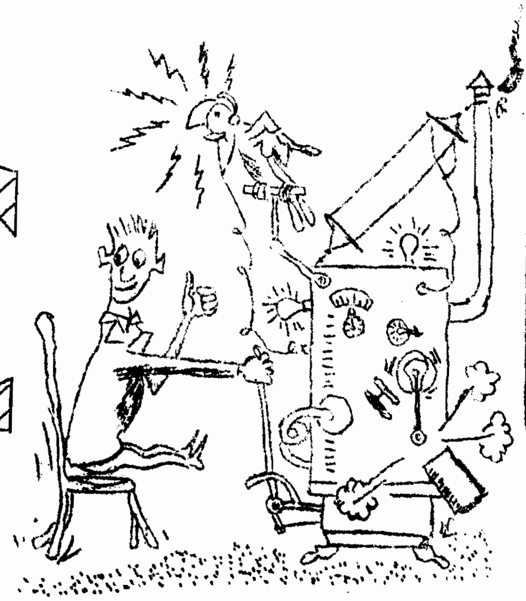
THE BI-TERMINAL MAGAZINE OF THE BRADFORD GRAMMAR SCHOOL AMATEUR RADIO CLUB

THE HAM



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THE BRADFORD GRAMMAR SCHOOL AMATEUR RADIO CLUB,

THE GRAMMAR SCHOOL,

BRADFORD, 9

Volume I "THE HAM" Number 4

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BIENNIALLY

EDITORIAL

The last issues sold far better than we anticipated. Despite our having printed six extra copies, they were all sold out within a week. Because of this we have produced some order forms so that no-one need be disappointed. If you have not already filled one in, you will find one somewhere in this copy. It will help both us and you if you fill it in and hand it to a member of our staff as soon as possible.

This extra sale has meant that we now have some money on the right side of the balance. By the time the next volume comes out, if not before, we shall make a considerable reduction in the price or increase the size.

It was pointed out to me the other day that in this magazine you get circuit diagrams and information that many firms charge several shillings for, also you can easily get in touch with the authors.

One thing I feel that I must point out is that we can not print anything which is copyright so I would be glad if those of you who do contribute will keep your articles free from such material.

After the last edition I was told that the quality of the articles was far better when we wrote it and that the person concerned would not lower the value of the magazine be contributing. We appreciate the compliment, but hope that it will not deter you from contributing.

Activity in the Society has reached a high level and you should all be very careful as the likelihood of accidents is far greater and it only needs one to close the Society.

There have been a far larger number of entries for the D.F. Contest than we anticipated, and it should be a great success. As this is our last issue before the Easter holiday, I would like to wish you all good luck in the Contest.

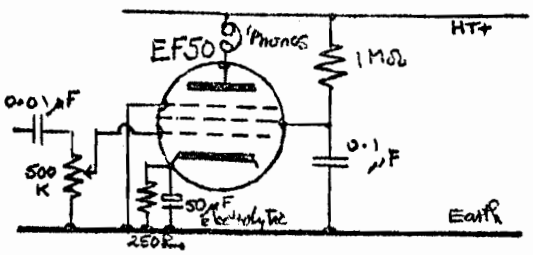
John P. Stott, G3MAB
Editor.

BEGINNERS' SERIES

4. The Audio Frequency Amplifier

Our receiver now consists of two stages: a radio frequency amplifier and a detector. The next stage is an audio frequency amplifier which amplifies the output from the detector.

Figure one shows a circuit diagram you could use. You have now reached the stage when you should ensure that all leads are as short as possible, as excessive length will cause hum and other complications.



In the detector stage, the phones in the anode circuit should be replaced by a resistor (about 200K.) and the output taken by means of the .01mfd. condenser shown from the junction of this resistor and the RFC.

You will probably have enough gain using a triode valve (6J5) in which case the circuit is the same except for the connections to the other grids being missing. Instead of a triode you could use a pentode connected up as a triode. This is achieved by joining screen grid and anode and leaving suppressor grid disconnected. The circuit shows a pentode stage as this will enable you to hear even very weak stations.

We are no longer going to suggest any layout. We leave it to you as so long as you remember to keep it as compact as possible, you cannot go far wrong.

The set should drive a speaker by now, but next time I shall describe an output stage which will enable you to drive a speaker very well.

