Radio Constructor

Vol. 2, No. 1 **Annual Subscription 16/-** **August, 1948**

Editors:
ARTHUR C. GEE, G2UK W. NORMAN STEVENS, G3AKA

Technical Editor:
LIONEL E. HOWES, G3AYA

Advertisement & Business Manager:
C. W. C. OVERLAND, G2ATV

Editorial

THE more observant of our readers will have noticed the index number of this issue—No. 1, Vol. 2. The less observant also now realise that this issue leaves behind it the first complete volume of our magazine.

It is common practice at this stage to issue forth with flowery phrases on past glories and the progress made during the preceding issues. However, you may rest assured that this Editorial will not follow those rather hackneyed lines. If one wants to reminisce on past successes (and perhaps a few failures!) of *Radio Constructor*, what is better than to consult the index sheet supplied with this number?

As a departure from the usual practice, we are not going to look backward, but rather in the other direction—forward. What of our future policy? In a nutshell, it will remain substantially the same as hitherto and adjusted from time to time on the basis of suggestions put forward by readers. In this direction it will be seen that everyone has the opportunity of guiding the make-up of future issues. We like to feel that *Radio Constructor* is a friendly medium of disseminating information and topical news and we count on readers co-operation to fulfil this end.

How about size and format? The present format appears to enjoy universal acclaim, and so we do not foresee any alteration in the immediate future. The matter of size (i.e., the number of pages) is best described by a very large question mark! Every reader—and no less your Editors—wants more pages. Many prospective readers would welcome more copies on the bookstalls. Therefore, when the present paper restrictions ease, and there is no sign of this happening before this volume has been completed, we will be faced with a double problem. More pages or more copies. Obviously, it will depend largely on just how much extra paper we will be allocated, but when (or if!) the time comes you may rest assured that we will do our utmost to accomplish both aims.

Talking of prospective readers, we feel that it would be a generous gesture on the part of readers if they would pass along their copies, when finished with, to their less fortunate friends who cannot obtain the magazine. Of

• • • • *The Future*

course, if you are one of those who like to file their magazines this is more or less ruled out! Whilst on the subject we would like to draw attention to the details of our arrangements for binding Volume 1, which appears elsewhere in this issue (page 341).

For your future reading we have many interesting articles, ranging from modification of surplus gear, receivers, transmitters, test gear, semi-theoretical articles, items on pure theory and so forth. It is reiterated that if YOU have any gear, or have adapted any ex-WD apparatus for civilian use, that would be of interest to fellow readers, we are always ready to consider articles for publication. Why not take up the pen and let others partake in the enjoyment you yourself are already deriving from your pet circuit?

W.N.S.

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All materia used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman will redraw in most cases, but relevant information should be included. All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

COMPONENT REVIEW. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6579.

Radio Miscellany

By *Centre Tap*

PERIODICALLY one reads of the accounts stunted by enterprising journalists of how, after introducing a simple fault in a receiver such as breaking a wire and replacing the sleeving they take the receiver to a number of radio dealers for servicing, each time with the same fault. In due course, they write a colourful report of the wide range of excessive charges made for "repairing" it and itemizing the imaginary work and charges made for alleged replacements. I first heard of this stunt being worked in America and it has been worked at least twice over here. The results are similar every time with repair bills ranging from a half-a-guinea to a couple of pounds. The dealers, of course, are never named and the implication by the non-technical journalist is that most radio dealers are racketeers preying on the customers' ignorance of the innards of their receivers.

The same thing applies to watch and clock repairers and other trades where the customer is unable to dispute the amount of work claimed to have been done. A demand for a detailed account of how the charge is computed results in costs being quoted for dismantling, inspecting, cleaning, aligning, testing and perhaps fitting new components or valves, etc., some, or all of which may be justified : the customer cannot say. He cannot distinguish the new parts and as for inspection, testing and alignment, he has no idea what it entails, how long it takes, what instruments are needed or whether it was really necessary. So it is perhaps only natural if he is of a suspicious turn of mind that he should regard any sizeable bill as excessive and complain bitterly. He denounces radio servicing generally to all and sundry and quite a lot of people suddenly remember that their set cost them thirty bob only last month, and they begin to feel uneasy and wonder if they too were "rooked."

Computing the Charge.

I have seen quite a bit from both sides of the counter and have known both many conscientious dealers and a few shameless radio "spivs," as well as hearing of many customers who imagine they have been fleeced. Indeed, I have heard some of the latter allege that an unscrupulous dealer stole the best parts out of their sets which they substituted by inferior parts—this usually is about as sensible as the tale of the rascally watchmaker who pinches the jewels out of a watch entrusted to him for repair! There were, I know, cases of where parts were "borrowed" from waiting receivers during the war, to get another set out of the way. This may be excusable under given circumstances, but without allowing further argument into it, it would be as well to examine representative charges made by dealers who pride themselves on fair and straight dealing.

Firstly, there is the "examination fee" (payable in any case other than estimating) which is five shillings. This charge would be better described as fault location. Then comes the labour charge for time spent, at the rate of two shillings and sixpence per hour. To this is added the retail cost of any replacements together with collection and delivery charge, if any.

From such a scale it will be seen that the deliberate disconnection repair would cost seven shillings and sixpence. One does not often hear of repair bills as low as that from the larger repairer although one more frequently hears of modest accounts from the small one-man business. The latter, strangely enough, is the one most often suspected of radio "spivery."

Equipment.

The dealer has repeatedly pointed out that his test equipment is costly, perhaps £250 or more, although to my knowledge this is sometimes an idle boast. It is, too, also debatable whether there is any justification for an equipment charge to be made against a repair for which the equipment is not needed.

