult, and until the procedure for setting up a particular amplifier has been mastered, an artificial aerial should be used as the transmitter load. This can conveniently take the form of an ordinary house lamp, coupled by a two- or three-turn link to the amplifier and with a wattage somewhat greater than the expected transmitter output. Under no circumstances should a radiating aerial be used until the quality has been checked on a monitor. The modulation should be checked for spurious sidebands, by tuning either side of the carrier on a receiver. Any spurious omissions will be readily apparent as transient "break-through" and may be heard as much as several hundred kilocycles away from the carrier frequency.

Suppressor Grid Modulation

The gain of a pentode, other factors remaining constant, may be controlled by varying the voltage on the suppressor grid. A source of audio frequency connected in the suppressor grid circuit will modulate the carrier to about 95 per cent. with negligible distortion. A typical circuit is shown in Fig. 1.

To set up a suppressor modulated amplifier, the first step is to ensure that it is operating satisfactorily under C.W. conditions, with the appropriate positive bias on the suppressor grid. Note the output and then apply negative bias to the suppressor until the output drops to a quarter of its original value. This should, preferably, be done by noting the R.F. current flowing in the artificial aerial under C.W. conditions and then reducing it by half. Apply modulation and increase the A.F. gain until the aerial current increases by about 20 per cent. on peaks, an indication that the depth of modulation is about 90 per cent. Most valve manufacturers quote the correct operating conditions for suppressor grid modulation but the above procedure gives an idea of how to set up an amplifier if the necessary data are not to hand.

Suppressor grid modulation is the simplest to adjust, but it is also one of the most inefficient. For example the PT15, which will produce an output of about 80 watts on C.W., will only give about 18 watts on telephony, using this form of modulation.

Valve Grid Leak Modulation

If an R.F. power amplifier employs grid leak bias, and the resistance of the leak can be varied, then the

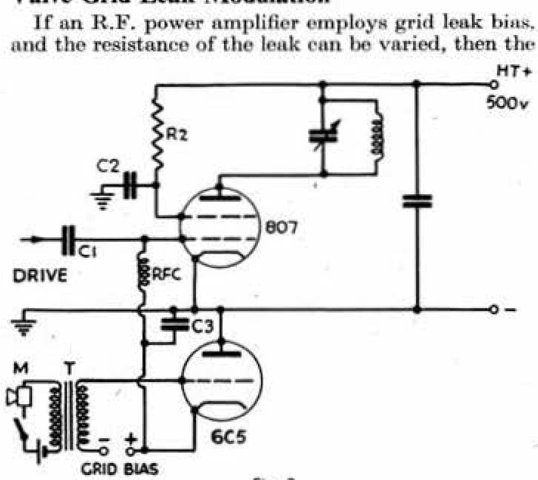


Fig. 2.
Valve Grid Leak Modulation. The 6C5 valve acts as a variable grid resistor for the 807, the anode current of the 6C5 being the grid current of the 807. C1, 50 $\mu\mu$F; C2, C3, ·002 μF; R1, 25,000 ohms 5 watts. M is a carbon microphone and T its associated transformer.

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grid bias, and consequently the output of the amplifier, will also vary. Suppose that a valve is substituted for the grid leak, and an A.F. voltage is fed to its grid. Assuming that the circuit constants are correct both for the amplifier and the valve grid leak, then substantially linear modulation up to about 90 per cent. can be obtained.

A practical circuit is shown in Fig. 2. In this case the amplifier is an 807, and the modulator or valve grid leak is a 6C5. Other combinations can, of course, be used, but the selection of a modulator valve to suit a particular type of amplifier is largely a matter of trial and error. However, for the various amplifier valves used by the writer, the 6C5 has been quite satisfactory.

Adjustment of the modulated stage is difficult, but the following procedure has been found to be the best. Set up the transmitter for C.W. operation using grid leak bias, connect the artificial aerial, and note the R.F. current. Now connect the valve grid leak in place of the resistor and adjust the grid bias on the valve leak until the P.A. anode current is the same as before. Decrease the drive to the amplifier until the aerial current is halved; an A.F. voltage applied to the valve leak grid will cause modulation of the amplifier to take place. If downward modulation occurs, tighten the aerial coupling. If too much upward modulation occurs—indicated by a greater than 20 per cent. increase in R.F. current in the aerial ammeter—decrease aerial coupling, or increase the drive slightly. Correct adjustment of drive, aerial coupling, and bias on the valve leak will enable a good quality, well modulated signal to be produced, but a great deal of patience is needed if the optimum results are to be achieved.

The efficiency of this system is low (about 30 per cent.) but it does offer a very economical way of modulating a carrier, the only A.F. equipment needed being a carbon microphone, its associated transformer, and one small triode.

Screen Grid Modulation

Those who have served with R.A.F. Signals will remember the TR1133, the first V.H.F. airborne transmitter-receiver in the world to be put into operational use. This set used screen grid modulation of a frequency doubling stage, followed by a Class B linear R.F. amplifier, and from a communication point of view, the speech quality and modulation left nothing to be desired. Unfortunately, with most tetrodes the relationship between the screen grid voltage and output is not quite linear, with the result that some distortion occurs. With 90–95 per cent. modulation, however, it is not serious, and

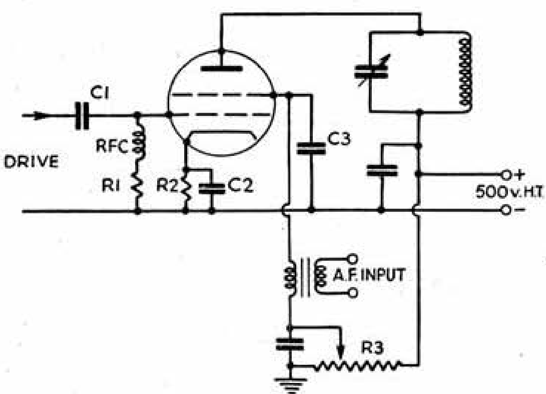


Fig. 3.
Screen Grid Modulation. R3 can consist of a number of resistors in series, the screen grid D.C. voltage being adjusted by a Yaxley type switch. C1, 50 $\mu\mu$F; C2, C3, C4, ·002$\mu\mu$F; R1, 100,000 ohms; R2, 300 ohms, R3, 50,000 ohms 20 watts.

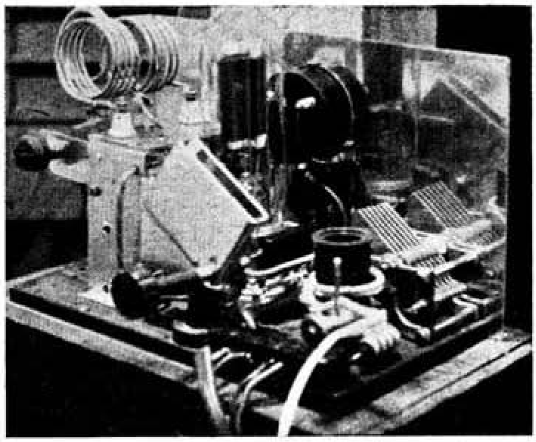


Fig. 4.
A Grid Modulated P.A. stage. Using a type 211 valve, this amplifier is capable of an output of 65 watts. A valve with the anode brought to a top cap is to be preferred for operation on the 14 and 28 Mc/s. bands.

reports of excellent speech quality were obtained by the writer whilst using this system during some hundreds of contacts.

The circuit, given in Fig. 3, is simple and the adjustment straightforward. Efficiencies around 50 per cent. are easily obtainable. Two 807's in parallel and 600 volts H.T. produce an output of 35 watts. The amount of A.F. power required is small, 5 watts being sufficient to modulate fully 100 watts input.

To set-up the amplifier for telephony, adjust the voltage on the screen grid until it is half the value used when operating on C.W., and apply modulation. The current in the aerial should increase by the usual 20 per cent., but it is possible that downward modulation will occur. If so, increase the aerial coupling slightly, and if necessary, reduce the screen grid voltage. The quality should be checked on a monitor before connecting the transmitter to a radiating aerial, and the A.F. gain control set to the position which gives the fullest modulation consistent with good quality. When it is desired to operate on C.W., the screen grid voltage will, of course, be increased to its full amount, and if a high resistance voltmeter is connected permanently between screen and earth, it will greatly facilitate re-setting to the correct screen grid voltage for telephony.

Grid Bias Modulation

Of all the efficiency systems, grid bias modulation is probably the most popular. It is capable of giving excellent results, efficiencies of 35–40 per cent. being obtainable with full modulation and negligible distortion. If it is considered that 95 per cent. modulation is satisfactory, then higher efficiencies of about 50 per cent. are obtainable with tolerable distortion.

To obtain the best results, it is imperative that the following requirements be incorporated in the transmitter:

(1) The source of R.F. drive must have good regulation. This can be achieved by using a driver capable of giving at least twice the power needed by the amplifier grid circuit and dissipating the excess power in a resistance. It is also important that the drive be free from all traces of hum, and to this end the exciter power supply must have ample smoothing.

(2) The modulator valve must either be a low impedance triode, or if a tetrode or pentode, have a swamping resistor connected across

the modulation transformer secondary. Negative feedback is also helpful in obtaining good regulation of the A.F. source, but this reduces the gain of the amplifier, and generally means that another stage of amplification is required.

(3) The grid bias supply must have a low internal resistance and good regulation. Battery bias is satisfactory, but a voltage regulated power pack is to be preferred.

The reason why emphasis is placed on the regulation of the R.F. drive, audio, and bias sources is that during modulation the impedance of the amplifier grid circuit varies, and unless the above points are strictly adhered to, severe distortion is certain to occur. This applies particularly to a modulated stage operated at increased efficiency.

The circuit is shown in Fig. 5. The grid bias unit has only to supply the current flowing through the potentiometer network which gives a continuously variable control of bias voltage, and a small selenium rectifier in a voltage-doubling circuit is quite satisfactory. If optimum results are to be obtained, the voltage available should be at least four times the cut-off value for the selected amplifier valve. The voltage regulator valve can be any triode capable of passing the amplifier grid current. An EF50, with screen, suppressor and anode strapped together, will be satisfactory in the majority of cases, but if the amplifier is to be used on C.W. (under which condition it passes a fairly heavy grid current), then a larger valve should be employed. The grid swamping resistor can be of the 5 or 10 watts type connected across the grid coil, the correct value being found by trial and error, or alternatively a 6 watt car bulb, link-coupled by a two turn link, the amount of power dissipated being adjusted by varying the position of the link.

The highest permissible H.T. voltage should be used for the modulated stage, but since high voltage transformers are obtainable at very reasonable cost, this should present no difficulty from the point of view of financial outlay.

The adjustment of the grid modulated stage is best carried out in the following manner—

Calculate the maximum permissible input to the amplifier, assuming an efficiency of 35 per cent. For example, with a T40, which has a plate dissipa-

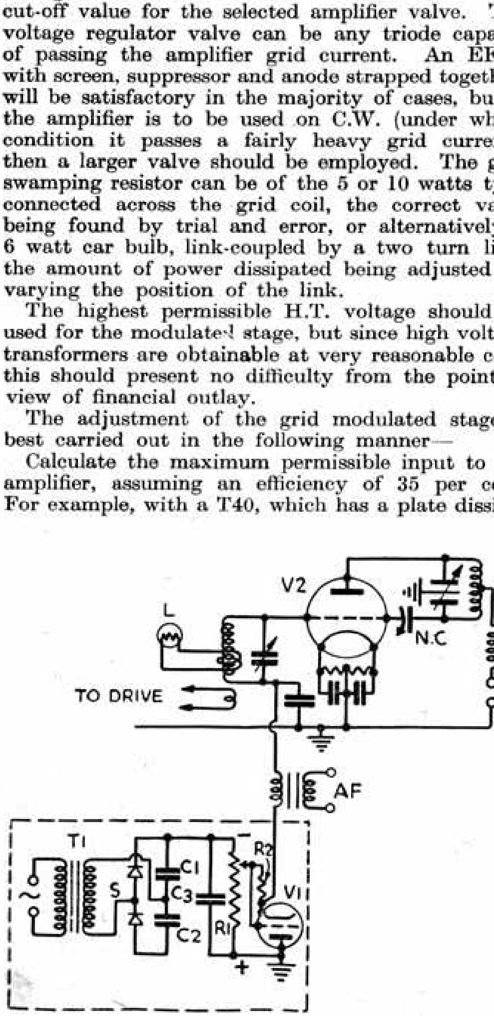


Fig. 5.

Grid Bias Modulation. The regulated bias supply and the lamp L, are important features in producing satisfactory results from a grid modulated stage. TI is the bias mains transformer (output 200 volts) and S is a selenium rectifier, which can be seen in the photograph of Fig. 6. C1, C2, 1 μF; C3, 4μF; R1, 100,000 ohms 3 watts; R2, 250,000 ohms. V1 is a triode-connected EF50.

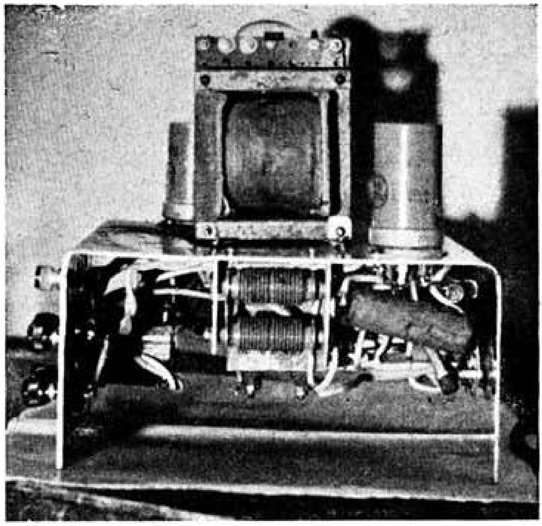


Fig. 6.

A Low Level Modulator. This modulator is used in conjunction with the P.A. shown in Fig. 4. The selenium rectifier can be seen in the foreground, together with its associated transformer on the left. The modulation transformer is a mains transformer, to the left of which is the EF50 regulator valve.

tion of 40 watts, the input should not exceed 60 watts, of which 40 watts will be dissipated at the anode and the remaining 20 watts will be available as R.F. power at the anode. This ensures that during the period of adjustment no damage can be caused to the valve as a result of exceeding the rated plate dissipation. The input can be increased later after the preliminary stages of setting-up the amplifier have been completed.