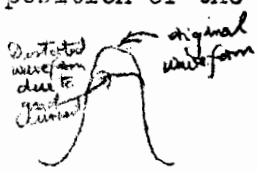
THE DESIGN OF CIRCUITS

by David Noble, G3MAW

To evolve a circuit suitable for use using valves which you already possess, is is not a difficult matter; 'the gen' is either found in, or calculated from the valve book. This article is intended to help you do this, and contains the elementary information necessary.

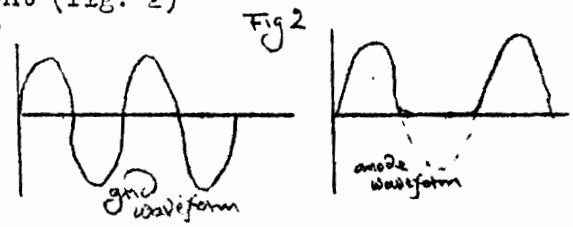
In the first instance, then, let us consider the simple circuit of a 2-valve amplifier, using an EF50 and a 6V6. The H.T. voltage is to be 300 volts, and the specified require an L.T. of 6.3 volts.

Let us first consider the EF50 pre-amplifier stage. The voltage of the cathode with respect to that of the grid is first to be considered. In the first case, it must never become negative with respect to the grid, because then electrons will be able to flow to the grid; in this case, if the a.c. input to the grid causes the grid to become positive with respect to the cathode, electrons will flow and cause the position of the waveform to become distorted.



As the input may reach a level of a considerable fraction of a volt, the cathode must therefore be about 1 volt positive with respect to the grid. However, this is not the only consideration. When the cathode reaches a certain voltage with respect to the grid, the anode current stops. Under these conditions, the anode current cannot possibly be less than zero however much more negative the grid goes, and a second form of distortion is apparent (fig. 2)

Fig 2



We thus know that our cathode voltages should be about 1½ volts positive with respect to the grid. (the value can be found in a valve book).

Now the grid is usually at chassis potential for D.C., thus the cathode should be 'biassed' 1½ v. positive with respect to the chassis. Now the total current from the cathode is 10 mA which go through the anode, and 3 mA which go through the screen grid, therefore the total is 13 mA. A resistor of 115 ohms carrying the current will develop the required voltage across its ends. (E=IR, Ohm's Law) (The nearest preferred value is 120 ohms).

One more point about the cathode - a condenser of about 25 mfd is connected across the resistor in order to remove the A.F. from this point. The reason for this is as follows: If we have the valve with its resistor in the cathode, operating under steady conditions, then increase the grid voltage slightly, more anode current will flow. Hence, more cathode current will flow, more voltage will be lost by the resitor, and the cathode will become more positive with respect to the grid, and this will lessen the anode current change for a given change in grid voltage, and the 'gain' of the valve will be less. It will have been noted that the grid is at earth (chassis) potential, as far as D.C. is concerned; this is achieved by connecting a 1 megohm resistor between grid and ground. The A.C. input is a voltage without much current, and smaller resistors would tend to reduce considerably the amplitude of this voltage, and also to distort low notes. The input to the grid should be made with screened lead the outer earthed, and kept well away from other wires, especially anode or heater wires which might introduce feedback or 'hum'.

An H.T. line of 300 volts is rather large for an EF50; a voltage of 250 is preferable and the surplus 50 volts is dropped by a 3.7Kohm resistor (3.9 K - pref.) (Total valve current = 13 mA; $R=\frac{E}{I}=\frac{50000}{13}=3700$) It should be noted that the total wattage dissipated by this resistor is 50 x .013 = .65 watt. The H.T. dropped in this way has a 8 mfd condenser connected to ground; this is so that there will be no A.C. ripple of any type (mains or A.F.) remaining which might affect the output.

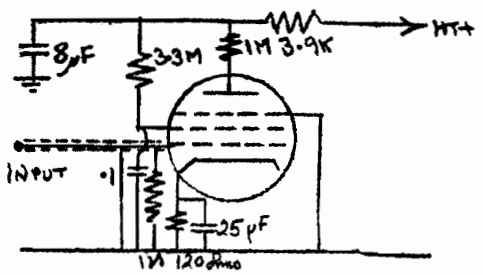
The anode is connected to the H.T. through a resistor, which develops varying voltages as the anode current varies due to the varying grid voltage. The anode voltage varies considerably more than the grid voltage and it is this amplified voltage which is applied to the next stage. Now, the 'maximum power theorem' states that optimum power is obtained from a source if the load is equal (in resistance) to the internal resistance of the source. The valve book states that the anode impedance of an EF50 is 1 megohm. Thus if we connect a 1 megohm resistor to the anode of the valve and to the 8 uF condenser, and go on to consider the screen grid.