A Story Without A Moral.

In the early days of the war, a certain enthusiast, at that time a humble N.C.O., was stationed in a fair-sized country town and in his spare time he set to repairing a few portables and midgets belonging to his buddies. The need for components took him to the local dealer who, incidentally, did not normally stock them for re-sale. After two or three such visits the proprietor asked him if he would undertake some repairs for his Service Dept., as his regular man had been called to the Forces. The enthusiast was a very competent radio engineer, and Army pay being as it was at that time a few shillings a week, he agreed to put in a few evenings when he was free. The proprietor suggested a flat rate of three shillings and sixpence for all repaired sets which our friend thought quite fair.

The "Servicing Dept." turned out to be little more than a large cupboard under the staircase while the equipment consisted of a D.C. Avominor with a cracked glass, a cheap soldering iron of Japanese origin (retailed at one shilling and elevenpence pre-war), a small screwdriver and a larger one which evidently came in for many other uses such as levering open packing cases! The dealer was amazed our friend should require more than that—why, his regular man who, he hinted darkly, completely understood wireless, could find most faults without even having recourse to the meter!

Plenty of Work.

The first evening he put eight sets in working order. It happened there was nothing more complicated than replacing valves, electrolytics, line-cords, etc. He drew his twenty-eight shillings, less two shillings for the fish and chips the proprietor's wife fetched for his supper, cup of tea and bread and butter. The next evening he repaired six sets (only one sticky one) and upon paying him the dealer assured him there would be plenty of work coming in as he had advertised his Service Dept. was carrying on. At that time there was plenty of work and within a few days the passage was stacked high with waiting sets.

Our friend wasn't trusted with the stock, the proprietor fetched any needed replacements and busied himself with other odd jobs while keeping a watchful eye that sets were dealt with in strict rotation and that long or difficult repairs weren't shelved. No matter how long our friend worked the waiting jobs piled up until there was barely room to squirm through the passage. He noted, too, the percentage of easy ones had fallen very low which he subsequently discovered to be because they were collected through dealers in other towns who were without skilled help. They had picked out the easy ones and it was quite evident that many of the sets had been tampered with; however, he carried on, making quite useful spare time money (less supper deductions).

When the waiting repairs became embarrassing with the passage way completely choked and overflowing, the dealer asked him if he had a friend who would care to come along on the same terms. As a matter of fact he hadn't, so in order to speed up the turn around he suggested that if the dealer himself did the removal and refitting of the chassis from the cases, he would be free to spend more time on repairs, pointing out that the dealer was there in any case doing nothing in particular most of the time.

This arrangement resulted in a slight increase of turn-around and the dealer hinted that in view of this new arrangement the rate of payment should be revised. This was naturally resented by our friend especially as his supper bill had recently risen with the "cost of living," and the equipment now in use was his own. The fact that he was earning about £4 a week for spare-time work must have irked the dealer, but our friend felt confident that even if, as the dealer put it, he was on a "Good Thing," he knew perfectly well that the dealer himself was on a still "Better Thing."

Consequently, there was a certain amount of feeling on both sides which most evenings resulted in words, especially as the dealer was not only greedy, but a rather ill-natured fellow. After a run of lengthy jobs which meant three shillings and sixpence hard earned, he ran into three of the simplest repairs imaginable. The first was a receiver which had been "spring-cleaned" by its owner and two valves had been wrongly replaced. The second was a similar case of spring-cleaning but a grid cap of the open type had been replaced upside-down and was just fouling the metalising of the valve, while the third was a simple case of a loosened grub-screw on the tuning drive. It must have touched the dealer on the raw to see someone earn ten shillings and sixpence in less time than it took him to replace a chassis in a cabinet and it provoked him to more words and ill-concealed hints of easy money, which in turn drove our friend to check up on the charges that were being passed to the customer. The sets for delivery went into the garage and those for collection by the customer went into the shop. It was on the latter he was able to check as he knew there was no other cost chargeable to them.

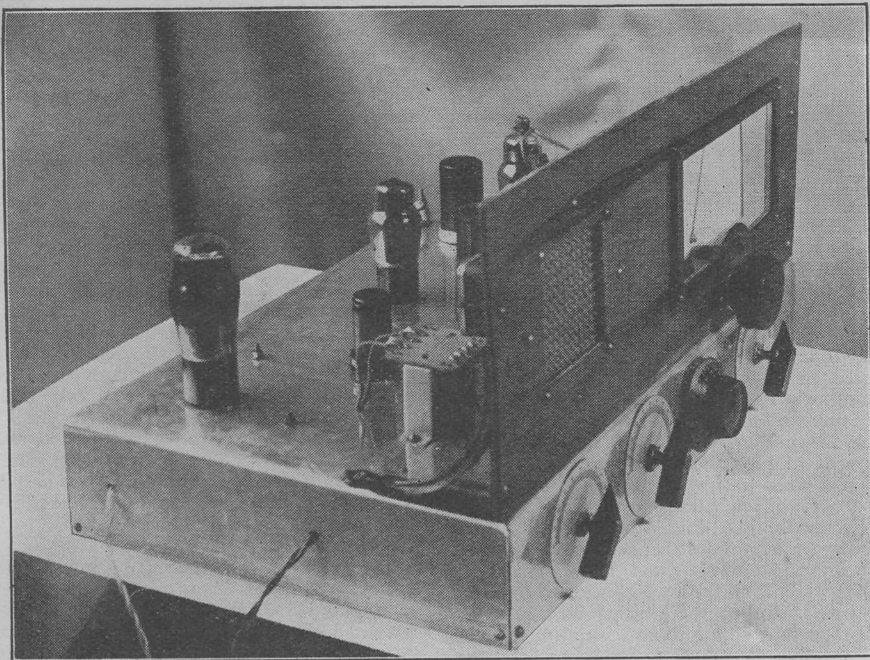
The bills for the three sets quoted, varied from twenty-five shillings to thirty-five shillings, apparently based on the value of the set or the estimated means of the customer. The colossal rate of profit (or profiteering if you will) took his breath away, but he saved it up until the next time there was "words." Even then the dealer tried to justify the prices by claiming he had to average out costs and that on some of the expensive repairs, such as burn-outs, etc., he actually lost. He couldn't, he explained, take an amount of perhaps half the cost of the set for a repair. Couldn't he? A quick check revealed some that ran into seventy shillings or more!