Apply maximum grid bias, adjust the drive so that P.A. grid current is one-fifth of the value recommended for C.W., tune the anode load to resonance, and couple the amplifier to the artificial aerial, increasing the coupling until the output just starts to fall. The input will be less than that previously calculated, so decrease the bias until the plate current reaches the correct value. Modulation should now be applied, with the modulator gain turned well down. If the plate current "kicks" upwards, decrease bias; if it decreases, increase bias, adjusting the aerial coupling so that the input remains the same. At one setting of the aerial coupling and bias controls, the plate current will remain constant and upward modulation will be obtained. The A.F. gain may now be increased until full modulation is obtained, as indicated by a 23 per cent. increase in aerial current. The amplifier should now be operating at an efficiency of 35–40 per cent. This may be increased by applying more drive, and reducing the aerial coupling slightly, but the A.F. gain should also be reduced so that the modulation does not exceed 90–95 per cent., otherwise severe distortion will occur on modulation peaks. The output of the amplifier should now be monitored, and if the quality is satisfactory, a radiating aerial may be substituted for the artificial load.

Most types of valve are suitable for grid modulation, and triodes, tetrodes and pentodes are all capable of giving good results. So far, the writer has tried two types of valve in grid-modulated amplifiers—the 807 and the 211. Two 807's in parallel gave an output of 45–50 watts on all bands, with 750 volts on the anodes. The 211, a triode, which is at present being used by the writer, has a plate dissipation of 100 watts, and gives 65 watts output with 1,300 volts H.T., and an input of 135 watts. It is hoped that these two examples of actual results obtained will give some indication of what may be expected from a grid modulated transmitter.

Low Level Modulators

As only a small amount of A.F. power is needed for the grid bias, screen grid and suppressor grid systems of modulation, a single 6L6 or similar valve, with 350 volts H.T., will give sufficient output to modulate 150 watts input. With grid bias modulation, a 10,000 ohm 5 watt resistance should be shunted across the modulation transformer secondary. The modulation transformer itself can be either a multi-ratio one, or an old mains transformer. One of the latter is at present being used by the writer, and came from one of the earliest all-mains broadcast receivers. The ratio of primary to secondary is 1 : 1, and whilst no claim is made for a linear characteristic over the whole audio frequency range, it gives extremely good results in practice.

The number of stages needed before the modulator valve will, of course, depend on the type of microphone selected, and whether or not negative feedback is used. For a carbon microphone one stage of triode amplification will be ample. Less sensitive types will normally need two stages. For example, with a moving coil microphone—one of the ex-Army types—two stages will give more than enough gain to drive the 6L6 to its full output, even when a considerable amount of negative feedback is incorporated in the circuit.

Cathode Modulation

Cathode Modulation provides a compromise between the high efficiency and high output modulators associated with anode modulation, and the comparatively low efficiencies and small modulators of grid bias modulation. By placing the modulation transformer in the cathode load of the P.A., variation of the H.T. and grid bias voltages take place simultaneously. If the ratio between the amount of plate and grid bias modulation is correctly adjusted, 100 per cent. modulation can be achieved with a higher efficiency than would be obtained with ordinary grid bias modulation. Fig. 7, curve (*a*), shows how the P.A. efficiency varies with the amount of A.F. power available. At one end of the curve, all the modulation is by anode control and the efficiency is high, whilst at the other end there is virtually no anode modulation and the control of the carrier is entirely by the grid bias system, so that the amplifier is operating at low efficiency. Between these two extremes are the efficiencies normally obtained with this system of modulation, the actual value depending upon the amount of A.F. power available.

The circuit is shown in Fig. 8. A multi-ratio modulation transformer is recommended, as the tap on the secondary can be used to control the amount of grid bias modulation. Any of the usual methods of obtaining grid bias can be used, but if the amount of A.F. power available is less than 10 per cent. of the input to the amplifier, then grid leak bias should not be used as the system now behaves more like grid modulation and the requirements for a stabilised bias supply becomes apparent.

The cathode impedance of a cathode modulated amplifier is given by the expression

$$Z = m\frac{E}{I}$$

where Z = Cathode Impedance,
m = Percentage of plate modulation (Obtainable from Fig. 7 (*b*)).
E = Amplifier H.T. voltage,
I = Amplifier plate current.

The tappings on the modulation transformer secondary, which are usually labelled in ohms, should be adjusted accordingly.

Operation of the cathode modulated amplifier is not difficult. First, connect the grid bias positive to the P.A. cathode, and set up the amplifier for

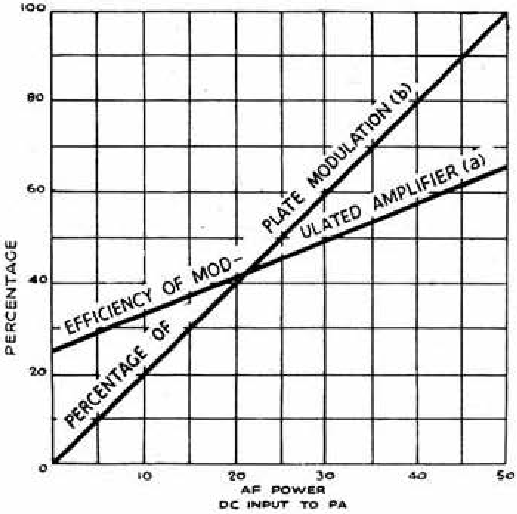


Fig. 7.
Cathode Modulation Curves. Adjustment, as described in the text, makes maximum use of whatever A.F. power is available. The graph shows the efficiencies and the percentage *plate* modulation (not the *total* percentage modulation) achieved for various ratios of A.F. to P.A. input powers.

C.W. operation. Modulation can now be applied, and unless the A.F. power is high only a small percentage of modulation will be obtained. Now connect the G.B. + lead to the first tapping on the modulation transformer, apply modulation and monitor the signal. Distortion will most likely be taking place and there may be downward instead of upward modulation; if so, decrease drive and

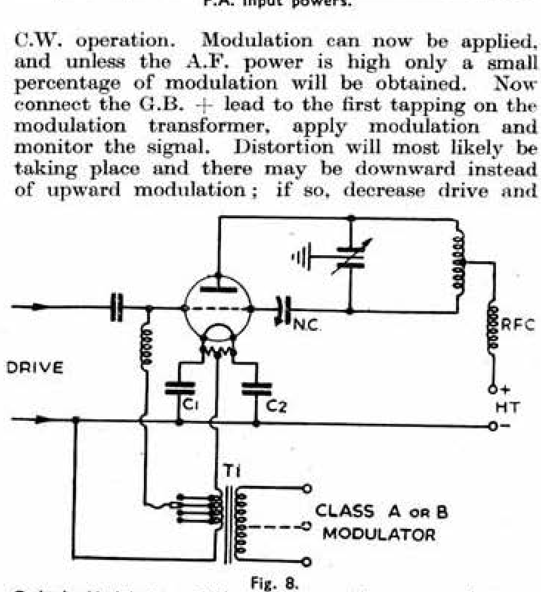


Fig. 8.
Cathode Modulation, which provides a mid-way course between anode modulation and grid modulation, with some of the advantages of both. C1, C2, ·001 μF. T1 is a multi-ratio modulation transformer. Other component values are as for a conventional P.A. circuit. (The lead between grid choke and transformer tap must be broken and grid bias inserted. A ·001 μF condenser should also be connected between H.T.—and lower end of grid choke.)

increase aerial coupling slightly. If, with upward modulation and good quality, the carrier is still under-modulated, then connect the G.B. + lead to the second tap on the transformer, and repeat the procedure outlined above. Eventually, the correct amounts of anode and grid bias modulation will be obtained for full modulation of the carrier. After a final check on the quality, the transmitter can be connected to the aerial proper.

Conclusion

No apology is made for the repeated references to the use of an artificial aerial. A great deal of interference is avoided for one thing, but apart from that aspect, an R.F. ammeter placed in series with the artificial aerial forms an approximate but very useful guide to the transmitter output and depth of modulation. A telephony monitor is another essential piece of equipment, and that described in the February, 1948, issue of the BULLETIN will suit admirably. The oscilloscope is, of course, the most useful item when setting up any system of modulation, but it has not been mentioned before, as, although such instruments may be constructed for a very reasonable figure, it is thought that there are many amateurs without them.

Finally, this article is in no way intended to be a theoretical treatment of the various systems of efficiency modulation. That aspect of the subject is adequately dealt with in the many text-books that are now available. But it is considered that as a result of the popularity of Class B anode modulation, there are many who have condemned the efficiency systems as being incapable of giving good results, without ever having given them a trial. In spite of their limitations, the writer considers that such systems most certainly have their place in Amateur Radio.

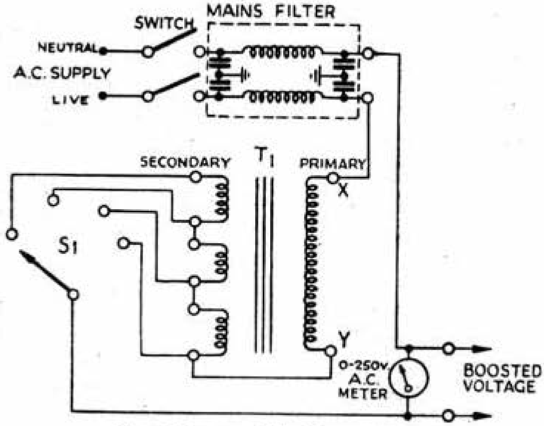
AN ECONOMICAL MAINS BOOSTING SYSTEM

By C. B. RAITHBY (G8GI)*

MANY amateur stations suffer from low A.C. mains voltage, particularly during peak loading periods, yet few operators seem to appreciate that a large auto-transformer is not essential to give the degree of boost usually necessary. Instead, quite a small multi-secondary low-tension transformer can be used.

The Transformer

A reasonable total current for a 150 watt telephony transmitter from a 230 volt A.C. supply is 5 amperes *i.e.* 1,150 watts. If the mains voltage falls to 210 volts *i.e.* a 20 volt drop, then the wattage required



Circuit Diagram of the Boost Circuit

to be replaced is only $20 \times 5 = 100$. Thus a transformer with suitable low tension windings, but with only a 100 watt primary can be used for "boosting." For instance a transformer with three low tension secondaries of 6·3 volts 5 amperes will operate successfully. Alternatively any L.T. transformer rated to deliver a total of 100 watts can be used.

The Circuit

Certain precautions must be observed to maintain the correct phase connections, etc. Considering the diagram, the following should be noted. (1) Connect the secondaries in series in such phase as to give addition of the voltages *i.e.* a total of 18·9. (2) Connect the transformer primary to give an increase of voltage on the meter. (Reverse connections X and Y if necessary). (3) Arrange the boosting to be in the live side of the mains.

Switches suitable for S1 are difficult to obtain and it is suggested that five amp plugs and sockets be used instead.

The voltage regulation is not particularly good with the arrangement but as this factor is invariably bad anyway when the mains voltage is subnormal, this is no additional handicap. There seems no reason why, with a transformer rated at 250 watts (or two transformers of less wattage suitably connected) a boost of up to 50 volts at 5 amperes should not be economically available.

This system has been in use at the writer's station for almost a year and often permits operating at times which would otherwise be impossible due to low mains voltage.

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New Propagation Theory

Mr. T. G. Mihran of Stanford University, California, suggests, in an article appearing in the September issue of *Proceedings of the I.R.E.*, that there is a correlation between the time-of-occurrence of the maximum F2 critical frequency during a single day and the average barometric pressure. A study of propagation records appears to show that when the daily mean pressure at the ground was high the maximum F2 critical frequency occurred in the mornings; whereas on days of low pressure the maximum critical frequency occurred in the late afternoon. Previous attempts to establish a link between barometric pressure and ionisation have not been conclusive and we wonder if a careful examination of amateur logs for the 28 and 58·5 Mc/s. amateur bands during the past few years would confirm or refute this new theory.

Pre-Amplifier

Messrs. A. F. Bulgin & Co., Ltd., point out that the descriptions and type numbers of the *Bulgin* switches referred to on Page 107 of the November issue of the BULLETIN are incorrect. The following are the correct types for each position :—

S1 (See Fig. 3, Page 109), D.P.M.B., List S277; S2, S.P.S.T., List S259; S3, D.P.C.O., List S270.

Bright Idea

Members who are constructing Morse tape recorders or other gear of a similar nature may not have realised that the Biro pen refill makes an excellent stylus. Mr. E. B. Grist, BRS4970, offers the suggestion.

MOTOR CAR INTERFERENCE

By B. M. ADKINS, (B.R.S. 4397)*

THE effects of interference from motor car ignition systems have been well-known to the radio amateur for many years, and it is a tribute to his tolerance that he has not registered more frequent complaints against this continued and increasing nuisance. From time to time some public spirited member of the community has tried to make more widely known the nature of the trouble and the ease with which it can be minimised, but until very recently these efforts seem to have met with little success and it has remained for the television viewer (perhaps less good-natured than previous sufferers) to raise his voice in strong protest and demand that something be done.

Once launched, however, the present campaign against interference has gained impetus with almost incredible speed, and the introduction in Parliament of the Wireless Telegraphy Bill, 1948 (see R.S.G.B. BULLETIN for November, 1948, page 111), marks the climax of what has undoubtedly been the most successful attack to date.

Fig. 1.
The effect of ignition interference on a television screen.

Whether or not the proposed legislation constitutes the most satisfactory solution to the problem is outside the scope of this article, but what *is* certain is that the universal acceptance of the necessary remedial measures will only be achieved when the general public have been made aware of these three important facts :

(i) that ignition interference is a serious menace, not only to television but to many other services using very high frequencies ;
(ii) that an adequate degree of suppression can be achieved both easily and cheaply ; and
(iii) that the devices necessary to obtain this suppression will have negligible effect on the performance of the engines which are "suppressed."

The nature of ignition interference

Investigations have shown(1) that ignition interference originates mainly at the sparking plugs, although a certain amount can be traced to the gaps between rotor arm and fixed contacts in the distributor, and also to the operation of the contact breaker in the low-tension circuit of the ignition coil.

Each spark consists of one or more high current surges, normally of an oscillatory nature, followed by a "flame discharge" having a duration of the order of a millisecond. Unless the H.T. circuit is damped by the inclusion of sufficient resistance, part of the oscillatory energy in every spark is radiated into space over a very wide band of frequencies ; there being a maximum disturbance usually in the region 30 to 50 Mc/s. (*i.e.* at present television frequencies). Within this region the interfering field at 10 yards range from the source may be greater than 1 millivolt per metre.

The effect of this interference on the reception of audible signals is to superimpose a series of clicks, each click corresponding to the firing of one plug so that a continuous buzz (not unlike the signals from early radar transmitters) is produced at high engine speeds.

On the screen of a television receiver the interference appears as broad horizontal lines of mottled light, accompanied by a "jumping" of the whole picture if the synchronisation of the time base is disturbed. The former effect is clearly seen in Figs. 1 and 2.