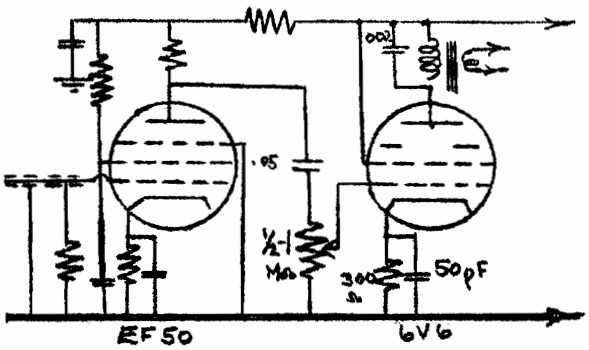
Now it is a fact that the potentials applied to the screen grid and to the

control grid are major factors in determining the total current from the cathode, and those applied to the anode and suppressor grid have relatively little effect. If the anode is disconnected from the H.T. line then nearly all the current that was flowing through it will flow through the screen grid, which will heat up due to the increased flow and (probably) burn out.

The large resistor which we have connected in the anode will have a large potential drop across it and in order to avoid the effect just mentioned, the screen grid must be dropped a similar potential. As the screen-grid draws .3 the current the anode draws, it should be put through a resistor $\frac{10}{3}$ times as large, about 3.3 Meg.

A 0.1 uF condenser is connected to earth to remove any unwanted A.C. from the screen grid. The suppressor grid is connected to earth. The circuit is thus as in the figure. The output is taken from the anode by connecting a condenser between the anode and the volume control; this condenser will pass the A.C. voltage signal but it will isolate the H.T. from the grid of the next valve. The output voltage is developed across the $\frac{1}{2}$ or 1 megohm potentiometer. This is tapped off by the slider of the control, which is connected directly to the grid of the 6V6; the cathode has a similar circuit to that already described; the resistor is calculated in a similar way to that of the EF50 (14v. at 50 mA gives 280 ohms) and shunted by a 50 mfd, 25 v. wkg condenser.





The anode is connected straight to the original H.T. line through the primary of the output transformer. Due to the low D.C. resistance of this, the screen grid may be connected to the H.T. line directly.

The suppressor grid is connected internally to the cathode of these valves.

A 0.002 uF condenser is connected across the primary of the output transformer to prevent undesirable oscillations. The output is connected from the secondary of the transformer to the loudspeaker.

The Use of Transistors

by Peter J. Barowitz (G3LZW)

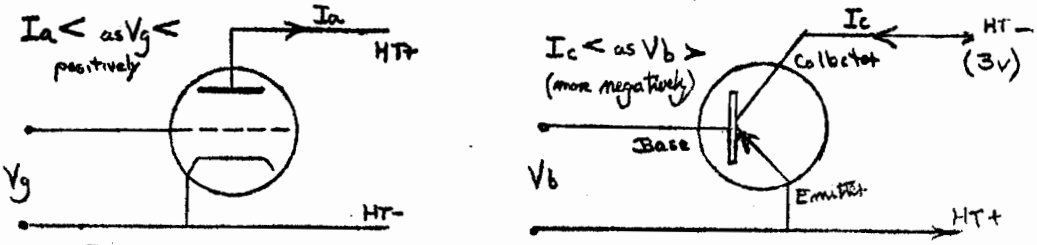
Part I - Introduction

A simple red spot transistor of the type that can be obtained for 7/6 on the surplus market, will give many years of pleasure to its owner, if carefully handled. In various circuits, the transistor greatly excels over the thermionic valve in performance.

This is the first in a series of short articles in a new field of radio, which should interest the experimenter. Items constructed as in this series may prove so successful that one is loath to dismantle them so as to use the transistor elsewhere. It may thus be a good idea to buy another. (The other way, which is best if the transistor is to be used several times, is to fit it with some form of small base and plug it in like a valve - Ed.)

Descriptions of the actual working of the transistor can be found elsewhere, but reference to the diagram and the following notes should be helpful. The transistor is effectively a 'triode crystal' and hence needs no heater. The 'H.T.' required to operate it is about three volts and the current drawn by it in the average circuit does not exceed 2 mA. Economy in consumption and size are therefore its main advantages.