The Final Blow.

There was nothing much our friend could do about it, at least not without a lot of bother, and he was a little bit nervous when he suddenly remembered that he hadn't declared his spare-time earnings for Income Tax assessment. In any case, he was expecting to be moved shortly but before they finally parted company there was a further incident.

A family evacuated from London took an expensive radiogram with them and they had wrecked the mains transformer and almost started a fire, by connecting it to DC mains. The dealer warned them it would not only be an expensive job but that they might have to wait many months for replacements. As they were expecting to move again they finally sold it to him in despair, for £10. After repair, it was sold to another dealer for £40. Reckoning the cost of transport as £1, replacements at £2, there is still £27 left, of which our friend's share for doing the job was three shillings and sixpence.

(*continued on page* 334)



Short Wave AC TRF5

By F. K. Parker

See p412 (Nov.)

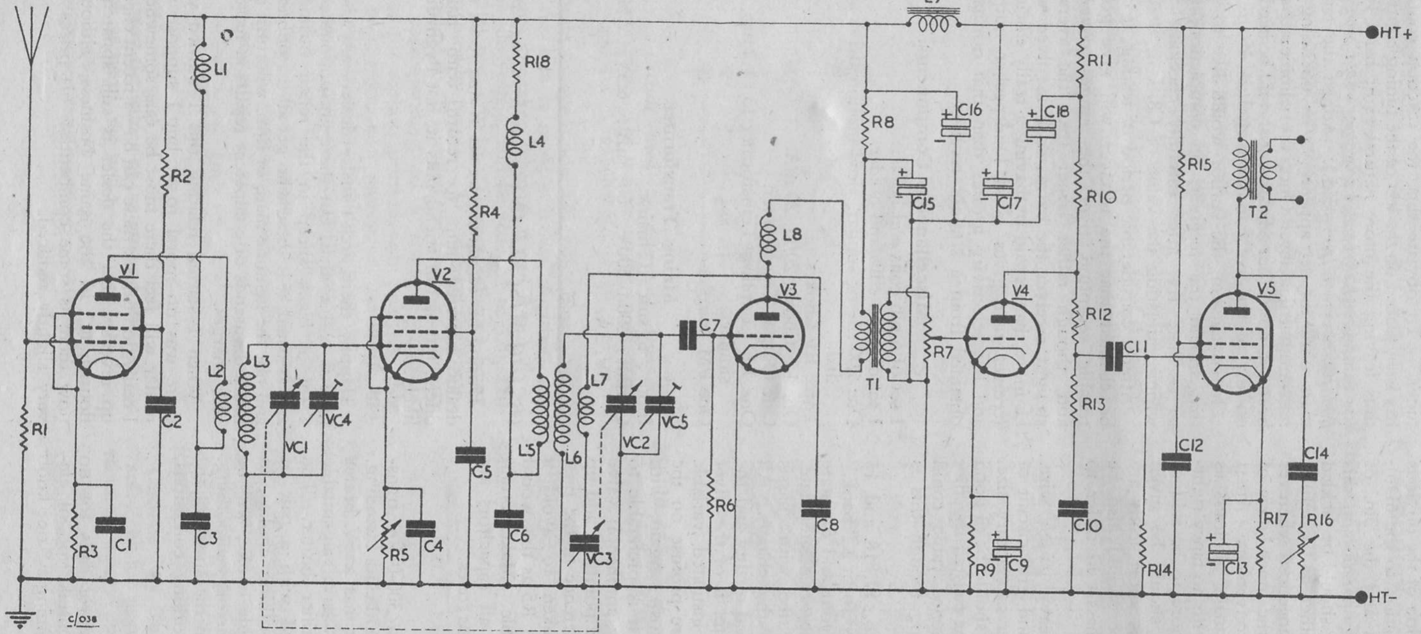
THE receiver about to be described is a 2-v-2 short waver, which covers the ranges from 1.8 to 33 Mcs. continuously, in five bands. The line up is EF50 untuned RF stage, transformer coupled to a 6D6 tuned RF stage, these two RF stages giving very satisfactory selectivity and a certain amount of gain. An RF gain control is included in the tuned RF stage and employs a 10,000 Ω potentiometer in the cathode circuit. The detector valve is a 6J5 used in cumulative grid circuit. The detector stage is transformer coupled to the first audio stage, another 6J5, and the potentiometer connected across the secondary of the coupling transformer acts as audio gain control. The first and audio output stages are resistance-capacitance coupled, the output valve being a 6F6 and which has a top cut tone control fitted.