Methods of Suppression

There are two standard methods for the suppression of ignition interference, the more common (and cheaper) being the fitting of damping resistors in the H.T. wiring to prevent its radiating oscillatory energy. The second, that of partially or totally enclosing the ignition circuits in screening boxes and shields, can be made very effective indeed, but because of its high cost is comparatively rarely used. (Total screening is employed in all military vehicles which are fitted with short-wave receiving equipment, as well as in aircraft.)

The fitting of resistors in the H.T. wiring may be done at one or more of several points, of which the most usual are :

(i) in the main lead from ignition coil to distributor, as close as possible to the distributor ; and
(ii) in the leads from distributor to sparking plugs, as close as possible to each plug.

Resistors are also sometimes fitted in the sparking plug leads where they leave the distributor, and occasionally some form of capacitance is arranged between the "hot" end of each resistor and the frame of the engine.

Fig. 2.
Motor ignition interference: 4-cylinder engine running in neutral at about 1,800 r.p.m., 20 yards from and approximately in the beam of a normal television dipole with half-wavelength spaced reflector.

* *Blagdon, Denbigh Road, Haslemere, Surrey*

With most car engines the fitting of resistors at the points mentioned in (i) and (ii) above will give ample suppression both for nearby short wave and television reception and for normal M.W. and L.W. broadcast reception in the car itself. Some authorities claim in fact that one resistor only, as in (i), is sufficient, but the present writer has found this to be the case only with engines where the other H.T. leads are very short and run close to metallic parts of the frame or in metal conduit tubes.

To achieve effective suppression the values of the inserted resistors are not critical, it being found in most cases that 5,000 to 20,000 ohms is satisfactory. It is usually desirable, however, to avoid a total resistance between coil and any one plug which is greater than 25,000 ohms.

The types of resistors used are preferably those having a large ratio of length to diameter, and therefore a low self-capacitance, and it is also important, especially when fitted close to the sparking plugs, that they should be sensibly unaffected by the high temperatures at these points.

Effectiveness of suppression

It has been determined experimentally(2) that resistors fitted as described above will reduce the interference due to ignition systems by 30 to 40 db on the long and medium wavebands, and by 20 to 40 db on short and ultra-short wavelengths. Except for very sensitive receiving equipment within the motor car itself, this degree of suppression is quite sufficient, and the photographs reproduced as Figs. 3 and 4 illustrate the results which may be achieved.

Figs. 3a and 3b, which were taken under similar conditions to Figs. 1 and 2 (4-cylinder engine running unloaded at 1,800 r.p.m. 20 yards from television aerial) are both of the same subject, Fig. 3b having been photographed very shortly after Fig. 3a. During this short interval the engine was stopped, the "unsuppressed" ignition system (distributor head, leads to sparking plugs and to coil) which had been used for Fig. 3a was quickly replaced by a second complete system containing 15,000 ohm resistors in each of the five H.T. leads, and the engine re-started at approximately the same speed. The effectiveness of the suppressors is very obvious.

In Fig. 4 an attempt has been made to compare oscillograms of the radiated "pulses" before and after the fitting of suppressor resistors. The same engine with alternative ignition systems was again used, and a small pick-up probe mounted inside the bonnet was coupled through coaxial cable to a 45 Mc/s. wideband amplifier, demodulator and cathode-ray oscillograph. Some difficulty was experienced in keeping the engine speed sufficiently constant, and this was only achieved above about 2,500 r.p.m. The oscillograph time base was synchronised by means of a second probe placed very close to one of the sparking plugs, the pulse due to this plug not appearing on the trace.

The conditions obtaining during the taking of the two pictures were identical except that when the right hand picture was taken the suppressors had been inserted. This picture clearly demonstrates their effect. Incidentally it may be noticed that the pulse on the left was suppressed less successfully than the other two; on subsequent investigation it was found that the resistor in this plug circuit measured only just over 1,000 ohms and was in fact a nominal 1,500 ohm component whose colour-coding had been mis-read.

(Continued on page 177)

(a) Fig. 3 (b)

These two pictures illustrate the effectiveness of inserting suppressors. The L.H. picture (Fig. 3a) was taken a few minutes before the R.H. picture (Fig. 3b). During the interval the engine of a nearby car was stopped and the unsuppressed ignition system replaced by a complete system containing 15,000 ohm resistors in each of the five H.T. leads.

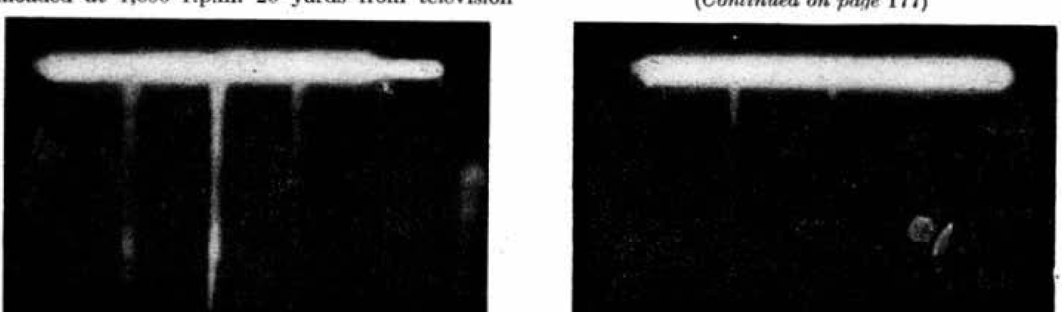


Fig. 4.

Oscillograms of radiated "pulses" before and after the fitting of suppressor resistors.

POST OFFICE EQUIPMENT

at the Amateur Radio Exhibition

By H. B. LAW*

MOST amateurs know the Radio Branch of the Post Office Engineering Department more for its licensing and control activities than for anything else. This is, however, only one aspect of the Department's work in the radio field and the stand at the recent Amateur Radio Exhibition was designed to give a wider view, to show something of the engineering background of its efforts to secure the best use of the limited spectrum space, and to illustrate how the Department solves the frequency control problems of its own extensive radio installations.

The apparatus exhibited included interference measuring, direction finding and frequency measuring equipment for the M.F., H.F., V.H.F. and S.H.F. bands, and typical crystal oscillators used for transmitter and receiver control. As it is not possible in the space available to describe all the equipment, the following article deals with those items in which most interest was shown.

Panoramic Receiver-Range 2250 to 2500 Mc/s.

The receiver is intended for general monitoring, frequency measurement and band-width measurement in the 2300–2450 Mc/s. amateur band. It consists of three main units (*a*) an S.H.F. unit incorporating a local oscillator and mixer to translate the signals to an I.F. of 60 Mc/s., (*b*) a frequency scanner unit, which accepts the 60 Mc/s. signals from the S.H.F. unit, shows them on a panoramic display, and provides listening facilities, and (*c*) a reference frequency generator which produces an adjustable but accurately known frequency in the 100–109 Mc/s. band, which is distorted in the S.H.F. unit to produce harmonics in the S.H.F. band. The general arrangement of the equipment is shown in the schematic diagram (Fig. 1).

stabilized supply of 170 volts negative to the cathode, which is itself fed from a 30 mA. 250 volts shunt-stabilized supply, negative to the earthed anode.

In the same unit is a calibrating harmonic generator consisting of a high burn-out silicon crystal (CV103) mounted across a section of wave guide. The output of the associated frequency multiplier 100–109 Mc/s., at a power of about 1/10 watt, is connected across the crystal, and the crystal, being non-linear, generates high-order harmonics. Harmonics above about 1600 Mc/s. are propagated along the wave guide, and fed, at the far end, into the aerial input cable. The crystal D.C., which is monitored in the reference frequency source, must not exceed 25 mA.

Scanning Display and Monitoring Unit

The I.F. signals from the S.H.F. unit pass through an amplifier (pass band 55–65 Mc/s.) and are then mixed with the output of a scanning oscillator having a motor driven tuning condenser which sweeps the frequency over the 55–65 Mc/s. band approximately 25 times a second. The mixer output goes to the Y amplifier (pass band 10–50 kc/s.) and is finally rectified, D.C. amplified, and applied to the Y plates of the C.R.T. The output of the scanning oscillator is also applied to a limiter and frequency discriminator (mid-frequency 60 Mc/s.) the output of which is amplified to provide the X-sweep of the C.R.T., which therefore displays the signal amplitude (Y) versus frequency (X). Displays 5 Mc/s. and 2 Mc/s. wide may be obtained by increasing the gain of the X amplifier. A calibrated attenuator preceding the Y amplifier permits relative level measurements.

The monitor receiver translates the 55–65 Mc/s. I.F. signals to a second I.F. of 13·3 Mc/s., using a manually-adjusted beating oscillator 68·3–78·3 Mc/s. The second I.F. output can be applied to either an F.M. discriminator, or an A.M. detector,

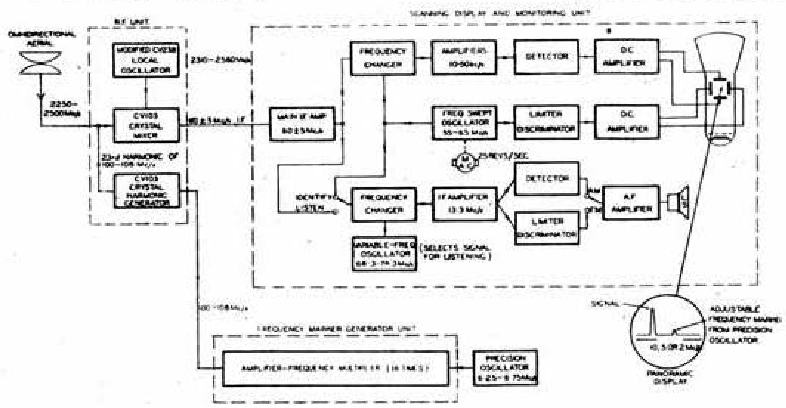


Fig. 1. Frequency and spectrum measuring equipment for use in the amateur band 2300–2450 Mc/s.

S.H.F. Unit

The local oscillator is a modified CV238, 10 cm low voltage reflex klystron in which the normal resonant cavity has been replaced by a wave guide closed by two plungers, one to preset the band and the other driven by a rack and pinion to tune over the band. A cam on the pinion-shaft tunes the coaxial-line-type mixer *via* a steel tape, and drives a dial calibrated in megacycles per second. The layout is shown in Fig. 2. Also driven from the same shaft is the reflector bias potentiometer, fed from a neon

and thence after amplification to phones or loud speaker. When the scanning display is in operation the signal input to the monitor receiver is disconnected and replaced by an input from the scanning oscillator. A pulse is produced in the receiver as the scanning oscillator sweeps through its tune frequency, and this is used to brighten the C.R.T. trace, giving a visual indication of the receiver setting.

Reference Frequency Generator

The reference frequency generator makes use of the well established technique for accurate measure-

* *Engineering Department, G.P.O., London E.C.1.*

ment, or synthesis, of frequencies in the H.F. band 3–30 Mc/s. It requires an input, adjustable over the frequency range 6·25–6·9 Mc/s., of accurately known frequency. This may be a frequency synthesizer, or some form of controlled oscillator having sufficiently high setting accuracy or an uncalibrated but stable oscillator whose frequency is measured by a frequency meter. The oscillator output frequency is multiplied by 16 in a series of frequency doublers producing an output in the range 100–109 Mc/s., which goes to the crystal distorter in the S.H.F. unit. The multiplier operates over the 9 per cent. frequency range without retuning.

Operation

The signal is tuned-in on the S.H.F. unit until it is displayed in the scanner unit. To listen to the signal the monitor receiver tuner in the scanner unit is adjusted until its "bright-in" marker lies within the signal in the display. The unit is then switched to "listen" and, after appropriate choice of the A.M. or F.M. detector, the signal should be heard in the loud speaker.

For frequency measurement the reference frequency source is adjusted so that a frequency-marker pip coincides with the signal in the scanner display. It is necessary to check that the marker pip is in fact coincident with the signal and not removed from it by twice the I.F., since very little discrimination against the image channel is obtained in the S.H.F. unit. This check is made by changing the S.H.F. unit tuning a little so that the signal moves on the display. If the marker pip moves with the signal all is well; if it moves in the opposite direction it is at the image frequency and another marker that satisfies the check must be sought by readjustment of the reference frequency source. The marker source frequency, in the band 100–109 Mc/s., may then be noted and it remains to determine the harmonic order. This may be done by reference to the receiver calibration, taking due precautions against image channel working, or alternatively the reference source may be readjusted so that an adjacent harmonic is aligned with the signal. Then if fx is the signal frequency (unknown), f_1 and f_2 (f_2 above f_1) are the two settings of the reference frequency source (known) and n and $(n-1)$ are the two harmonic orders (unknown):—

$$fx = nf_1 = (n-1)\,f_2 \text{ so that } n = \frac{f_2}{f_2 - f_1}$$

n is of course a whole number. In the present case, since n is about 24, f_1 and f_2 must be accurate to about 3 parts in 10^4 to give an unambiguous determination of n, and the calculation must of course be carried out with corresponding accuracy.

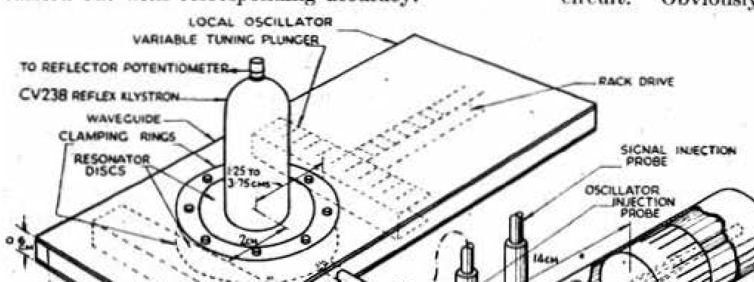


Fig. 2. Design of the R.F. Unit used in the 2250–2500 Mc/s. Panoramic Receiver.

Crystal Oscillator with Wide Frequency Swing

When operating transmitters in crowded frequency bands it is often an advantage to be able to shift the operating frequency and it is a disadvantage of crystal control that the amount of shift that can be obtained

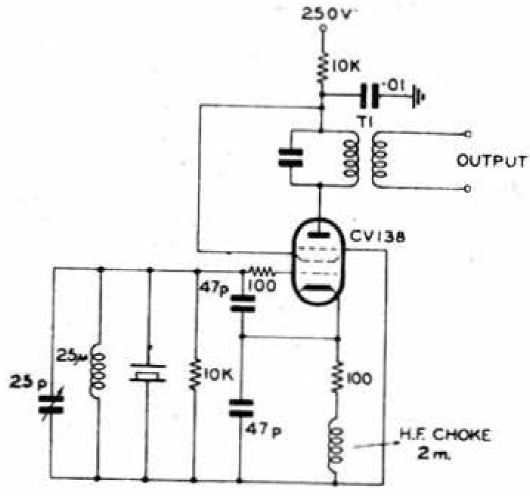


Fig. 3.