A simple analogy to the working of a valve is all that will be given here. The current drawn from the H.T. positive supply to a valve varies with the voltage on its grid. The transistor when in the usual connection as shown in the diagram has a collector representing the anode, an emitter representing the cathode and a base representing the grid. The current drawn by the collector from its negative supply varies as the current caused by the negative voltage on the base. The symbol for a transistor is shown in the diagram.



The amplification of a valve is produced since a small increase in Vg produces a fairly large change in the voltage across the anode load resistor. (V RxI). In a transistor increased base current produces a larger increase in collector current, the current gain of the average type being 60. This alone produces insufficient gain. The important point is that the collector impedance is much greater than the impedance of the base, therefore a given change in current produces a much larger voltage change in the collector than in the base. Hence the voltage gain of the transistor is much higher than its current gain, and a transistor running off -250 volts with a large series resistor to limit the voltage across the transistor to three volts can give the equivalent gain of two pentode stages in cascade because of the high voltage change produced by the collector current change, across the high resistance.

These facts all go to show how useful the transistor can be and the main limitation to its uses is the maximum useable frequency - the gain of the redspot type at medium waves not being sufficient to promote the use of self oscillation due to positive feedback (reaction).

The use of the transistor as a D.C. amplifier, this being the simplest, will be discussed in the next issue of the HAM, the application being a highly sensitive volt--meter. Until then, when you will be shown how to use a transistor, and make sure it works correctly before keeping it, - some surplus ones are duds - I personally will undertake to test any transistor you buy, for gain a stability, and will use a 'transistor voltmeter' to do it!

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WHY A.C. VALVES?

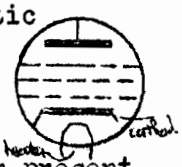
by David Noble, G3MAW

This article is intended to explain to the yonger readers of the HAM the reasons for using the various types of valves which are available. The common battery valve which is shown on the circuits pinned up in the Radio Room works quite well - off batteries. But if we wish to run it of A.C. mains we require special transformers, rectifiers and smoothing for the filaments. The reason for this is quite simple.

As most of you know, the negative voltage on the grid with respect to the heater voltage controls the anode current. If a varying voltage is applied to the grid, the anode current in exactly the same way; and the voltage developed across the anode load resistor varies in the same way but to a greater extent.

The input to the grid of the detector stage in a one-valve-set is about one-tenth of a volt. If now we apply an A.C. voltage to the filament, this voltage will vary by about 4 volts, i.e. the hum caused by the heaters will be 40 times as great as the signal!

To overcome this the A.C. type of valve was developed. The heater is a piece of wire inside a metal tube called the CATHODE which is coated with certain metallic oxides to improve the emission of the electrons. The cathode can then be maintained at a constant voltage with respect to the grid; and the only hum produced will be due to grid leads passing too near to the heaters. Figure one shows the diagramatic representation of a valve with a cathode. Figure 2 shows a power supply suitable for use with indirectly heated valves, as they are called. The heater voltage of 6.3 volts was chosen because it is the voltage of a charged car battery, and thus such valves can be used from accumulators.



It will be noted that directly heated rectifier has been used as the hum present at that point in the circuit is so great that the little extra is unimportant.