The circuit used is quite straightforward insomuch as there are no unnecessary trimmings, though a point that will probably arouse some interest is the inclusion of an LF Choke between the LF and Detector stages. This choke was found to remove the last traces of hum from the detector output. Should this smoothing network be omitted, and the reaction control, VC3, adjusted to be just below oscillation point, the detector valve would start oscillating at 100 cps.—the frequency of the mains hum on full-wave rectification. This trouble may possibly be bearable, indeed almost unnoticeable, on, say, 3.5 Mcs., but when it comes to the 28 Mcs. band that is quite a different story and the hum would undoubtedly seriously affect DX listening.

Bass boosting is included in the first audio stage, the 6J5, but this could easily be left out; however, it was found to be most valuable in reducing the noise level of a signal and it is highly recommended to retain this feature.

Construction.

The receiver was built on an aluminium chassis, measuring 18in. x 12in. x 3in. The writer is one of those who like ample room to spread things around, though, for those who are keen on making things as small as possible, there is scope for considerable reduction in general dimensions. The panel consists of suitable plywood, backed with metal foil, and is fitted to the chassis by means of two ordinary shelf brackets—items easily purchasable at the local ironmongers.



LIST OF COMPONENTS.

Resistors.

R1 500,000 Ω
R2 100,000 Ω
R3 90 Ω
R4 250,000 Ω
R5 10,000 Ω pot.
R6 5 M Ω
R7 500,000 Ω pot.
R8 100,000 Ω
R9 1,000 Ω
R10 50,000 Ω
R11 30,000 Ω
R12 68,000 Ω
R13 22,000 Ω
R14 1 M Ω
R15 2,000 Ω
R16 10,000 Ω pot.
R17 5,000 Ω

Capacitors.

C1 0.01 μF
C2 0.1 μF
C3 0.1 μF
C4 0.01 μF
C5 0.1 μF
C6 0.1 μF
C7 150 μμF
C8 100 μμF
C9 12 μF, 12V wkg
C10 0.05 μF
C11 0.1 μF
C12 2 μF, 500V wkg.
C13 50 μF, 50V wkg
C14 0.02 μF, 550V wkg
C15, 16, 17, 18—8 μF, 500V wkg

N.B.—All capacitors, except where otherwise stated, are 350V wkg.

Variable Capacitors.

VC1 160 μμF
VC2 160 μμF
VC3 100 μμF
VC4, VC5 : Trimmers
N.B.—VC1 and VC2 are ganged.

Valves.

V1 EF50
V2 6D6
V3 6J5
V4 6J5
V5 6F6
V6 5Z4G

(*See page* 334 *for miscellaneous parts*).

All wiring, with the exception of the obvious ones (such as top grid connection to the 6D6), is carried out below chassis and the 3in. of sub-space allows comfortable operation in this direction. The heater wiring should be tackled first, twisting the leads together and carefully screening them from other connections wherever possible. Run them round the inner edges of the sub-chassis as far as convenient. Apart from a casual comment to make all leads as short and direct as possible, with no fancy right-angle bends, there is little more to be said of this stage. The RF stages should be given plenty of attention as far as short leads are concerned. The wiring here should also be kept well away from the chassis in order to avoid undue losses.

It is advisable to use heavy gauge wire, especially in the RF stages and grid circuit of the detector, 18 swg being a satisfactory size. The heater wiring, of course, should be of good quality twin flex, or single flex twisted together in pairs. Alternatively, screened cable could be used for the heater wiring though this is hardly necessary.

The capacitors C9, 13, 16, 17, 18 and 15 can all be grouped together to form a " bank." This will make for a tidy layout and facilitate checking if the necessity arises at a later date. These components can be fitted with chassis clips and thereby bolted to the chassis. All components should be of good quality and the grid capacitors would be better if of the silver mica variety. Use ceramic insulated variable for tuning—excellent ones are profuse on the " surplus " market at low cost. Again, with the RF and detector stages it is preferable to use ceramic (or good quality amphenol) valve and coil holders. These little points all add up and make an appreciable difference in the final results. Care should be taken to avoid a faulty and/or noisy resistor at R5 as this would give rise to all sorts of trouble. Make certain that the voltage ratings of all capacitors are adequate, particularly the bias ones.

Power Supply.

The HT is drawn from a 300-0-300 transformer, with a 6.3V, 2.5A, heater winding. The rectifier valve, a 5Z4G, has a 5V heater and the transformer must have a suitable winding to supply the rectifier heater. The rectified voltage is smoothed with a pair of 8 μF capacitors. Two smoothing chokes, in place of the more usual single choke, will be found to give very satisfactory smoothing. The actual voltage applied to the anode of the 6F6 output valve, under working conditions, is 275.

Operation.

The operation of the receiver calls for no special care, save for the observation of elementary points. Avoid becoming a " one knob tuner." To obviate this, the reaction control has been placed on the left of the tuning control, thus leaving the more natural right hand free for tuning. (*Left-handed operators would probably find the reverse better*!—Ed.). Adjust the trimmers until the set appears to be operating at maximum efficiency. Once the trimmers have been set, no further adjustment should be needed on any of the five bands covered.

In conclusion, the author would like to say that should the receiver, on completion, fail to oscillate try, after carefully checking the wiring, adjusting the value of C8.

After a considerable period of testing, it can be claimed that the receiver will give good reliable reception over the ranges covered and, though rather larger than the average straight receiver the extra work involved will be more than repaid by having a really efficient receiver that gives good loudspeaker output and has selectivity greater than that normally obtained from a straight receiver.

Miscellaneous Components.