Circuit of variable frequency crystal controlled oscillator. The output transformer (T1) is tuned to crystal frequency.

by the usual means of a small condenser in parallel with the crystal is very limited. A useful increase may be obtained by neutralizing some of the fixed shunt capacitance of the mounted crystal by means of an inductor and a circuit which was demonstrated at the Exhibition is given in Fig. 3. This provides a range of adjustment of about 30 kc/s. with a particular 5 Mc/s. crystal.

If too small a value of inductor is used the crystal may lose control of the oscillations, or may fail to take control when switching-on, while with some crystals the frequency may jump when the capacitor is adjusted, instead of varying smoothly. The optimum value of the inductor, and the amount of frequency shift that can safely be obtained, depend upon the crystal and the results may vary somewhat with the temperature and degree of excitation. An amateur wishing to utilise this technique will probably have to adopt cut-and-try methods, using various values of inductor, until he gets a satisfactory circuit. Obviously he must be very sure of his oscillator before he ventures on the air with it!!

Further information on circuits of this type is given in "Variable-Frequency Crystal Oscillators," Stanesby and Fryer, *Journal of the Institution of Electrical Engineers*, Vol. 94, Part III A, No. 12, pp. 368–378 (1947).

Acknowledgements

The author expresses his thanks to the Engineer-in-Chief of the Post Office for permission to publish, to his colleagues for information about equipment of their design, and to Mr. A. H. Faulkner for the material and sketch used in the description of the Panoramic Receiver S.H.F. Unit.

ROTATING THE BEAM BY REMOTE CONTROL

By Lt.-Col. P. A. O. NORTHEY, A.M.Brit.I.R.E., A.I.E.E., (G6FQ)*

THERE may be a few other amateurs who, like the author, prefer to sit in a comfortable chair in the evenings and let science do the work for a change. To those kindred spirits the following suggestions are offered.

There are many ways of rotating a beam aerial and knowing roughly where it is "shooting." These vary from the odd bits of rope and lights that buzz round with it, to the "Rolls Royce" method described below. Each method has its merits, and each is, in turn, controlled by the depth of the user's purse.

Selsyn Motor Arrangement

Fig. 1 is a block diagram of the Selsyn motor arrangement. Ss (the small "s" is for "shack") is a Selsyn motor with a knob and pointer fixed to its rotor and a degree-scale fixed to its body. A is a torque amplifier, which can take the form of either an ordinary audio amplifier with a very good low-frequency response, or a pair of thyratrons suitably driven. M is a small motor, which can be either an induction motor (not the "squirrel-cage" type) or a split-field D.C. motor. Sm ("m" is for "mast") is a second Selsyn motor, the body of which is fixed, with the motor, to the mast-top. The rotor has some form of drive connected to the motor rotor, and the beam is mounted on the spindle of the Selsyn rotor.

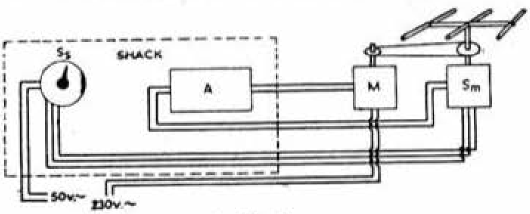


Fig. 1.
Block diagram of Selsyn motor method of rotating a beam aerial.

Audio-Amplifier and Induction Motor Method

Fig. 2 shows the circuit of this method. H is the knob on the rotor of the Selsyn Ss. A 50 volts A.C. 50 c/s. supply is fed into the rotor Rs (Selsyn's are mostly 50 v. 50 c/s.). The stator fields of Ss are connected to those of Sm in the correct sense. The rotor Rm is connected to the rotor of the motor by some form of drive mechanism as shown in the block diagram (once the pointer and the beam are aligned any slight slip in the drive will not matter). The field of Rm is connected into the torque amplifier (shown within dotted lines).

The output of the torque amplifier has a 4μF condenser connected across it, and is itself connected to one side or field of the induction motor (*i.e.* one side and the centre tap between fields). A mains supply is then connected to the centre tap and the other field.

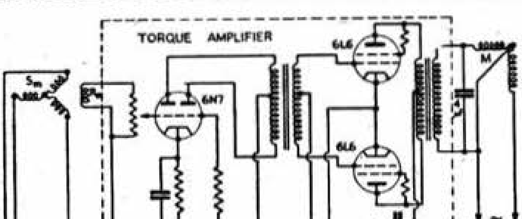


Fig. 2.
Circuit of audio-amplifier and induction motor method.

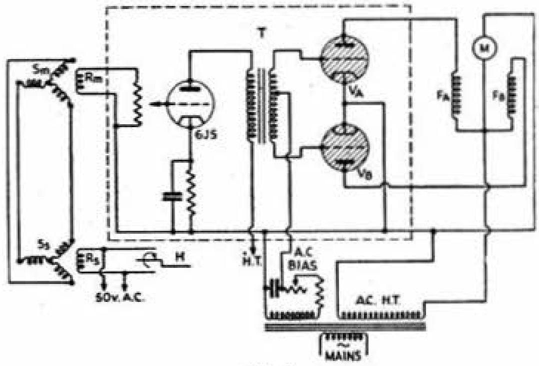


Fig. 3.
Circuit of Thyratron and split field motor method.

Theory of Operation

A change in position of H (Rs) will alter the currents proportionally in the fields of Ss. The fields of Sm, being connected to those of Ss, will also be altered and will produce a voltage in Rm which will remain until Rm is rotated to take up its exact zero position, *i.e.*, at right angles to the resultant field produced by Sm. This voltage in Rm is amplified by the torque amplifier and applied to one field of the motor, which will rotate as long as the voltage in Rm remains. The direction of rotation will be determined by the phase of voltage in Rs with reference to the mains-driven field in the motor. To cause rotation, the phase difference must be 90°, and rotation will continue one way or the other, as above, until there is no voltage in Rm.

Alteration of the position of the knob and pointer H, even by one degree, alters the zero-point of Rm, so the system will operate and the beam will turn until the new zero is reached.

Thyratron and Split Field Motor Method

Fig. 3 shows this method. The operating of the Selsyn motors is the same as described in the preceding section, with Rm driven by the motor, and the beam mounted on Rm. The A.C. bias is so connected to the torque amplifier as to be in opposite phase to the anode voltages applied to the thyratrons; an opposing voltage to make one or other conducting is applied through the triode and transformer T. If H is rotated to make, say, V_A conducting, field A will be energised and the motor will rotate in one direction, until it has rotated Rm to its new zero-position. If H is rotated in the other direction, F_B will be energised and the motor will rotate in the opposite direction—as also will the beam, mounted on Rm.

* *The Willows, Datchet, Bucks.*

The writer uses an ordinary gramophone motor, an old gramophone amplifier, a worm drive between Rm and the motor (a convenient method of lowering the normal speed of 78 r.p.m. to about 1 r.p.m.) and a Herbert Tee beam and mast. This beam is so light that any reasonable Selsyn bearings will stand its weight. A little ingenuity can make the system infinitely rotatable by feeding the R.F. through slip-rings or with an inductive loop. Many further gadgets can be added on similar lines—should expense be no objection.

Current Amateur Bands

THE following table shows the frequency bands which are now available to U.K. amateurs, together with the types of emission permitted.

Members holding transmitting licences are particularly requested to note that Frequency Modulation may not be used in the 144–146 Mc/s. band.

† Max. Power in Watts	Frequencies	† Types of Emission	Remarks
10	1,715– 2,000 kc/s.	A1, A2 or A3. A.M. only	
150	3,500– 3,635 kc/s. 3,685– 3,800 ,, 7,000– 7,300 ,, 14,000–14,400 ,,		
150	28–30 Mc/s.	A1, A2 or A3. A.M. or F.M.	
25*	58·5–60 Mc/s.		
25	144–146 Mc/s.	A1, A2 or A3. A.M. only	Subject to non-interference with Government Services working in the band 144–145 Mc/s.
25	420– 460 Mc/s. 1,215– 1,300 ,,	A1, A2 or A3. A.M. or F.M.	Subject to non-interference with Government Services working in these bands.
25	2,300– 2,450 Mc/s. 5,650– 5,850 ,, 10,000–10,500 ,,	A1, A2 or A3. A.M. or F.M.	

* *The Society has now been informed that authority to use the 58·5–60 Mc/s. band will be withdrawn on March 31 next.*

† *Max. Power and A3 is only permitted when authorised by the G.P.O.*

Radio Masts

It is understood that certain Local Authorities contend that the erection of a radio mast (to accommodate a rotary beam aerial) constitutes "Development" within the meaning of Section 12 of the Town and Country Planning Act, 1947.

Although the contention seems open to argument it is recognised that any resident may protest against the erection of a mast on the ground that it has depreciated certain amenities. A person who has had his plans approved by the Local Authority is in a stronger position to resist such a complaint, than is one who has erected a mast without seeking permission.

The possibility of the Local Authority taking action under Bye Laws should also be borne in mind.

Railway Communication

Memories of tests carried out in 1924 by the R.S.G.B. (G5FL) and the L.N.E.R. were revived by the news that an experimental two-way telephone service has been established by the *Bell System* on a number of trains running between New York and Washington D.C., to enable passengers to make normal telephone calls while travelling. The radio links are provided by special 20 watt transmitters installed on the trains and four 250 watt transmitters located at New York, Baltimore, Philadelphia and Washington. These stations operate within the frequency range 152–162 Mc/s., and permit direct communication over more than 70 per cent. of the journey.

Braaten Trophy

The Council has awarded the Braaten Trophy for the year 1948 to Mr. Frank Robb, GI6TK.

The trophy is awarded to the home member scoring the highest number of points in the annual A.R.R.L. Telegraphy Contest. In the 1948 event Mr. Robb led the field with a score of 121,728 points.

G.P.O. Stand at Amateur Radio Exhibition

Inquiries about transmitting licences and the interpretation of conditions attached thereto, were dealt with on the Post Office Stand during the recent Exhibition, there being at least one representative of the Engineer-in-Chief's office always present solely for that purpose. The questions covered a very wide field, particular interest being shown in the conditions governing interference and the keeping of log books, but a number of inquiries concerned "Business" and other types of licences.

MOTOR CAR INTERFERENCE—*Cont. from page* 173

Effects of suppressors on engine preformance

In 1939 the Institution of Automobile Engineers published a report(3) describing laboratory tests on four "suppressed" engines representative of all modern types, as well as road tests with about 20 vehicles ranging from small private cars to large commercial machines. The conclusions arrived at, which are summarised in Appendix A of Reference 1, were that practically all engines were entirely unaffected in performance except at very low speeds and light loads, when in certain cases a slight power loss was observed believed to be primarily due to insufficient turbulence in the cylinders.

The present writer, who has driven various "suppressed" cars for many years, has no reason to suppose that either engine performance or fuel consumption are in the least affected, but if such an effect exists it is certainly no greater than that resulting from fitting a silencer to reduce the ordinary noise which would otherwise be produced.

References

(1) Summarised in B.S. Code of Practice, C.P. 1001, 1947, Section 2. Published by the *British Standards Institution*.
(2) British Standard 833, 1939, Appendix E.
(3) Hendry, N.: "The effect of radio interference suppressors on engine performance." I.A.E. Report, March, 1939.

A corner of the G.P.O. Engineering Department Stand at the Amateur Radio Exhibition. In the foreground is Spectrum Measuring Equipment for use on frequencies in the 2,300–2,450 Mc/s. amateur band.

THE MONTH ON THE AIR

By A. O. MILNE (G2MI) *

FORTHCOMING R.S.G.B. CONTESTS

February	5– 6	"Top Band" (1·8 Mc/s.).
March	5– 6	B.E.R.U.
April	2– 3	144 Mc/s.
June	11–12	National Field Day.
July	3	144 Mc/s. Field Day.
August	20–21	420 Mc/s.
September	25	Direction Finding.
October	1– 2	Low Power (3·5 Mc/s.).
November	26–27	"Top Band" (1·8 Mc/s.).
Date to be announced.		Affiliated Societies.

Eighty

THE outstanding event of the past month, without doubt, was the remarkable signal strength of VK5KO on 3,508 kc/s. each evening between 19.00 and 19.45 G.M.T.

The first U.K. contacts with VK and ZL were made on this band about 24 years ago and repeated during the winter of 1935/36. Schedules with VK5KO were fixed this autumn by G6CJ and started in November. Contact was first made with G6CJ on December 10 and during the ensuing week some 60 U.K. and European signals were heard or worked. The log reports are on their way by air mail. G2JT, G2MI, G2UQ, G3ACC, G5BZ, G5IM, G5RV, G6CJ, G8AX, G8JR and G8US are some of the stations worked, although this is by no means a complete list.

On December 19 G6CJ tried a 4 band QSO and believe it or not it was 14 Mc/s. which failed.

VK5KO's signals peak at S7 to S8 and average an S5. 19.20 G.M.T. seems to give the peak signal strength. If you want to work him keep off his frequency and please don't work local contacts in the first 15 kc/s. of the band during that precious three quarters of an hour.

Several stations have thought they had failed to raise him and have indulged in chatter with someone else on VK5KO's frequency bemoaning the fact, when all the time he has been calling them. The main trouble has, however, come from people who don't realise or won't believe what is happening.

Don't waste time and cause QRM by calling CQ DX—listen and keep the channel clear. ZC8PM and VS6AJ are two more worked by G2MI, 6GM and others but don't call them whilst they are in QSO! These remarks should not be necessary, unfortunately they are.

Top Band Contest

For hundreds of stations, this event appears to be a regular meeting ground for "old-timers," but the newcomer is also much in evidence. Comments and criticisms were requested. They have arrived, yet, however virulent the comments, invariably the letters have ended expressing the great pleasure derived from the event.

Amateur 'phone was conspicuous by its absence—extremely sporting of the non-participating members. It is also notable how, for reasons unexplained, the band appears to clear itself of all but amateurs.

The scoring, much praised and blamed by as many, was experimental, due to criticism last year that London had complete advantage, yet, the change brought no more than about two GM and GW stations on the air; GC, GD and GI were completely absent.

The D2's and other continentals were not ascertainable factors before the contest, so to find a G and a D2 sharing first place is some satisfaction to the planners. Undoubtedly the scoring is weighted in favour of the D2's, yet they did not pull all that much ahead.