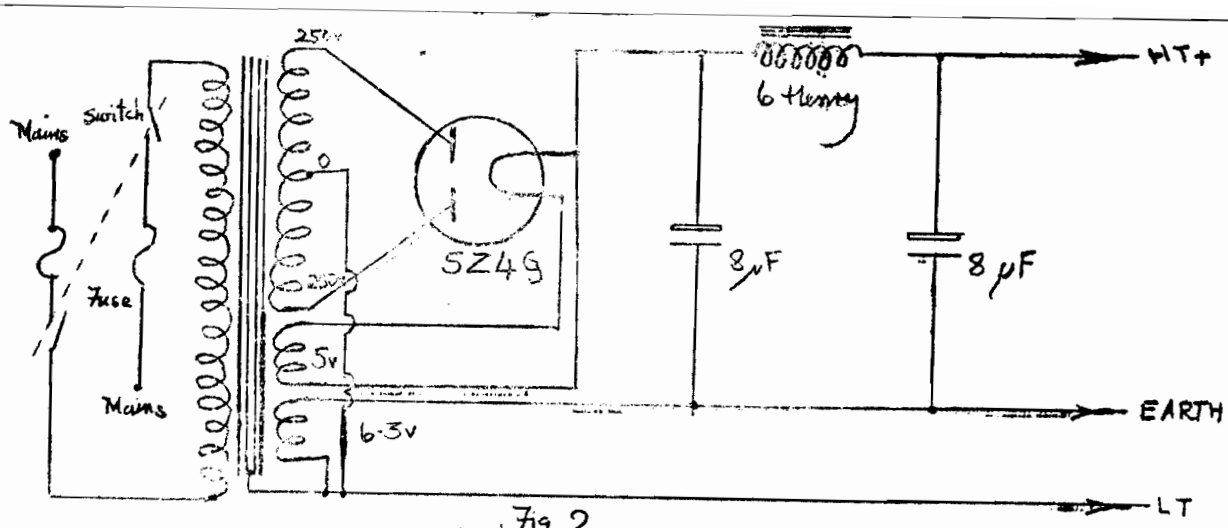


Fig.2

A Power Supply for use on A.C. Mains.

ORDER YOUR HAM

Those of you who have not already done so will find an order form in this copy of THE HAM. It will be of great assistance to us if you will complete it and hand it to any member of the Editorial Staff. Should you not wish to purchase further copies please put a line through the order form and hand it in, preferably with your reason written on the back.

PLEASE HELP US TO HELP YOU BY COMPLYING WITH THIS REQUEST

DIRECTION FINDING NOTES

The application of cathode bias to V1 (the 955 R.F. stage) has been found to effect a reduction of H.T. consumption by over 50%. The bias is applied by fitting a 1K resistor in the cathode and decoupling the R.F. with a 2000 pF condenser across this resistor.

D.Noble, G3MAW

'THE HAM' SERIES OF CIRCUIT DIAGRAMS

Reprints of all circuits which have appeared in the 'HAM' are now available price one half penny each from the Editor.

They include: a three valve receiver;
a general purpose power supply;
a four valve ten watt high quality amplifier;
a simple intercom;
a 160m converter for a broadcast receiver; plus a BFO for fitting to an unmodified broadcast receiver;
a low power modulator;
a direction finding receiver;
and all the circuits which appear in this and subsequent copies.

A SIMPLE TRANSISTOR RECEIVER

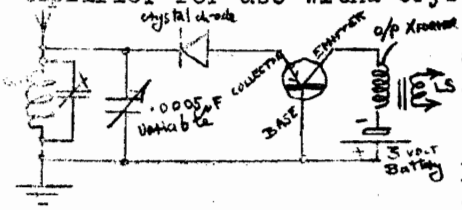
by Richard L. Hodgson, G3MAL

The greatest disadvantage of the crystal receiver, as all beginners soon find, is its lack of audio power. This is naturally very small as no batteries are involved and the output is merely the rectified, and un-amplified, signal from the station. On top of that a good aerial and earth are needed if the set is to work at all.

In order to overcome these difficulties the usual practice is to build a battery valve amplifier, into which the crytal set can be fed. The cost and time needed, however, make this hardly worth the bother. Instead at a very small cost (10/-) compared with that of the valve amplifier a transistor can be used to do just the same job. It has other advantages: 1) No H.T. is needed only a 3 volt battery which will lost literally for years. 2) There are hardly any extra components. 3) The output is sufficient to work a loudspeaker, or if a short aerial is used to give good 'phone results. 4) The receiver

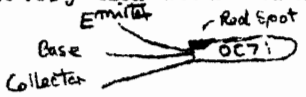
can be built extremely small and is quite portable.

The type of transistor suitable is the OC71 (7/6) and the circuit showing it as an amplifier for use with a crystal set is illustrated below. The transistor itself is very small and has 3 connections known as the base, collector and emitter. There is marked on one side of the transistor a red spot and the connections can be traced using this mark.

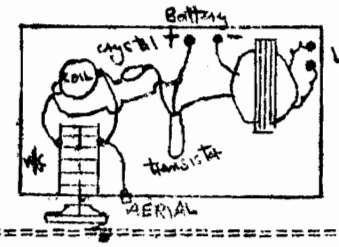


When soldering the transistor into the circuit a thermal shunt must be used so that the transistor is not damaged by heat. They are very delicate and should be handled with care, the wiring of the battery is very important as regards the polarity and any mistake will result in the destruction of the transistor. If a loud-speaker is used an output transformer is needed though it is necessary with 'phones.