1 set of 6-pin coils and holder.
1 set of 4-pin coils and holder.
One 200 : 1, or similar, slow motion drive and dial.
Three RF Chokes.
One LF Choke, 20 H, 20 mA.
One Output Transformer.
One LF Coupling Transformer (3 : 1 ratio, or similar).
One PM Speaker.

Mains Transformer.

Input : to suit AC mains.
Output : 300-0-300V, 60 mA ; 6.3V, 2.5A ; 5V, 3A.

(*RADIO MISCELLANY—cont. from page* 331)

During his remaining weeks in that town the dealer pestered him to return with rising offers, but as our friend puts it, not Pygmalion likely.

The Moral.

Happily there aren't many dealers anywhere near as bad as that, but there are undoubtedly a lot of black sheep in the repair business, and as usual, it is these who get all the publicity and not the genuine man, or firm, who turn out many thousands of competent repairs at reasonable charges.

When I started relating this I warned you there was no moral to it, but I suppose the reader will feel there must be one somewhere. I really don't think there can be—a recent check-up revealed that the dealer is still apparently flourishing, in the same business, although now there is some competition his prices are very slightly reduced.

The Theory of Thermionic Valves

By Kenneth R. Goodley

Part 5—Dynamic Characteristics—The Cathode Ray Tube—Time Bases

Dynamic Characteristics.

THE circuit in Fig. 9 shows a triode valve with a five thousand ohm resistor in the anode circuit. With 140V HT and —10V on the Grid, no current flows and the anode voltage is equal to the applied HT. This condition is represented by point A on the graph (Fig. 10). If the grid potential is made less negative until 2mA anode current is flowing the voltage drop across R, by Ohms Law, is :—

$$V = I \times R = \frac{2}{1{,}000} \times 5{,}000 = 10$$

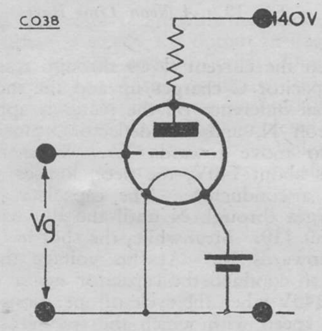


Fig. 9. Circuit used to determine Dynamic Characteristics. The resistor in the anode circuit is 5,000 Ω.

So anode voltage is now 130 (point B on graph).

If the bias is made still less negative, and readings are taken when 4, 6 and 8 mA flow, the anode voltage will be reduced to 120, 110 and 100 respectively. These conditions being represented by points C, D and E on the graph.

The line A—E is called the *Dynamic Characteristic*, corresponding to a load of 5,000 Ω. Except for a short portion near point A, this line is straight, and represents the range in which distortionless working is possible. The slope of the characteristic will depend on the value of R (note the 10,000 Ω line also shown on the graph). The slope will always be less than the gm, decreasing with increase in R.

The new slope is given by :—

$$gm^1 = \frac{gm}{1 + \frac{R}{Ra}}$$

Taking the values of the gm and Ra from the graph as usual, we find :—

$$Ra = \frac{\Delta Va}{\Delta Ia} = \frac{10}{1.6\,mA} = \frac{10{,}000}{1.6\ A} = 6{,}250\ \Omega$$

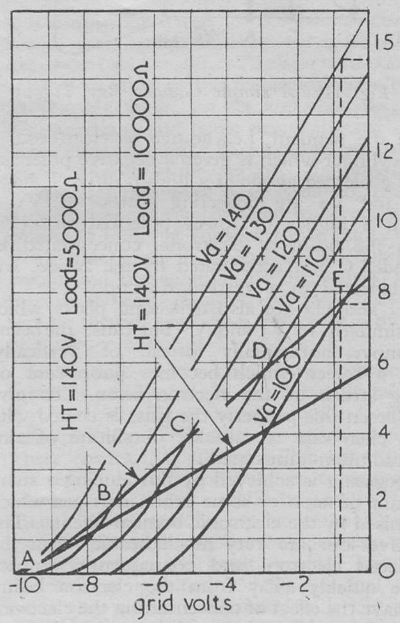


Fig. 10. Graph showing the Dynamic Characteristics of the circuit of Fig. 9.

$$gm = \frac{\Delta Ia}{\Delta Vg} = \frac{1.6}{.9} = 1.77\ mA/volts$$

So—

$$gm^1 = \frac{1.77}{1 + \frac{5{,}000}{6{,}250}} = \frac{1.77}{1.8} = .983\ mA/volts$$

It should be remembered that the Dynamic Characteristic is the characteristic of a *circuit* and not of the valve alone.

The Cathode Ray Tube.

The cathode ray tube is a type of thermionic valve which is used extensively in the laboratory, in Radar "indicators" and, of course, in television receivers.

Cathode Ray Tubes are of two types—the "soft" or gas focussing, and the "hard," or vacuum, tube.

Gas focussing tube : Fig. 11 shows the general arrangement of the electrodes.

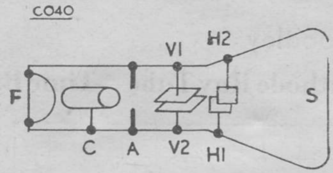


Fig. 11. A simple Cathode Ray Tube.

F is the filament, i.e., source of electrons. C is a cylinder which is given a negative potential. A is a pierced anode at a high positive voltage. V_1 and V_2 are deflecting plates. If V_1 is given a higher or lower potential than V_2, then the beam of electrons, concentrated by cylinder C and accellerated by the anode, will be deflected in a vertical direction.

H_1 and H_2 are also deflecting plates which act similarly to V_1 and V_2 but cause the beam. to move horizontally instead of vertically. S is a screen which becomes fluorescent on being struck by the electron beam. To give the screen this property the glass is coated with such chemicals as sulphide or silicate of zinc or cadmium tungstate.