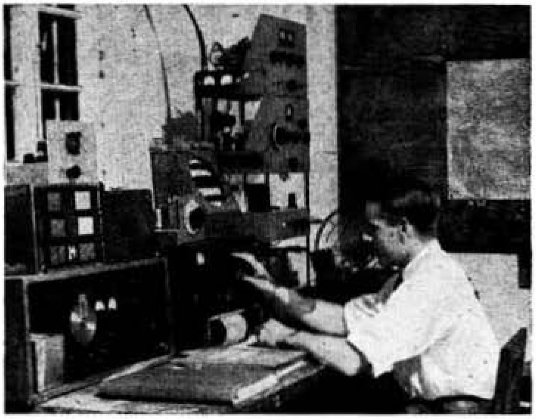
The London Region (No. 7) is certainly at a slight disadvantage, but not nearly so much so as some correspondents would appear to think. The weight against London is felt in the higher scores, but in the lower figures, scored in ones, London had all in its favour.

London appears to be at a disadvantage of about half a point per average contact, whereas D2 had the advantage of two points per contact, yet, whilst D2KW made 86 contacts, G4AU, the leader in Region 7 made 154. OZ1W made 100 contacts.

G6BQ must have mention, because he submitted pages of graphs and classified results from 1936 to 1948 to prove his points. There are many—far too many, unfortunately, for individual mention, who have given much time sending their views on the contest to the Committee, and they are asked to accept this acknowledgment for their very kind co-operation.

Our personal preference is for one point per contact regardless. What about an R.S.G.B. Districts-worked multiplier?

* *29 Kechill Gardens, Hayes, Bromley, Kent.*



AROUND THE EMPIRE

F/O Bob Honey whilst operating as ST2CH in Khartoum, provided many British amateurs with an opportunity to contact the Sudan. This view of the station shows that his consistent signals were the result of carefully planned and up-to-date equipment. The two transmitters—one on either side of the modified H.R.O. receiver—both employ push-pull 807's with 80 watts input and V.F.O. drive. A 3-stage 50 Mc/s. convertor rests on top of the H.R.O. Auxiliary apparatus includes a BC221 frequency meter, an over-modulation indicator and a Wheatstone automatic Morse sender. The drive mechanism for the rotary beam can be controlled from the operating position. F/O Honey is now in the Suez Canal Zone of Egypt and is temporarily off the air.

Notes and News

VU7AA ex VS8AA advises us that he is now **MP4BAF**. He is on 14,350 and hopes to be in the 14,000–14,100 part of the band soon. W2FSN who has been operating as KP4FH is now QRT and hopes soon to resume his old call. G5GK has shown us a nice QSL—PJ5KO—and wonders if it is a "first."

VS7WG QSL's but is shortly returning to G. G5CI says LZ1AA on 14,040, C.W., claims to be the first official LZ station.—QSL to Box 830, Sofia. An American voice signing LZ1AB has also been heard.

ZD2KC is now in South Africa. He QSL'd every contact but is now without a log. It was packed in one of his bags which a careless wharfinger managed to drop into Lagos Harbour! Although it was fished out again, it was just too bad that his bag also contained a 2 lb. packet of permanganate of potash crystals. The results may be left to the imagination! He hopes soon to be on the air with a ZS call and sends 73 to all old friends.

Eric Trebilcock, BERS195, asks, "Why don't the GD's QSL? They agitated for a separate prefix and now do not act up to their responsibilities!" Well, GD3UB and 6IA recently came through with a nice fat wad of cards. Other GD's please note! Eric reports YJ1AA, Port Vila, New Hebrides, on 14 Mc/s. 'phone around 10.00 G.M.T., also FU8AA on 14 Mc/s. C.W. at 21.00 G.M.T. VK9NR on Norfolk Is. counts as a separate country and is operated by VK5NR.

We learn from Ken Jowers that all AP2 licences have been cancelled.

Tristan da Cunha

Many British amateurs have recently worked ZD9AA who puts in a terrific C.W. signal on 14 Mc/s. around 19.00 G.M.T. This station is operated by members of the South African Government Meteorological station staff. Power is derived from two Lister diesel engines and a vertical aerial is in use. All contacts will be QSL'd. A mail is due to leave Cape Town on January 21 and cards will be sent on the return mail. It is hoped that this lonely outpost will be getting a rather better mail service than one per year in the near future. The frequency used at ZD9AA varies but the slightly chirpy signal radiated is easily recognised by the good operating and the dislike on the part of the operator of people who call exactly on his own frequency and particularly of those who try to "bust-up" his QSO's. He gets very caustic about such people and has several times threatened to QRT for the evening if they do not behave. Good for you O.M.!

Postscript

The writer and his wife wish to thank the hundreds of members who so kindly sent them Christmas cards and greetings. The job of replying individually is beyond us. A happy New Year to all.

AROUND THE VHF's

By W. H. ALLEN, M.B.E. (G2UJ)*

The New Bands

IT is good news that the G.P.O. has permitted the use of the entire 144 to 146 Mc/s. band as from January 1, but it will be a disappointment to many that on this, as on the other V.H.F. bands released at the same time, the maximum power input allowed is no more than 25 watts. This low figure is, no doubt, the result of compromise between the claims of amateur and commercial users of the V.H.F.'s, and in order that overtures which may be made in the future to the authorities for increased facilities in this direction shall receive sympathetic consideration, it is imperative that interference with other services be kept to the absolute minimum. Valve efficiency tends to fall seriously above, say, 30 Mc/s. with many types, and it becomes, therefore, increasingly difficult to achieve a reasonable return in terms of R.F. for the permitted 25 watts of H.T. power. V.H.F. operators feel the need for a more liberal input allowance, and at the proper time official representation will be made to that end, but for the present we would ask all members to exercise the greatest care that interference is not being caused by their transmissions to other and more vital services.

Five Metres

Many staunch supporters have told us how much they appreciate the three months' extension which the G.P.O. have granted in regard to the closing date for this band. The announcement having been made after these notes went to press last month took some of the point out of the "Final Fling" week-end arranged on December 18–19, but nevertheless quite a number of stations were active who had not been heard on five for some time, and many enjoyable QSO's were the result. Conditions were, for the most part, poor, and no G–DX or continental contacts have been reported.

G2AOL (Otford, Kent), was licensed in September last, since when he has worked 97 stations in 21 countries. He is on the band daily from 1830 to 1915, and again from 2215 to 2245 and would be glad of contacts at any distance.

Two Metres

G2ADZ (Oswestry), has been active since the middle of November, and was able to take advantage of the exceptional conditions which prevailed at the end of that month. November 25 produced QSO's with ON4FG (362 miles), PAOPN (320 miles) and PAOZQ (330 miles). His signals were heard by F8OL at 390 miles but no QSO resulted, probably due to the fact that ADZ was not searching low enough in the band for the French station. GW5SA (Neath, Glam.), with the Welsh mountains between him and Oswestry, has been heard, and it is hoped to effect a QSO before long. G5BM and 6ZQ, 85 miles away in Cheltenham, come in like locals, and seem quite unaffected by conditions. This is in marked contrast to the experience of G2UJ, who finds that the signals from stations only 20 miles distant vary greatly in strength according to the conditions ruling at the time. G2ADZ is active between 1900 and 2030 every evening, but seldom later unless conditions look promising. G4LU, also in Oswestry, keeps a sked. at 2000 most evenings with G5LJ in Birmingham.

It will be recollected by readers of these notes that 2ADZ was one of the few post-war stations to employ a straight receiver on five metres, and besides his superhet. converter, he has one working on this band. He has received G6VX at 170 miles on it, but the impossibility of keeping R.F. out of the audio section makes it a very tricky piece of apparatus to handle.

Admittedly there have been no openings of any consequence this month, but this, we submit, is no reason for the total absence of signals on the band for days at a time, and we feel that it is a state of mind to be deplored if V.H.F. stations regard it as a waste of time to operate unless abnormal conditions of propagation are present.

BRS 1711 (Topsham, Devon), listening on 14 and 28 Mc/s., has overheard QSO's between MF2AA (Trieste), ZB2A (Gibraltar), and stations in this country, indicating that they have two metre apparatus available, and it is suggested that further information might be obtainable as to their frequencies and times of operation.

SM5GQ states that at least a dozen Swedish stations are active and looking for G contacts on two metres.

Seventy Centimetres

After our remarks last month regarding the comparatively short distances so far worked on this band, we have pleasure in giving details of a contact at 1920 GMT on December 20 between G3AHB/A, operating from the roof of the E.M.I. building at Hayes, Middlesex—100 ft. above ground—and G2FKZ at Dulwich, a distance of 15 miles. 3AHB/A employed a pair of 6J6's in push-pull as a self-excited oscillator on 436 Mc/s. with an output of 2 watts, and a broad-band dipole in a parabolic reflector. Vertical polarisation was in use at both stations. The M.C.W. signals from 2FKZ were S8/9, with only occasional fading, while 3AHB's 'phone was Q5 S5 throughout the contact which lasted more than an hour. These stations intend to keep a sked. each Wednesday at 1900 GMT, and contacts with other stations would be welcomed.

* *32 Earls Road, Tunbridge Wells, Kent*

The Aerial Problem on Seventy Centimetres

With the exception of G3AHB, mentioned in the last paragraph, it seems standard practice for multi-element beams of Yagi pattern to be employed on this band. It is, of course, comparatively easy on the mechanical side, to produce such arrays, but feeding them, and ensuring that each element is truly resonant and contributing its full quota to the overall performance is a matter of considerable difficulty which increases with the complexity of the system. A further disadvantage when searching for possible contacts, is the extreme sharpness of the beam, and it would appear that except for point-to-point work, an aerial with good vertical, but less horizontal directivity would be preferable. A multi-element vertical co-linear array would seem to offer possibilities of all-round response combined with considerable gain, and the addition of a reflector—which could be moveable while the aerial itself remained stationary—would increase this still further in a given direction without sharpening the horizontal pattern to an embarrassing degree.

The multi-element "turnstile" aerial, much used in the U.S.A. for television transmission, is another type which would repay some investigation.

The author had some experience during the war with a broad-band dipole mounted in a reflector constructed of wire netting on a rectangular framework, and curved in the horizontal direction to represent a section of a paraboloid. This array gave very considerable gain over a band of frequencies extending from 350 to 650 Mc/s., and was not at all difficult to construct. Its chief function was to provide a sharp bearing for DF purposes, and the beam in the horizontal plane was no more than 10° wide, with a sharp "nose" of about 2°. It would appear that with both the dipole and the reflector in the vertical plane, extremely low angle radiation could have been obtained without the horizontal directivity becoming unreasonably sharp.

We would welcome the expression of readers' views on these points, as with active stations scattered with respect to one another some attention to "broadcast" transmission and reception seems indicated.

DX on the Commercial Bands

Our mention of this subject in the October issue has brought a letter from BRS 15792 who recalls that in May 1947, whilst operating a V.H.F. D.F. station at Fayid, Egypt, contact was maintained for two hours with a similar station at Shaibah in the Persian Gulf on a frequency of 116·1 Mc/s. Signals were Q5 when using the normal T.1131 transmitter and R.1132A receiver or the much lower powered SCR 522 equipment. Some three months later an aircraft flying in the vicinity of Fayid contacted Malta Q5 both ways on a frequency of 117·1 Mc/s.

The closing date for these notes for the February issue is Saturday, January 22.

Points to Remember

G/Capt. H. W. Evens, G6CH, had some trouble recently in working Southern Rhodesia. The following effort reached him as the result of making his difficulties known to one of the locals.

For "DX contacts" you must know,
The points to where your signals go.
In order that they do not stray,
Just check their bearings every day.
But if at night, on stars you trust,
And think in "Astro" terms, you must,
Locate the "Plough," and find the "Dog,"
And hope the "Pole Star's" clear of fog.
If on "Magnetic" you rely,
Remember! when you sight with eye,
That "True North" off the needle fine,
Is eleven and a half degrees off line.
So when you've set your beam by me,
And QSO'd across the sea,
You'll have no more, that doleful moan
"I can't raise VQ2's on 'phone."

PER ARDUA AD ASTRA.

OUR FRONT COVER

THIS 144–146Mc/s. Transmitter designed by Stratton & Co. Ltd. of Birmingham and kindly loaned by Odeon Radio, Harrow, is a typical example of the use of Mullard V.H.F. tetrodes.

The circuit consists of a 6V6 oscillator operating between 12 and 12·186Mc/s., followed by a QVO4–7 trebler, a QVO4–7 doubler and another QVO4–7 as doubler driver to the QQVO4–20 P.A.

Full constructional details are described in the Eddystone 145Mc/s. Guide.

Contest Rules

THE following General Rules for R.S.G.B. Contests to be held during 1949 (with the exception of N.F.D. and Direction Finding Contests) have been drawn up by the Contests Committee and approved by the Council.

1. The British Isles, for the purposes of all contests, includes the following prefix zones: England (G), Scotland (GM), Northern Ireland (GI), Wales (GW), Channel Islands (GC), and the Isle of Man (GD).

2. Entrants must provide their own log sheets, which will be accepted only if submitted on foolscap or quarto paper, legibly written or typed, and set out according to the Rules applicable to the particular contest. Incomplete entries will be disqualified.

3. Details at the top of the entry form must be completely filled in, and the declaration signed, otherwise the entry will be disqualified. The person signing the declaration will be recorded as the competitor.

4. All entries must be posted within seven days of the close of the contest, and addressed to the *Hon Secretary, R.S.G.B. Contests Committee, New Ruskin House, Little Russell Street, London, W.C.1.* The postmark will be regarded as the date of posting.

5. Proof of contact may be required.

6. Contacts with, or reports from, ships or unlicensed stations located in countries where licences are obtainable will not be permitted to count for points. The decision as to whether a station is to be classed as unlicensed will rest with the R.S.G.B. Contests Committee.

7. Only the entrant will be permitted to operate his apparatus during a contest.

8. Any competitor receiving consistent tone reports lower than T8 will automatically be disqualified.

9. The input power to the final stage of the transmitter must not exceed that specified for the particular contest, nor may this figure be exceeded in any previous stage.

10. The conditions laid down in the entrant's licence shall be rigidly observed.

11. Contest operation during local hours of restriction in the use of electricity for wireless which have been publicly announced is forbidden. The duration of such restrictions must be recorded on the entry form.

12. Specially appointed band-monitoring stations under the auspices of the R.S.G.B. will be active during contests. Any station reported operating off-frequency, or causing consistent interference with over-modulation or spurious transmissions, will be disqualified without appeal.

13. The judging of entries will be carried out by the R.S.G.B. Contests Committee, who reserve the right to amend or alter these rules at any time prior to the commencement of a contest. The President's decision will be final in all cases of dispute.