The addition of this transistor amplifier will, I am sure prove most satisfactory and well worth the small trouble.



TRANSISTOR TYPE OC71
(Actual Size)



Simple Test Equipment

1 A High Gain A.F. Amplifier

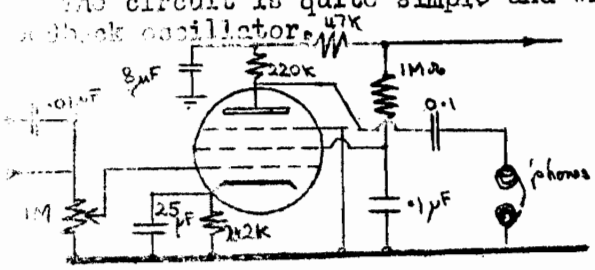
One piece of test equipment that you will find very useful is such an amplifier. It can be used for checking small outputs from early stages of amplifiers and other such applications. With a crystal set it gives you a bedside receivor, and it could be used as an intercom. amplifier.

The valve is an EF50 or similar valve. The two inputs are provided so that it can be coupled directly to a mic., etc. or through the condenser to eliminate D.C.

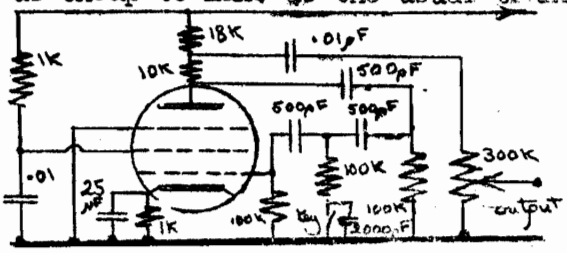
2 An Audio Oscillator

You will find that such an oscillator will be useful for checking amplifiers and for code practice. The circuit given gives a perfect sinusoidal waveform on 1 Kc/s. It is best used with an oscilloscope, but a sine wave is pleasant to listen to for Morse and distortion is fairly readily noticed.

The circuit is quite simple and will prove as cheap to make as the usual transformer audio oscillator.



(1) A.F. Amplifier



(2) 1000cps A.F. Oscillator.

THE FREQUENCY CONTROL AND MEASUREMENT OF AMATEUR TRANSMITTERS

Part I

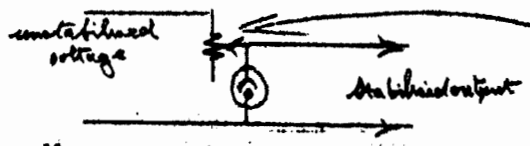
by David M. Pratt, G3KEP

Before anyone can obtain an amateur transmitting licence, they have to satisfy the GPO that they have a satisfactory method of frequency stabilisation in the transmitter, and also, that they possess a suitable frequency meter for the amateur bands on which they intend to operate.

Frequency Control

Frequency stabilisation is equally as important on telephony as it is on telegraphy. On telegraphy (C.W.) it is necessary to have a stable note free from drift and chirp, and on telephony the transmissions should be free from frequency modulation. Both these effects can usually be eliminated by the use of a voltage regulator valve (e.g. VR105/30, VR150/30) If a P.A. stage is operating under its correct working conditions, there should be no variation of the Anode current of the P.A. when 100% modulation is applied. Nevertheless, it is very unusual for any amateur transmitter to be operating exactly under its correct recommended conditions, and, therefore, precautions should be taken to ensure that the H.T. applied to the oscillator stage is kept at a constant potential when the main H.T. line to the transmitter is varied during modulation. When the transmitter is keyed, depending which

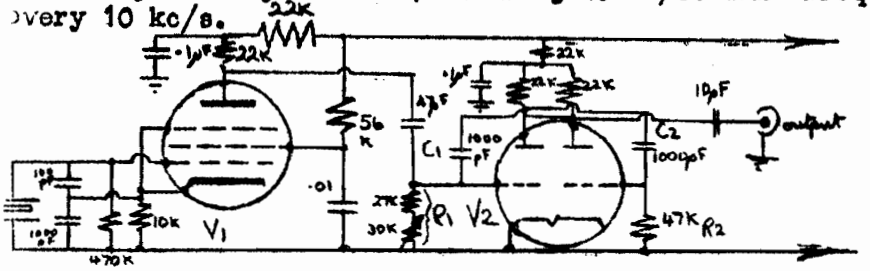
part of the transmitter is keyed, it is likely that the H.T. will vary. "A satisfactory method of frequency stabilisation" is shewn below:



Set resistor to give striking voltage across regulator valve-base while on load; but with regulator valve out of circuit.