Focussing is achieved by introducing a small amount of neon or some other inert gas which is ionised by the electronic bombardment. The positive ions are very much heavier than the displaced electrons and consequently do not move quickly away from the electron beam, but have the effect of concentrating the electrons at the centre of the beam, thus making the spot on the screen smaller and brighter.

The gas-focus tube has the disadvantage that if an alternating potential of high frequency is applied to the deflecting plates making the spot move rapidly to and fro, there is a definite tendency for the heavy positive ions not to follow the rapid voltage changes and so spoil the focus.

The Vacuum Type.

No gas is introduced into the tube, but two or three anodes are used, which when supplied with suitable voltages will focus the beam. While the focussing is not so good as in the soft tube, it permits higher frequencies to be used without any further deterioration.

Deflection.

Apart from the method already described, deflection is sometimes produced electro-magnetically.

This system necessitates the fitting of coils to the exterior of the tube. When currents flow through these coils, their magnetic fields will react with that of the electron beam causing a deflection.

Time Bases.

In many applications of the Cathode Ray Tube it is necessary to have a continuous horizontal sweep of the spot. This is termed the time base, and is obtained by applying an increasing DC voltage to the horizontal (or X) plates. This voltage is then removed as quickly as possible so that the spot immediately returns to its original position. Thus the voltage is of "saw-tooth" form. A simple circuit illustrating this principle is shown in Fig. 12.

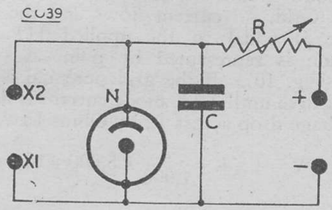


Fig. 12. A Neon Time Base.

When the current flows through resistor R, the capacitor C charges up and the increasing potential difference on the plates is applied to the neon N, and the deflectors, causing the spot to move towards X_2. When the PD reaches about 140V, the neon ionises and becomes a conductor. The capacitor partially discharges through N until the PD has fallen to about 110. Meahwhile, the spot has moved back towards X_1. At this voltage the neon ceases to conduct, the capacitor again charges up to 140V when the cycle of operations recurs.

The speed with which the spot crosses the screen can be controlled by making either R or C variable. An increase in either decreases the speed of the spot.

Fig. 13 shows a graph of the saw-tooth wave form produced by the Neon Time Base.

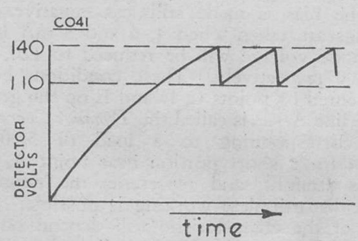


Fig. 13. Sawtooth produced by Neon Time Base.

Since a neon tube produces only a partial discharge of C, the sweep of the spot is limited, and in practice a gas-filled triode (*Thyratron*) is used. This produces a greater discharge of the capacitor and a correspondingly greater "sweep."

The necessary constant current to produce a linear increase in PD across C is provided by an RF Pentode.

Local Oscillators

A discussion of the practical design and aspects of heterodyne oscillators.

By L. F. Sinfield

MUCH has been written on the theoretical design of circuits in text books and magazines, but little has been said regarding practical design. One major cause of trouble in this respect is the heterodyne or local oscillator of the superheterodyne receiver. Due to coil design, valves, wiring, layout, switching and so forth, many defects occur in the constructed set which are impossible to predict in theory. Most other circuits appear to work out reasonably well in practice without modifications from the original theoretical design, though snags often occur when it comes to the local oscillator.

The important point with the local oscillator is to obtain a steady RF output of fixed amplitude, or within certain limits. Due to the wide coverage of the oscillator, this is not achieved until practical tests (and modifications) have been carried out on the completed receiver. The circuit of this stage is completed after the results of the practical tests—or should be!

Manufacturers of commercial receivers are fully aware of the importance of local oscillator design with respect to stable operation, freedom from parasitics, harmonics, peaks and dips, which result in whistles, dead-spots, squegging, feedback and so on. Much time is devoted by these firms on practical development. The writer of this article has been engaged on receiver design at various times and places and this opportunity is being taken of passing on details of practical tests which are within the capabilities of the average constructor. Most amateurs are very cautious when it comes to the local oscillator and merely build the set strictly to the theoretical circuit and if it works—it is just taken for granted that all is well. All he is concerned with is that it oscillates over the required ranges. If instability occurs, many constructors have no idea of the cause, the tests or the cure. It is hoped, therefore, that the following information will cast some considerable light on a subject which has been far too long sadly neglected.

Ailments.

How many constructors, when building a superhet, have trouble with whistles, dead-spots, squegging and similar complaints? A great number! Most of these faults can be traced to the design of the local oscillator circuit.

For perfect operation, this oscillator should have a constant amplitude output over each and every waveband. Due to unpredictable happenings, due to wiring, stray capacitances, valve characteristics and inter-coil coupling, it is almost impossible for the average constructor to design such an oscillator from a purely theoretical standpoint. The best method, therefore, is to advance the theoretical circuit as far as possible, build the set and then take some measurements and make practical tests. Then, modifications should be incorporated for optimum results. One point of importance even sets which have been designed, tried and proved cannot be guaranteed to be equal if the circuit is built by another constructor, due to small differences in wiring layout, component layout and the components themselves. Therefore, it is better to apply practical tests to all sets be they of your own design or a duplicate of someone elses.