14. No correspondence can be entered into regarding any decision made by the President or the Contests Committee.

15. Rules applicable to a particular contest will be published in an issue of the R.S.G.B. BULLETIN.

"Top Band" Contest, 1948

Results of the "Top Band" (1·8 Mc/s.) Contest held during the weekend November 27–28, 1948.

Position	Call Sign	Region	Contacts	Points
{1	G2FSR/A	6	144	411
{1	D2KW	D2	86	411
3	G8AB	5	148	398
4	G2DU	6	130	376
5	G3AGQ	3	127	371
6	G5RI	2	131	365
7	G4AU	7	154	361
8	G5MY	4	125	359
9	G6BQ	7	145	346
10	G3CMI/A	4	119	340
11	G3FAB	3	117	338
12	G8NF	2	121	336
13	G3AUH	4	123	334
14	G6DL	3	116	326
15	G5HB	8	112	322
16	GW2HH	10	109	320
17	G2DTD	6	108	318
18	G6NB	7	132	310
19	G6HD	7	134	308
20	GM3AWF	13	102	304
21	G6CT	5	110	299
22	G8TR	1	115	294
23	G2FJD	5	101	292
24	G3BSM	8	101	291
25	G2HPF	5	104	290
{26	G3DYQ	8	99	289
{26	G5ZX	3	101	289
28	G2MI	7	127	287
29	G6WH/A	3	100	284
30	G3ABG/A	5	97	275
31	G6NC	9	96	273
32	G6ZN	2	99	269
33	G2BQC	4	94	267
34	G6GM	9	91	263
35	G8WF	2	97	261
{36	G3QD	4	94	258
{36	G3EDW	5	96	258
38	G3AH	1	99	257
{39	G6VC	7	89	256
{39	D2CH	D2	53	256
41	G2HW	1	97	253
42	G4DC	7	115	249
{43	G3AIG	7	114	246
{43	G8ML	9	87	246
45	G3ARS	1	95	245
46	G6JJ	7	114	241
47	G8VR	7	100	236
48	G2NJ/A	4	84	235
49	G2VD	7	103	233
50	G5TO	2	84	230
51	G2IK	9	78	228
52	G6NM	1	85	224
53	G3CBU	7	100	222
54	G8GF	3	80	221
55	G2YU	5	75	219
56	G8LB	8	75	217
{57	G2FVX	7	100	216
{57	G3LP	9	77	216
59	G3AEX	7	103	214
60	G2JF	8	74	212
61	G2LC	7	97	209
62	G3GX	7	104	204
{63	G3BTP	7	89	203
{63	G2DJS	7	77	203
{63	G3AKY	2	73	203
66	GM2DRD	12	68	202
67	G2HP	7	90	196
68	G2FRG	9	71	195
{69	G6PR	7	85	193
{69	G3CAZ	8	69	193
{71	G3AZ	7	95	191
{71	G5HS	3	65	191
73	G2AOL	7	76	188
74	G3AMF	7	88	187
{75	G2CPL	5	66	185
{75	GM2HIK	12	63	185
77	G8BM	1	69	181
78	G8JM	7	89	174
79	G4QA	2	68	173
80	G3CHY	1	72	172
81	G3MI	6	61	171
82	G3BHS	8	61	169
83	G2PT	7	82	164
84	G5FY	7	58	162
85	G2KF	8	57	157
86	G2RD	7	77	153
{87	G3VF	1	63	147
{87	G2DAN	3	53	147
89	GM8MJ	14	48	146
90	G3YF	7	71	142
91	G3APV	2	55	141
92	G2HDU	4	53	139
{93	G6VD	4	52	136
{93	G2CXW	1	55	136
95	G3CYY	2	50	126
96	G6MH	5	48	124
97	G8KU	2	43	121
98	G2BTO	1	54	120
99	G3DCC	7	69	119
100	G2DWQ	9	42	113
101	G2JN	8	40	108
102	G6UT	5	36	106
103	G5LF	7	57	102
104	G2SO	5	43	101
105	GW3CBY	10	33	99
106	G3AMT	8	39	93
{107	G6GN	9	33	89
{107	G3BDV	7	57	89
109	G3AVI	1	33	83
110	G3DDM	8	28	77
111	G4GA	7	53	71
112	G3NT	2	24	69
113	G2XG	7	31	59
{114	G2DCG	8	21	53
{114	G2NH	7	25	53
116	G5IV	2	22	52
{117	G3EKP	1	24	51
{117	G5YN	9	17	51
{117	G2AJU	5	19	51
120	G2FFN	5	23	48
121	G8LN	7	27	47
122	G2HOX	7	20	44

Check Logs

The following stations are thanked for forwarding check logs: OZ1W (100 contacts), G2HR, WQ, ZZ, G2CWY, G3HR, PV, G3ALE/A, AOK, DGM, G4DV, GJ, RA, G6CJ, LB, LJ, QM, YP, ZT, GW5BI, BRS250, 1535.

"Top Band" Contests, 1949

TWO "Top Band" [1·8 Mc/s.] Contests have been arranged for 1949. The first will be held during the week-end of February 5–6, 1949.

Intending entrants should note that slight changes in the Rules and Scoring System have been introduced since the contest held during November, 1948. The Contests Committee will appreciate the comments of entrants on these changes.

Rules

1. The contest is open to all fully paid-up members of the Society resident within the British Isles (Prefix Zones G, GC, GD, GI, GM, GW) and the British Occupied Zone of Germany (D2).

2. The contest will take place between 9 p.m. G.M.T. on Saturday, February 5, and 8 a.m. on Sunday, February 6.

3. Entries will only be accepted if submitted on foolscap or quarto paper and set out in the form below :—

Top Band Contest
February 5–6, 1949

Name.. Call Sign..................

Address ....

Transmitter ....

Aerial System ....

Receiver ....

Con-tact No.	Time	Call Sign of station worked	Report				Points Claimed		
			Sent	Reg.	Recd.	Reg.	3	4	5
1		G2——	599	07	599	06		4	
2		G3——	599	07	599	07	3		
					Sub-Totals				
					TOTAL				

Declaration : I declare that my station was operated strictly in accordance with the rules and spirit of the Contest and I agree that the ruling of the President of the R.S.G.B. shall be final in all cases of dispute.

Signed..

4. Details at the top of the entry form must be completely filled in and the declaration signed, otherwise the entry will be disqualified.

5. Entries must be addressed to the Hon. Secretary, R.S.G.B. Contests Committee, New Ruskin House, Little Russell Street, London, W.C.1. No entry will be accepted bearing a postmark later than Monday, February 14, 1949.

6. Contest operation during local hours of restriction in the use of electricity for wireless which have been publicly announced is prohibited.

7. Proof of contact may be required.

8. Contacts with or calls from ships or unlicensed stations will not be permitted to count for points.

9. The contest is confined to two-way telegraphy contacts only.

10. Only the entrant will be permitted to operate his apparatus during the contest.

11. An exchange of RST report and Region number will be required before points for a contact can be claimed. The report and Region number must be sent as a six character group, e.g. 579RO7 or 579R11 for Regions 7 and 11 respectively.

12. Only one contact with a specific station during the contest will be permitted to count for points.

13. The system of point scoring will be as follows :—

(*a*) For entrants in the British Isles (G, GC, GD, GI, GM, GW)—
Three points will be scored for contact with a station in the entrant's own R.S.G.B. Region.
Four points will be scored for contact with a station in any other R.S.G.B. Region.
Five points will be scored for contact with a station outside the British Isles (*e.g.* D2).

(*b* For entrants in the British Zone of Germany (D2)—
Three points will be scored for contact with a station in the British Zone of Germany (D2).
Five points will be scored for contact with a station outside the British Zone of Germany (D2).

14. The power input to the final stage of the transmitter or to any preceding stage must not exceed 10 watts.

15. Any competitor consistently receiving tone reports lower than **T9** will automatically be disqualified.

16. Stations can also be disqualified for unethical operating procedure reported by the monitoring stations.

17. An award will be made to the station with the highest total score. Certificates of merit will be awarded to the stations placed second and third.

18. The Contests Committee reserves the right to alter or amend these Rules at any time prior to the commencement of the contest.

19. The President's decision will be final in all cases of dispute.

Take Note

Logs of non-contestants should be marked "Check Log." Before attempting another contact, be sure that the last one was completed. Be sure that your report records are correct. Do not work stations twice. Be sure you post your log in time.

Slow Morse Transmissions

Day	*G.M.T.*	*kc/s.*	*Call*	*Town*
Sundays	11.00	1800	G2LC	South Ruislip
Sundays	20.30	1802	G2DLJ	Derby
Mondays	20.00	1900	G2AJU	Stutton, Ipswich
Mondays	20.00	1800	G2DJS	Bradford
Mondays	20.00	1750	G3DSR	Derby
Mondays	20.00	1900	G3DDM	Petersfield
Mondays	21.00	1900	G3BLN	Bournemouth
Mondays	21.00	1850	G8VR	London, S.E.2
Tuesdays	22.00	1896	G8TL	Ilford
Tuesdays	22.30	1820	G6JB	Salcombe, Devon
Tuesdays	23.00	1820	GM4AN	Kirkcaldy
Wednesdays	20.00	1783	G3AFD	Southampton
Wednesdays	20.00	3625	PA0AA	Hilversum
Wednesdays	22.00	1800	G3DLC	Grays
Thursdays	22.00	1873	G2BCX	South Woodford
Thursdays	22.30	1873	G3ARU	South Woodford
Thursdays	22.30	1803	G3OB	Manchester
Fridays	19.00	1900	G3BLN	Bournemouth
Fridays	20.00	1900	G2AJU	Stutton, Ipswich
Fridays	20.00	1860	G3AKW	Wirral
Fridays	20.00	1900	G3DDM	Petersfield
Fridays	20.30	1868	G8LZ	Gravesend
Fridays	22.30	1820	G6JB	Salcombe, Devon
Fridays	23.00	1820	GM4AN	Kirkcaldy
Saturdays	23.00	1800	G3CHY	Ashton-u-Lyne

We wonder if any other listener can equal the record of the Northumberland member who reports good progress—at the evergreen age of 82 years!

Further volunteers for this service are still required. Details to Mr. C. H. L. Edwards, G8TL, 10 Chepstow Crescent, Newbury Park, Ilford, Essex.

15th A.R.R.L. International DX Contest

Rules for this year's A.R.R.L. DX Contest as published in the January, 1949, issue of QST are practically identical to those of previous DX Contests except that the C.W. quota for Canadian (VE) stations has been raised to five. This change should help British entrants since in the past the sparse amateur population of certain VE call areas has penalised overseas stations working for a maximum multiplier. The contest is open to all amateurs operating fixed stations. British entrants should endeavour to contact as many amateur stations located in the continental U.S.A. and Canada on as many bands as possible. U.K. stations are not permitted by the terms of their licence to use the 27 Mc/s. band. As in previous contests a self-assigned three figure number (which remains the same throughout the contest) is added to the RST report when working C.W. and to the Readability-Strength report when working telephony.

The Contest Timetable is as follows :—

Telegraphy Event.
0001 G.M.T. February 12 to 2400 G.M.T. February 13.
0001 G.M.T. March 12 to 2400 G.M.T. March 13

Telephony Event.
0001 G.M.T. February 19 to 2400 G.M.T. February 20.
0001 G.M.T. March 19 to 2400 G.M.T. March 20.

National Field Day, 1949

The Contests Committee announces that in view of the popularity of the 1948 low-power N.F.D., the rules this year will again limit the D.C. power input to the final stage of the transmitter to a maximum of 5 watts. This power may not be derived from supply mains. Other rules for the event, which will take place between 5 p.m. on Saturday, June 11, and 5 p.m. on Sunday, June 12, will be similar to those for the 1948 N.F.D. as published in the January, 1948, issue of the BULLETIN. Full details for this year's contest will be published later. Co-operation from portable stations within the Empire and overseas is again invited.

Australian Contests

We learn from Mr. W. T. S. Mitchell, Federal Secretary, W.I.A., that the following VK Contests will take place during 1949 :—

National Field Day,	January 29–30.
Trans-Tasman	Late May or June.
Remembrance Day	August 13–14.
VK-ZL DX	First four week-ends in October.

Low Power Contest, 1948

The Contests Committee regrets that the entry from Mr. Robertson (G6WR), was omitted from the results of the contest as published in the November, 1948, BULLETIN. His score was 2,808 points, placing him 21st in the list.

Syria and Lebanon

Syrian amateurs are now using the prefix YK instead of AR which was used by both Syria and Lebanon when these countries were under French Mandate. Syria and Lebanon are now independent Republics and in order to avoid confusion it has been decided to use the new prefix allocated to Syria at the Atlantic City Conference.

HIC ET UBIQUE

COUNCIL, 1948

President:
VICTOR M. DESMOND, G5VM.
Executive Vice-President: W. A. Scarr, M.A., G2WS.
Hon. Secretary: K. Morton Evans, O.B.E., G5KJ.
Hon. Treasurer: A. J. H. Watson, F.S.A.A., G2YD.
Hon. Editor: Arthur O. Milne, G2MI.
Immediate Past President: S. K. Lewer, B.Sc., G6LJ.

Members: I. D. Auchterlonie, G6OM, F. Charman, B.E.M., G6CJ, D. N. Corfield, D.L.C.(Hons.), A.M.I.E.E., G5CD, G. H. L. Edwards, A.M.I.E.E., G8TL, R. H. Hammans G2IG, J. W. Mathews, G6LL.

General Secretary: John Clarricoats, G6CL.

G.P.O. Liaison Officer: Arthur E. Watts, G6UN

November Council Meetings

Resume of the Minutes of a Meeting of the Council of the Incorporated Radio Society of Great Britain held at New Ruskin House, Little Russell Street, London, W.C.1, on Tuesday, November 23, 1948, at 6 p.m.

Present.—Mr. S. K. Lewer (Immediate Past President in the Chair), Messrs. Corfield, Edwards, Hammans, Mathews, Milne, Watson and John Clarricoats (General Secretary).

Apologies.—Apologies were presented for the absence of the President (Mr. V. M. Desmond) and Messrs. Auchterlonie, Charman, Evans, Scarr and Watts.

Wireless Telegraphy Bill, 1948.
Council having studied the new Bill requested the G.P.O. Liaison Committee to give further attention to various points of detail.