Frequency Measurement

Until a few years ago, it was necessary to be able to measure the frequency of a transmitter to an accuracy of 0.1 % using a crystal controlled type heterodyne wavemeter. Now, however, as proof that the transmitter is operating within the authorised bands is all that is required, in most cases a single 100 kc/s crystal oscillator will suffice. A snag arises, however, when it is desired to operate within a band whose edges are not multiples of 100 kc/s (e.g. 40 metres - 7 - 7.15 Mc/s), and harmonics of 50 Kc/s are then required. The circuit below shows a 100 Kc/s crystal oscillator and a multivibrator locked by the crystal oscillator to 10 Kc/s. This frequency marker radiates harmonics every 10 kc/s.



V1: EF50, SP61, etc.
V2: 6SN7, ECC32, etc.

The grid resistors and grid/anode coupling condensers determine the operating frequency of the multivibrator. The theoretical values can be calculated from the following formula:

$$\& \quad f = \frac{1000}{R101 + R202}$$

Where f = frequency in kilocycles;
R = Resistance in ohms;
C = Capacitance in microfarads.

A variable resistor is shewn in the grid circuit to 'lock' the multivibrator to give exactly 9 'pips' between every two harmonics of the crystal oscillator.

(Next issue, an accurate heterodyne frequency meter will be described)

B.G.S. AMATEUR RADIO CLUB TOP BAND CONTEST

Starting with the next top band contest, the points will be additive and a prize will be given to the member obtaining the most points by December, 1958. Logs for each contest should be submitted to G3KEP on the Saturday following at break in the Radio Room. In the cases when this time falls in a school holiday, logs must be received on the first Saturday after the School is re-opened. The log should be set out as follows:

TIME STATIONWORKED HIS RST MY RST NAME QTH POINTS

N.B. Points cannot be claimed if only part of the log entry can be completed.

Points will be scored as follows: B.G.S. Members - 3 points
Other stations within 10 miles radius of B.G.S.- 4
Other English Stations - 5
Stations other than English stations - 6

All contacts must be on C.W. using standard (non-contest) procedure.

The next Contests are on SUNDAY, 2 MARCH and SATURDAY, 5 APRIL from 7 to 9 p.m.

IMPROVE YOUR C.W.

The R.S.G.B. 1st. Top Band Contest, 1958 will be held from 2200 to 0300 GMT on 1/2 March Further details can be obtained from G3KEP.

RADIO AMATEURS' EMERGENCY NETWORK

Born from the splendid work done by radio amateurs during the disastrous East Coast floods of January and February, 1953, and sponsored by the Radio Society of Great Britain, the Radio Amateurs' Emergency Nework is open to ALL radio amateurs and Short Wave listeners.

In registering your station facilities and your availability as an operator, with the Radio Amateur Emergency Network you are not incurring financial or legal obligations. Your signature to the registration form simply means that your equipment , your skill and your experience become available to your community, if needed, during an emergency (e.g. sea flooding, inland flooding or severe blizzard) and that to this end you will participate in organisational preparedness and training as part of a local and/or national network of Amateur Radio stations.

The primary purpose of the organisation is to provide a communications network in the event of an emergency - and especially during the first few vital hours. It will in no way usurp the normal activities of the Post Office.

Remember that your co-operation may result in the saving of Life and property. Such a service, rendered at no cost to the community, will reflect, in the eyes of the General Public, the true Spirit of Amateur Radio.

Obtain a form NOW from G3KEP, so that there will be an active group in this area.

BE PREPARED AND KEEP PREPARED FOR AN EMERGENCY

DIRECTION FINDING CONTEST

The 17 boys who have applied for the Direction Finding Contest on Saturday, 22 nd March, 1958 should note that if they do not enter for the contest, the receiver components with which they were issued should be returned to David Noble.

CURRENT NEWS BY D.M.P.

First, I must explain that our normal writer for this article has been unable to submit his usual contribution due to the heavy pressure of other work with which he has a temporary interest. We hope that Andrew will be able to write the article for next issue.