In the case of sets which have been designed for mass-production, it will normally be found that anti-parasitic resistors, amplitude limiting resistors and other items have been incorporated. These ensure that all sets will behave more or less equally, with production tolerances. In this instance, it will usually be possible for the amateur to copy successfully, without practical tests on the oscillator, on the condition that he adheres rigidly to circuit, wiring, layout and materials as specified for the original model. Since this requisite information is not readily available, it is better to consider that the set just constructed is not an exact copy and apply tests and modify if required.

Grid Time Constant.

Almost the whole of the operation of the oscillator stage can be studied by breaking the grid leak at the "earthy" end and inserting a sensitive moving coil milliammeter with a FSD of around 1 mA. The oscillator grid passes current according to the amplitude of oscillation. This, of course, assumes that no DC bias is applied to the valve, the operating bias being obtained by the grid capacitor and resistor. By calculating from Ohms Law ($I \times R=V$) the current through the grid leak ($I \times R$) will determine the approximate peak voltage of the RF at the grid. The grid time constant should be relatively long compared with the frequency—values of 100 $\mu\mu$F and 50,000 Ω are about average. If trouble is experienced due to squegging on the higher frequency bands, it may be necessary to reduce the grid leak value, but this should not be reduced, if possible, below 22,000 Ω.

Using the normal triode-hexode or triode-heptode valves such as the 6K8, X65, ECH35 and 6J8, or separate triode oscillator with a hexode or heptode mixer such as a 6C5, 6J5 feeding a 6L7 or 6SA7, it can be reckoned that the average peak heterodyne voltage required for optimum mixing will be 10 volts (e.g., 200 μA through 50,000 Ω or 500 μA through 20,000 Ω). It will be found that this voltage can be considerably different from this and still give good mixing.

If the grid current appears to be excessive, however, it will shorten the life of the valve. On the other hand, if the grid current is too small, stable operation and good mixing will not be obtained. It is therefore recommended to try to keep that peak grid voltage between the limits of 5-15 volts over all bands and, if possible, arrange for the smallest variation over the tuning range of each band.

Using the Meter.

This meter method can be safely used at all frequencies up to some 60 Mcs., by which time the conventional values and circuits have usually been discarded anyway! Break the earthy end of the grid leak, open about ⅜in. so as not to disturb the wiring unduly and join in a short length of twisted flex. The other end of the flex should connect to the meter, which, incidentally, must be of low resistance compared with the grid leak (i.e., up to 500 Ω). The low meter resistance should prevent audio and hum pick-up from being fed via the grid lead, while the twisted leads have sufficient self-capacitance to by-pass RF pick-up. The earthy lead also has a shielding effect on the other. However, should trouble be experienced due to instability from the leads, a small RF by-pass capacitor can be mounted across the set ends. The flex lead must be kept clear from coils and wiring and preferably run out close to the chassis.

Current Readings.

The insertion of the meter, providing the above precautions are taken, will have no effect on oscillator operation. If the indicated current is too high, it should be reduced by inserting a suitable carbon resistor (¼ watt is sufficient) in series with the oscillator coupling coil of the range in use. This resistor is also very helpful in the prevention of harmonics, parasitics and peaks.

If the indicated current is too low, then the coupling between the windings of the oscillator coil must be increased, grid leak combination modified, HT on oscillator anode increased—in fact, anything that will have the effect of increasing the amplitude of oscillation.

Often, on tuning through the entire band, sharp peaks or drops will be noticed on the meter. Sometimes these are parasitics and it is a good plan to always fit a small resistor of some 33 Ω either at the grid pin or anode pin of the oscillator valve, preferably the grid. The ¼ watt carbon type should be used and the wire kept to an absolute minimum between the pin and the resistor body.

A more frequent cause of peaks or dips is due to adjacent coils being tuned by trimmer and stray capacitances and absorbing the oscillator voltage at that resonant frequency, thereby causing a dead spot in oscillator output and a "hole" in the tuning. This may be best overcome by arranging to short out all oscillator coils not in use. Failing that, short out all the tuned windings not being used. As a final resort, short out the tuned winding of the adjacent coil of *lower* frequency range. The latter, although usually effective, may not always cure the trouble.

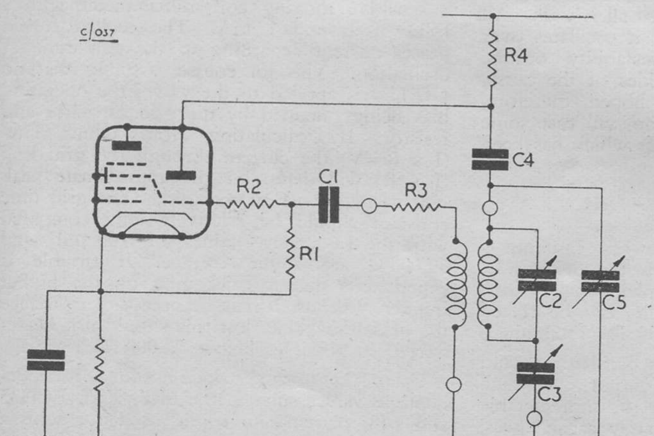
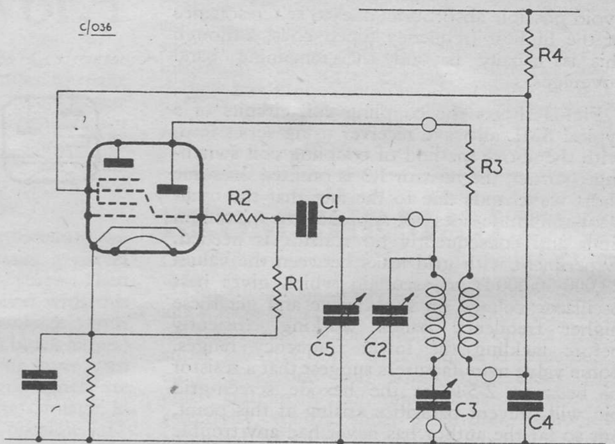


Fig. 1. The conventional series-fed circuit with self bias. Typical values are:—

C1 : 100 μμF, *silvered mica.*
C4 : 0.1 μF.
C5 : *Oscillator section of tuning gang.*
R1 : 50,000 Ω.