Membership.
Resolved—
(*a*) To elect 157 Corporate Members, 38 Associates and 16 Junior Associates. Total elected 211.
(*b*) To grant Corporate Membership to 16 Associates who had applied for transfer.
(*c*) To grant Life Membership to Messrs. N. Champness, G2AAU, of Washington, D.C., U.S.A., and W. A. Cheek, of Hamilton, Ontario, Canada.
(*d*) To grant affiliation to the—
Gravesend Amateur Radio Society
Luton and District Radio Society
Mansfield District Radio Society
Merseyside Wireless Transmitting Amateur Society
subject to the receipt of satisfactory reports from the appropriate Regional or County Representative.

Headquarters' Station.
It was reported that frequency drift observations on transmissions from GB1RS taken at the Marconi Wireless Telegraphy Works, Great Baddow, Essex, showed that an accuracy of better than 1 cycle in 3·5 Mc/s. had been fully maintained.
The thanks of the Council were recorded to Mr. R. L. Varney, G5RV, who had initiated the observations.

"Service Valve Equivalents."
It was resolved to place an order for the printing of a further 15,000 copies of the above booklet, the previous printing of 10,000 having become exhausted in about four months.

"Transmitter Interference."
The thanks of the Council were recorded to Messrs. A. O. Milne and J. W. Mathews, joint authors of the above booklet. It was reported that copies of the booklet had been sent to a number of official bodies and that substantial orders had been received from Government Departments interested in transmitter interference problems.

"Top Band."
Mr. Mathews reported that he had been advised by Mr. L. Fuller, G6LB, of Chelmsford, that a representative of the G.P.O. on duty at the G.P.O. stand at the Amateur Radio Exhibition had informed a member of the Chelmsford Group that U.K. amateurs would be losing the "top band" on January 1, 1949.
The General Secretary gave it as his opinion that the information was incorrect.

Audited Annual Accounts and Balance Sheet.
The Honorary Treasurer (Mr. Watson) presented the Audited Accounts and Balance Sheet for the year ended September 30, 1948, and in explanation thereof read his Report to the Members.
Resolved on the motion of Mr. Mathews, seconded by Mr. Edwards, to accept and adopt the Audited Accounts and Balance Sheet for the year ended September 30, 1948, and to approve same for publication in the Society's Journal in the form suggested by the Honorary Treasurer.

Annual Report of the Council.
The Secretary presented a Draft of the Annual Report of the Council for the year ended September 30, 1948, which had been prepared and circulated prior to the meeting.
Resolved to accept and adopt the Report subject to such minor amendments as had been suggested by Members of the Council, and to authorise publication of the Report in the Society's Journal.

Other Business.
The Council also dealt with a variety of miscellaneous matters and received a Report from the Technical Committee dealing with the progress of technical booklets.
The Meeting terminated at 9.15 p.m.

Representation

The following are additions or alterations to the list of Representatives published in the February, 1948, and subsequent issues:—

Town Representatives

Region 8.
Surrey—
Guildford ... Mr. W. E. Roberts, BRS8919, 52 Saffron Platt, Tilehouse Estate.

Correction
In the list published in the June, 1948, BULLETIN Mr. J. Wylde, G8BM, was recorded as T.R. for Wallasey instead of Wirral Area Representative.

Vacancies
Messrs. J. W. Nuttall, G6SQ, J. R. Tuck, G6TD, C. H. Walker, G3AZT, R. Chadbone, G8JK, and R. C. E. Beardow, G3FT, have resigned as Town Representatives for Southport, Coventry, Rugby, High Wycombe and Romford respectively. Nominations for their successors should be made in the prescribed form and sent to reach the General Secretary by January 31, 1949.
Mr. M. M. D'Arcy, G3AGL, having relinquished his membership, a vacancy now exists for the office of Town Representative for Wanstead and Woodford. Nominations in prescribed form should reach the General Secretary by January 31, 1949.

Result of Ballot

County Representative

Region 9.
Gloucestershire ... Mr. R. M. Sharp, BRS7961, 112 St. Michaels Hill, Bristol 2.
Result: Mr. Sharp, 25 votes; Mr. Barber, 22 votes.

London (I.E.E.) Meeting

Nearly 100 V.H.F. enthusiasts attended the meeting held at the Institution of Electrical Engineers, London, on Thursday, December 30, 1948, when Messrs. W. A. Scarr, M.A. (G2WS), and D. N. Corfield, D.L.C.(Hons.), A.M.I.E.E. (G5CD), opened a discussion on equipment suitable for operation in the 420 Mc/s. band. Both speakers as well as Messrs. Newton (G2FKZ), Knott (G3CU) and Winston described various items which had been brought for display.
Messrs. H. A. M. Clark (G6OT), L. Herdman (G6HD), Hackney (G6YP) were among those who contributed to the discussion. The Chair was taken by Mr. A. O. Milne (G2MI).

Representatives Expenses

In order to reduce clerical work and to save postage, Representatives are requested not to submit to Headquarters very small quarterly claims for out of pocket expenses but to wait until such time as the total amount due has reached 5s.
It was recently reported to the Council that a T.R. had sent to his R.R. for submission to Headquarters, a claim for 7½d. for postages.

A.R.R.L. Antenna Handbook

The A.R.R.L. advise that the 4th Edition of the above publication is now out of print and that a much enlarged and completely rewritten 5th Edition is due to appear towards the end of March. The U.K. selling price has been fixed at 7s., postage paid.
Members who ordered but have not been supplied with the 4th Edition should receive the new edition early in April.

New R.S.G.B. Car Plaque

A most attractive chromium-plated call-sign type car plaque of new design is now available from Headquarters, price 15s. post free. The plaque is made with two sturdy fixing bolts and is provided with suitable nuts. The design has been carried out by the well-known Birmingham firm of *T. A. Butler & Co. (1927) Ltd.*
The cast metal type of car plaque with or without callsign is still available.

Atlantic City Conference

The G.P.O. have recently issued a photostatic copy of the English version of the Radio Regulations annexed to the Atlantic City International Telecommunication Convention. Included within its 300 odd pages are the complete tables of frequency allocations to the various services, the new "Q" Codes and lists of international callsigns. The price is 3s. 6d. from *H.M. Stationery Office.*

Appreciations

The General Secretary and Miss Gadsden wish to thank the many members who sent them Christmas and New Year greetings. These expressions of kindly remembrances were most warmly appreciated.

Barnet and District Radio Club

Although of recent formation, the Club has already more than 30 members. Morse classes are held and the clubroom has workshop and library facilities. It is hoped to establish a Club station early in 1949. Meetings are held on alternate Wednesdays at 8 p.m. Details may be obtained from the Secretary, Mr. C. J. Spencer, BRS7634, 31 Byng Road, Barnet, Herts.

British Sound Recording Association

The following meetings will take place at the Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2, and commence promptly at 7 p.m.

Friday, January 28, 1949, E. D. Parchment, "Gramophone Record Processing."

Friday, February 25, 1949, S. R. Lance, "Disk Recording and Reproducing Styli."

Friday, March 25, 1949, Desmond O'C Roe, B.Sc., "Design of a Cutter Head for Disk Recording."

Region 11 Dinner–Meeting at Llandudno, November 24, 1948

Front Row: GW3KY, 3DIX, 3AKB, 5YB, 2CCU, 2HAQ, 4OH

Derby and District Amateur Radio Society

Fortnightly meetings are held at 67B London Road, Derby, and include demonstrations and lectures of equipment built by members. The Society transmitter has been completed and is now active under the call G3ERD/P. Prospective members should contact Mr. W. A. Mead, G5YY, 135 Clarence Road, Derby.

Hounslow and District Radio Society

Plans for 1949 were fully discussed at a recent meeting. Future activities will be concentrated on transmitting, receiving and television. The Society's station has now been completed and will operate under the callsign G3FHD. The Secretary is Mr. A. Pottle, B.Sc., 11 Abinger Gardens, Isleworth, Middlesex.

Romford & District Amateur Radio Society

After serving the above Society for 12 years as Hon. Secretary, Mr. Ronald Beardow, G3FT left last month with his wife and twin children, to begin a new life in Canada. Mr. Beardow hopes soon to contact his friends in England using a VE3 call sign. Romford members wish him and his family good luck for the future.

The position of Hon. Secretary has been taken over by Mr. D. Coppendale, G3BNI, 9 Morden Road, Chadwell Heath, Essex, to whom all matters concerning the Romford Society should be addressed.

"V.H.F. Technique"

Mr. A. J. Bayliss, G8PD, co-author of "V.H.F. Technique" draws attention to the fact that the term $2\pi F$ has been omitted from the two formulæ given on Page 55. For co-axial line circuits :—

$$C = \frac{1}{2\pi f \times 138 \log \frac{b}{a}\left(\tan \frac{360L}{\lambda}\right)} \times 10^{12}\ \mu\mu F$$

For open parallel wire lines :—

$$C = \frac{1}{2\pi f \times 276 \log \frac{D}{r}\left(\tan \frac{360\ L}{\lambda}\right)} \times 10^{12}\ \mu\mu F$$

where f is the resonant frequency required.

Off to ZS

Mr. W. Nuttall, G6SQ, recently T.R. for Southport, sailed last month for South Africa. He sends greetings to all old friends at home and hopes to be on the air shortly under a ZS call sign.

Around the Trade

A comprehensive reference chart, measuring 3ft. 3in. by 2ft., has been designed and printed by the Communications Division of *Mullard Electronic Products Ltd.* Based on the Atlantic City decisions, the chart shows the allocation of frequencies over the entire telecommunication spectrum: 10 kc/s. to 10,500 Mc/s. Frequencies allotted to each of the 18 different telecommunication services in each of the three Regions—which are defined—may be readily observed due to the extremely clear colour printing. Among many other uses, the chart shows at a glance which bands are exclusive amateur allocations and, in the case of shared frequencies, the other services which have a right to work in the band. It should prove of value to amateurs and, in particular, local clubs should find space on their walls for this excellent chart. Copies may be obtained from Headquarters price 6s. 8d. post free.

* * *

Taylor Electrical Instruments Ltd., announce that mass production methods are being employed in the manufacture of a modified version of their Model 70A meter. Known as the 70B, the new instrument will approximate to First Grade Standard and will have a total of 50 ranges available. A mirror scale and knife-edge pointer will be fitted and the sensitivity on A.C. and D.C. ranges will be 1,000 ohms per volt. A self-contained buzzer will be incorporated for quick continuity tests and provision made for decibel ranges. The instrument will be fitted with a *Taylor* Moving Coil meter.

The price has been fixed at £14 14s. 0d.

* * *

After consultation with the Radio Communication and Electronic Engineering Association, the Commissioners of Customs and Excise have agreed that, in general, wireless receiving sets which are designed, got-up and offered for sale solely for amateur or professional communication reception shall for the present be regarded as not chargeable with Purchase Tax under Group 18 of the Tax Schedule. This exclusion from tax does not apply to sets which are of the domestic or portable types used for the reception of public broadcast programmes.

Traders manufacturing such communication receivers which they claim to be not chargeable with tax are advised to secure confirmation of non-liability from the Commissioners at City Gate House, Finsbury Square, London, E.C.2, submitting (in duplicate), full specification, advertising or other literature descriptive of the receiver and other appropriate information including frequency coverage, incorporation of beat frequency oscillator, number and details of switched tuning ranges, wholesale price, etc.

* * *

Denco (Clacton) Ltd. have received a ruling from the Board of Trade that as their D.C.R. 19 Receiver is designed and sold for communication purposes it will not be subject to purchase tax. The retail price of the set has been fixed at £49 10s. 0d. and only one version (embodying long, medium and short wave bands) will be marketed.

* * *

Antiference Limited report that certain concerns are offering for sale an item described as "The World's Finest Antiferance Device." We have been requested to notify readers that *Antiference Limited* are not the manufacturers of the article offered and that they have no connection whatsoever with the concerns in question.

* * *

Telegraph Condenser Co., Ltd., hold stocks of the various Capacitors (tolerance $\pm$ 5 per cent.) recommended on Page 25 of the new R.S.G.B. publication "Transmitter Interference" for use in high-pass filters.

EXPERIMENTAL STANDARD FREQUENCY TRANSMISSIONS

GB1RS

The Headquarters' Station, GB1RS, transmits daily for two minutes at each hour from 1800 G.M.T. to 0900 G.M.T. on a frequency of

3500.25 kc/s

when the following message is sent automatically in Morse Code at a speed of 12 words per minute :

CQ de GB1RS QRG 3500·25 kc/s $\overline{\text{VA}}$ GB1RS

Overseas members are invited to report on the reception of these transmissions.

FORTHCOMING EVENTS

REGION 1

Accrington.—February 9, 7.30 p.m., Cambridge Street Schools.
Ashton-u-Lyne.—February 6, 3 p.m., New Jerusalem Schools, Katherine Street.
Bolton.—February 1, 8 p.m., Y.M.C.A.
Burnley.—February 2, 7.30 p.m., Mechanic's Institute, Manchester Road.
Bury.—January 20, 27, February 3, 17, 7.30 p.m., Club Room, Spring Mill, Tottington, Nr. Bury. February 10, 7.30 p.m., Atheneum, Market Street.
Chester.—January 25 and fortnightly, 7.30 p.m., United Services Club, Watergate Street, Chester.
Darwen and Blackburn.—January 21, February 4, 7.30 p.m., Weavers' Institute, Darwen.
Manchester.—February 7, 7.30 p.m., Reynold's Hall, College of Technology, Sackville Street.
Oldham.—January 26, February 9, 7.30 p.m., Civic Centre, Clegg Street.
Rochdale.—February 6, 3 p.m., Drill Hall, Baron Street.

REGION 2

Barnsley.—January 28, February 11, 7.30 p.m., King George Hotel, Peel Street.
Bradford.—January 25, February 8, 7.30 p.m., Cambridge House, 66 Little Horton Lane.
Catterick.—Tuesdays, 7 p.m., Loos Lines, Catterick Camp.
Doncaster.—Wednesdays, 7.30 p.m., 73 Hexthorpe Road.
Harrogate.—Wednesdays, 7.30 p.m., rear of 31 Park Parade.
Hull.—January 26, 7.30 p.m., Imperial Hotel, Paragon Street.
Middlesbrough.—January 31, February 14, 7.30 p.m., 400 Linthorpe Road.
Newcastle-upon-Tyne.—January 31, 8 p.m., British Legion Rooms, 1 Jesmond Road.
Sheffield.—January 26, 8 p.m., " Dog and Partridge," Trippet Lane. February 9, 8 p.m., Albreda Works, Lydgate Lane.
Spenborough.—February 2, 16, 7.30 p.m., Temperance Hall, Cleckheaton.
York.—Wednesdays, 8 p.m., 29 Victor Street.

REGION 3

Birmingham (South).—February 6, 20, 10.30 a.m., Stirchley Institute.
Stourbridge.—February 1, 7.45 p.m., King Edward's School, Science Block.