Since our last issue, Committee meetings are held on alternate Monday lunch times when current club topics are discussed. Tony Fell is in charge of Radio Amateurs' Examination tuition; Peter Barowitz for Constructional Activity; John Stott for films and lectures; and Richard Hodgson for Club outings.

We are grateful for the gift of useful gear from the son of a deceased old-timer in Halifax.

Richard tells us that next term he hopes to be able to arrange a visit to the I.T.A. station at Emley Moor. Further details of this will be posted on the Society Notice board nearer the time. Meanwhile, we would advise non-members who wish to attend this visit to join the Club as it may only be attended to members of the Club. The party will, of course, be limited.

Tony has arranged R.A.E. tuition, and as all the entries are now in, we would recommend that all candidates pay as much attention as possible to the lectures so as not to let themselves or the lecturers down. On the subject of obtaining a transmitting licence, I would mention here that, following normal practice, G3KEP will be radiating Slow Morse Practice Transmissions on 1.9 Mc/s every week day from 2100 to 2115 hrs local time starting Monday, 12th May, with increasing speed until the September test at Leeds.

The local Amateur Television Transmitting station is nearing completion, and a lecture in connection with this will be held at the Bradford Amateur Radio Society on Tuesday, 4th March, 1958.

Boys who are in the Scout movement should note that there will be a Scout Jamboree on the Air on 10/11 May when Scout groups of the U.K. will be organising Radio Field Days. Further details of this may be obtained from Tony Fell, G3LXF.

Because of the mismatch between the Modulator and P.A. in the big transmitter, and the close proximity of the modulator from the power supplies, it has been decided to temporary abandon the present modulation system, and a 'Clamper-tube' modulation system

has been designed by G3KEP, It is under construction, and will be fitted to the P.A. chassis and used until satisfactory results can be obtained from the present modulator. The Club's BSR Moving Coil microphone will be used with this modulator.

We would like to remind members of the excellent service that "The Ham" offers to readers for advertising gear, etc., wanted or For Sale. David Noble G3MAW will supply any intending advertisers with an advert form which should be completed and returned before 26th March.

Material required for inclusion in Current News should be addressed to reach Andrew M. Pomfret, G3LZZ by 22th March.

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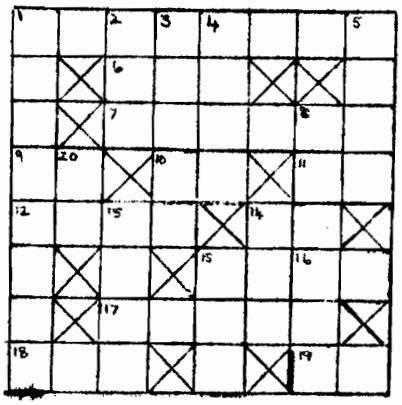
CROSSWORD No. 3 compiled by Richard L. Hodgson, G3MAL



CLUES ACROSS

1 - They taught the U.S.A. Something (8)
6 - One of the better class receivers(3)
7 - To what everybody looks forward to though not always optimistically.(6)
9 - Expensive records (2)
10 - - , that and the other (2)
11 - Make sure the switch isn't, before you touch. (2)
12 - Medieval torture instrument, now used in transmitter assemblies (4)
14 - 6.3 volts (2)
16 - They are often painful to the ear(2)
17 - It has unlimited uses (5)
18 - If you're in doubt, - and see (3)
19 - What the wife was (2)

CLUES DOWN

1 - A great improvement on the T.R.F. (8
2 - The high frequency end of the radio spectrum. (3)
3 - A wheeled vehicle (5)
4 - T9 is a good one. (4)
5 - Type of machine gun (4)
8 -
20 - The final stage of a transmitter (2)
13 - Read (4)
15 - Nocturnal bird (3)

CONTRIBUTIONS FOR THE NEXT ISSUE WILL BE ACCEPTED UP TO WEDNESDAY, 26th MARCH.
THE NEXT TOP BAND CONTEST AFTER PUBLICATION OF THIS MAGAZINE IS FROM 1900 - 2100 GMT ON SUNDAY, 2nd MARCH, 1958. (LOGS TO BE IN BY SATURDAY, 8th MARCH)

"The Ham" is printed and Published by David M. Pratt, G3KEP, 27 Woodlands Grove, Cottingley, Bingley at The Grammar School, Bradford 9 for the B.G.S. Amateur Radio Club on the Saturday following the beginning of each half-term