REGION 4

Derby (Derby and District A.R.S.).—January 19, February 2, 16, 7.30 p.m., Club Room, 67B London Road. February 9, 7.30 p.m., Annual Dinner (venue to be announced locally).

REGION 5

Cambridge.—January 21, " The Jolly Waterman." Junk Sale.

REGION 7

London.—January 28, Annual General Meeting, 6.30 p.m., Institution of Electrical Engineers. Tea at 5.30 p.m.
Barnes and Putney.—February 8, 7.30 p.m., 28 Nassau Road, S.W.13.
Barnet.—February 12, Bunny's Restaurant, 15 Station Road, New Barnet.
Croydon (Surrey R.C.C.).—February 8, 7.30 p.m., " Blacksmith's Arms," South End.
Edgware (Edgware and District R.S.).—January 19, 26, February 2, 9, 16, St. Michael's School, Flower Lane, Mill Hill.
East London.—January 16, 2.30 p.m., Lambourne Room, Ilford Town Hall. " Practical work of South London U.H.F. Group—420-460 Mc/s.," C. Newton, G2FKZ. February 13, 2.30 p.m. " Exciting," A. H. Koster, G3ECA.
Enfield.—January 16, February 20, 3 p.m., George Spicer School, Southbury Road.
Hoddesdon.—February 3, 8 p.m., Salisbury Arms Hotel.
Holloway (Grafton R.S.).—7.30 p.m., Grafton School, Eburne Road, N.7. (Mondays, Wednesdays and Fridays.)
Peckham.—February 7, 7.30 p.m., " The Kentish Drover," Rye Lane.
Slough.—January 20, 7.30 p.m., Congregational Church Hall, Church Street. " The V.F.O.," J. Gilbert, G2DDG.
Southgate.—February 4, 7.30 p.m., The Merry Hills Hotel, Oakwood.
St. Albans.—February 9, 8 p.m. " The Beehive," London Road.
Sutton and Cheam.—January 18, February 1, 15, 8 p.m., " Ye Olde Red Lion," Cheam.
Welwyn Garden City.—February 1, 8 p.m., Council Offices.

REGION 9

Bristol.—January 21, February 18, 7.30 p.m., Keen's Cafe, Bristol, 8.
Exeter.—First Friday, 7 p.m., Y.M.C.A., 41 St. David's Hill.
Plymouth.—Third Saturday, 7 p.m., Tothill Community Centre, Tothill Park, Knighton Road, St. Judes.
Torquay.—Third Saturday, 7.30 p.m., Y.M.C.A., Castle Road.

REGION 13

Edinburgh.—January 27, 7.30 p.m., Chamber of Commerce, 25 Charlotte Square.

REGION 14

Glasgow.—January 19, First Annual Dance, 7.30 p.m.-1 a.m., Cranworth House, 20 Cranworth Street, Hillhead, W.2. Tickets 8s. 6d., inc. Buffet. January 26, 7 p.m., Institute of Engineers and Shipbuilders, 39 Elmbank Street.

Amateur Radio in British Zone of Germany

Major R. G. Shears (D2KW-G8KW), Secretary, Radio Committee, British Signals Communication Board, with Headquarters in Bad Salzuflen, advises the Society that it has become necessary to introduce an additional letter in the callsign prefix in view of the fact that only a portion of the " D " callsign block was allocated to Germany at the Atlantic City Conference. The following prefixes came into effect as from January 1, 1949:

DL2 British Zone of Germany.
DL4 U.S. Zone.
DL5 French Zone.

These prefixes only apply to Allied amateurs. In the event of German nationals being licenced, callsigns in the series DL 1, 3, 6, 7, 8, 9 and 0 will be used.

Radio amateurs in the British Zone are no longer permitted to use the 58·5-60 Mc/s. band, neither may they operate between 29·7 and 30 Mc/s.

As at November 24, 1948, 94 licences were in force in the British Zone.

* * *

About 50 amateurs from all parts of the Western Zone of Germany were present at the third postwar " Hamfest " held recently in Hanover. The ever-increasing interest in Amateur Radio amongst the Military, R.A.F. and civilian occupation personnel was reflected in the number of new calls recorded in the visitors' book alongside those of such stalwarts as D2KW (G8KW), D2AV (G6BD), and D2MW (G8MW). A special welcome was given to Major D. A. MacDonnell (G8DK, ex-XU1DI) now back in Germany after a spell of operation in ZC6, MD5, MD7, etc. His present call is D2NO.

The Chairman (D2MW) spoke of the beneficial influence of Amateur Radio in a world beset by fear and unrest. Major R. G. Shears, D2KW, Organising Secretary of Amateur Radio in the British Zone, outlined licensing procedure and explained that in the near future all licenses would be issued by the German Postal Authorities to both Allied and German nationals. No official licences had yet been granted to Germans. D2KW also urged more active participation in R.S.G.B. Contests, especially N.F.D. and " Top Band."

Mr. E. G. Styles, D2GU, QSL Manager, explained the general working of the Bureau and emphasised that the final efficiency of the service must depend upon the co-operation of all D2 station operators. Later, a number of films on radio subjects were screened. Before the dinner, which marked the end of another highly enjoyable " Hamfest," the " Order of the Handle " was ceremoniously presented to D2GU.

Book Reviews

THE AMPLIFICATION AND DISTRIBUTION OF SOUND. (2nd edition). By A. E. Greenlees, A.M.I.E.E. Published by Chapman & Hall, Ltd., London. Price 16/- net.

Good books on the subject of installation, maintenance, and operation of P.A. systems are scarce. This book, first published in 1938, re-printed three times, now appears as a second edition with revisions, additions, and rearrangements.

It is a simple and sensible survey of the principles, but includes a great deal of practical wisdom and engineering gumption. The text, except for a few simple calculations of the most elementary sort, is unmathematical. The author illustrates his work with diagrams of components, circuit diagrams and many graphs; all are excellent.

The first chapters on fundamentals, components, and amplifiers, will interest architects and non-technical readers, mainly, but the chapter on special features of amplifiers, such as programme metering, volume expansion, etc., will attract the technical reader. Amplifier performance, including simple noise measurement, is everyone's business; and from here on, through microphones, record reproduction, loud-speakers, installation planning, lines and load matching, operation and maintenance, the author's treatment is interesting, useful and eminently practical.

Later chapters cover test equipment, central installations, specifications, and in the appendix are gathered extra notes and information.

The book is simple, readable, useful and sound in technical matters. It is recommended.

T. P. A.

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The finest British Made Communications Receiver. Available from stock. Guaranteed for 12 months. Cash price **£27 10s.** (*Carriage Paid*), or **£5 15s.** deposit and 78 weekly payments of **6**/- into a local Bank.

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OSCILLOSCOPE UNITS.—Steel case, welded chassis, hinged glass window. A gift at **10/-.**

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MICROPHONES.—Carbon table stand microphones, excellent quality. **10**/- each.

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A COMPLETE V.F.O./transmitter for less than £10. Type 37, modified for C.W. or mod. 20–80 Mc/s. Condition as new. Offers.—Box 519, PARRS, 121 Kingsway, London, W.C.2. [519

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A.R.88D as new, £40; HRO with P.P. coils 7–30, £20; Transformer 6·3/150/400, £2; 813's, £1; 803's, £1; 807's, 5s.; 6V6's, 5s.; 6F6's, 5s.; 22 odd resistors, 5s.; 26 fixed transmitter condensers, £1; Loudspeakers P.M., £1 each; Test jacks, 6d.; Various relays, 4s. each; 0–5 D.C. M/A's, 5s.—BRS16922, Solway Close, Claremont Gardens, Marlow, Bucks. [498

AVAILABLE.—One only, 1,100 volt, one kilowatt, power pack components, comprising transformer, swinging and ordinary smoothing choke, two 1,500 volt condensers. Best offer over £8. —S.A.E. to G5LF, 14 Silverston Way, Stanmore, Middlesex. [458

BC342, modified, perfect condition, bargain, must sell, £15.10.0. buyer collects.—BATEY, 63 Darkes Lane, Potters Bar, Middlesex. [532

B.S.W.L. Join British Short Wave League—over 20 departments (Q.S.L. Bureau, DX Certificates, Technical, Translations, etc.). Members receive "Short Wave Review" each month. For details send S.A.E.—H.Q., 145 Uxendon Hill, Wembley Park, Middlesex. [542

B2 and "Walkie Talkie" receiver for sale. Wanted Hallicrafters Sky Champion. Offers.—Box 535, PARRS, 121 Kingsway, London, W.C.2. [535

CALL BOOK.—Complete list of HAMS throughout the world, 10s., plus 9d. postage; Radio Handbook, latest edition, 17s. 6d., post paid. Order now; the above are in stock. C.Q.—The Amateur magazine published in the U.S.A., subscribe now, only 20s. for 12 large monthly issues.—DALE INTERNATIONAL PUBLICATIONS, 105 Bolsover Street, London, W.1. [206

CRYSTAL Microphone Inserts (Cosmocord Mic-4), guaranteed brand new. 12s. 6d. Post free.—RADIO-AID LTD., 29 Market Street, Watford. Phone: Watford 5988. [527

DST100, 14 valve communications receiver, 30 Mc/s.–50 kc/s. continuous coverage. B.F.O. A.V.C. noise limiter, etc., 230 V A.C. Good condition.—Offers to BRS17016, 22 Lightwoods Hill, Smethwick. [508

EDDYSTONE 504, with complete accessories, manual, aerial co-axial assembly, matched speaker, all in condition as brand new. £30. Little used owing to working night shifts.—IVAN PENROSE, 27 Causewayhead, Penzance, Cornwall. [523

EXCELLENT gear, surplus to requirements: R1155 complete, £4; converted and in new cabinet, £9; Midget superhet, in latest bakelite cabinet, £10; Wearite oscillator, £3; CR100, perfect, £35; R1132A complete, £5; many valves and miscellaneous gear, very reasonable; all enquiries welcomed and replied to.—BRS15920, 179 Shelford Road, Trumpington, Cambridge. [506

FOR SALE.—12-in. triple cone P.M. Bakers speaker. 15 ohm speech coil. Perfect condition £5.10.0.—STANIFORTH, 30 Banky Meadow, Burbage, Nr. Hinkley, Leicester. [517

G3BAE (School Master) seeks lodgings with fellow Ham or B.R.S. Near Sale.—Apply 187 Newton Drive, Blackpool. [531

G3XI QRT—complete station, must be sold. 150 watt transmitter plate modulation 813—pp 807's—90% Woden transformer. Tobe + 24 receiver—B.C348—1132 converted 144—25 watt V.F.O.—Phillips oscilloscope, crystal mikes—crystal calibrator, spare valves, tools, etc. Send for lists. Bargain price for lot.—19 Rivercourt Road, W.6. Riv. 6827. [533

HALLICRAFTER S29 Sky-Traveller, 9-valves, 4-wave, 30,000–550 kc/s., A.C./D.C. and battery, bandspread tuning, good condition, £15.0.0. Carriage paid.—EDWARDS, Clontinaglare, Saintfield, Belfast. [522

H.R.O. Senior. Nine coils. 50 kc/s.–30 Mc/s. Four bandspread. 230 A.C. power pack, spare set valves. Best offer secures. BC.221 frequency meter, new, spare valves. £10.—Box 518, PARRS, 121 Kingsway, London, W.C.2. [518

HRO Junior, with coils for 50 kc/s. to 30 Mc/s. and power pack, all mounted on 3 ft. rack, with divided compartment for the coils and spare panel for speaker; excellent condition, £25.—RAEBURN, 9 Cartsbridge Road, Busby, Renfrewshire. [501

M.C.R.1. with coils, power pack, speaker and phones, £8 or offers. Two pairs Autosyn motors, 32V A.C., one fitted with compass dial, drive or indicate beam, £3 a pair. B.C. receiver, 4 valve L & M, £7.—Box 504, PARRS, 121 Kingsway, London, W.C.2. [504

MODULATOR, commercial job. 6SJ7-6C5-6J5-p.p. 807's, Woden UM2, O.K. for crystal mike. Cost £16; bargain, £5. HRO coil 3–7·3 Mc/s., new, £2; 28 Mc/s. bandspread ditto, £2. —G8UA, 406 Higher Brunshaw, Burnley, Lancs. [505

NEW, not surplus, 75W modulator transformer, P.P. 807 class AB2 into 200 mA. Multi-ratio sec., 39s. Boxed 816, T20, 17s. 6d. each. 125 k.c. I.F. transformers, 10s. 6d. pair.—G3LB, Ripon, Yorks. [502

NEW 1155 receiver, converted new panel, 6V6 output, less power pack and speaker £12. Heavy duty 6 ft. rack £3; Rotary converter, new, 12V. D.C. input, 230 A.C. 50 c.p.s. 150W. output £5; 87 ft. Adastra tubular steel aerial masts complete £5; Milliamperemeters 0–5, 0–100. 5s. each.—GILES, G3AEB, Hainford, Norwich. [526

QSL's and Logs by Minerva. See our art series.—Samples from MINERVA PRESS, Elm Park, Romford, Essex. [516

QSL's and log books (P.M.G. approved); samples free; state whether G or BRS.—ATKINSON BROS., Printers, Elland. [483

QSL cards G, BRS, SWL, from 7s. 6d. 100. Printed notepaper, 3s. 6d. 100 sheets. Samples free.—G2DJA, 137 Randall Avenue, London, N.W.2. [472

ROTARY converters 24V. D.C. input: 230V. 50 cycles 100 watts output. Brand new, £3 10s. 0d.—M.O.S., 3 Robert Street, London, N.W.1. [446

R107 Receiver, 20, 40, 80, 160 metres, first class condition, £13. B2 Receiver, 20, 40, 80 metres, with A/C power pack and phones, all new, £8.—GW3DFB, 33 The Parade, Barry, Glamorgan. Evening phone, Barry 1702. [503

R1155 1.7–18 Mc/s. separate power pack 6F6 output, complete speaker. Transformer G.E.C. 230/115V·5KVA. 2–12 volt dynamos 150 watts, Delco Remy £16 or offers.—COOKE (JNR.), 25 Beltring Road, Eastbourne. [538

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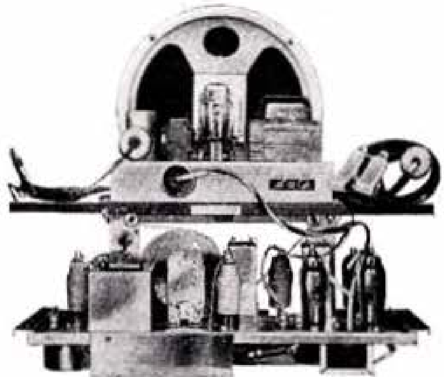

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