Fig. 2. The parallel-fed oscillator circuit. Values are:—

C1: 100 μμF, silvered mica.
C4: 100 μμF, silvered mica.
C5: Oscillator section of tuning gang.
R1: 50,000 Ω.
R4: 27,000 Ω (see text).



Iron dust-cored coils are better than air core for the above, since the field is more concentrated and so minimises interaction between coils. There is bound to be a change in indicated current over the tuning range of each waveband and providing that the minimum and maximum grid currents are not exceeded, and the change is gradual with no peaks or dips, no anxiety need be felt.

Stability and Coupling.

Having dealt with obtaining an even amplitude oscillator voltage, let us now consider oscillator circuits and how to increase stability and coupling. It will be assumed that the standard two-winding coils (which are now being manufactured for amateur construction) are to be used, in conjunction with a 6K8 type valve. Fig 1 illustrates the conventional series-fed circuit, with self bias and a small anti-parasitic stopper (R2). The tuned coil has a parallel trimmer (C2) for ganging at the high frequency end of the band, and a series capacitor C3 for ganging at the low frequency end.

The resistor R3 limits oscillator output amplitude and its value will depend on coil and circuit design, the value being determined by tests previously mentioned. The resistor R4 drops the HT voltage for the oscillator anode to the value specified for the valve (100 volts for the 6K8). C4 is for RF by-pass. Feedback of audio or hum via R4 may result in flutter due to the variation in oscillator anode voltage causing variation in oscillator frequency. This can be remedied by shunting C4 with an additional capacitance of 8 μF. It is specified * that in order to obtain the greatest stability in oscillator frequency, the hexode screens should be at the same voltage as the oscillator anode. In view of this, the screen grid has been connected to the junction of R4 and C4 instead of to a separate network. Further stability can be obtained by using a neon stabiliser valve across C4. The electrolytic would then not be necessary, although care must be taken to ensure a sufficiently high current through the neon for constant voltage. A VR105-30 type valve is particularly suitable. With additional RF decoupling, this stabilised supply could also be used for the screens of RF and IF stages and as HT for the BFO.

To increase the isolation between the injection electrode and the oscillator tuned circuit the oscillator anode is sometimes tuned. To keep the tuned circuit at earth potential, it is then usual to use parallel feed as shown in Fig. 2.

The circuit functions are the same as Fig. 1, except that R4 and C4 are different values, R4 now being the anode load and C4 a blocking capacitor. If R4 is too low in value, it may give an appreciable damping on the tuned circuit due to effective shunting. If R4 is too high, however, the drop across it due to anode current may cause anode voltage to be too low. An RF choke may be inserted in series with R4 to overcome these effects, but care must be taken to ensure that the choke is not self-resonant in the band used. Naturally, the hexode screen grid will require a separate network.

Another variation of the parallel feed circuit connects the earthy end of both coils together, the coupling coil now being taken to C3 instead of earth. As C3 is common to both, it gives increased coupling.

It is sometimes found that the wavechange switching on the coupling coils has the selector arm on the earthy side of the highest frequency coil so that on all lower frequency ranges this coupling winding acts as a small VHF choke in series with the other coils' coupling windings and aids in preventing parasitics. Care must sometimes be taken with this, however, to

* *Vide "Radio Designers' Handbook."*

avoid possible absorption due to self resonance of the highest frequency tuned coils, although this is usually beyond the remaining band coverages.

Fig. 3 shows the coupling coil circuits of a typical SML all-wave receiver using series feed, with the above method of coupling coil switching. Often, the resistor R3 is omitted on some short wavebands due to the fact that the oscillator amplitude does not approach the maximum limit and consequently no resistor is needed. Experiment with grid leaks between the values 22,000-50,000 Ω to ascertain which gives best oscillator voltage on short wave and get these higher frequency bands working efficiently before tackling the lower frequency ranges. Some valve manufacturers suggest that a resistor of between 2-5 Ω at the hexode screen-grid pin will prevent parasitics arising at this point, but so far the author has never had any trouble here and so has not needed to include them.

Only the main points have been dealt with in this article, but attention to those mentioned will give improved results which will repay the time and trouble involved on practical design and testing. Before leaving the subject, here are a few pointers on the mechanical side which are important when applied to short wave work :—

(*a*) Arrange the short wave coils nearest the wave-change switch so that the connecting leads are very short to these ranges. The inductance of the wire to the switch can be considerable when compared with the low coil inductance.

(*b*) Use heavy gauge wire, preferably 18 swg for short wave circuits.

(*c*) It is best to ignore the metal chassis as a conductor (if not of copper) and perform all earth bonding of RF circuits by means of heavy gauge copper wire or copper bonding braid.

(*d*) Keep all leads as short and direct as possible and arrange the component positions with the object in mind.

(*e*) Use silvered mica capacitors up to 0.01 μF, plain mica for values around 0.01 μF, and non-inductive paper types for values above 0.01 μF. The trimmers and padders should be stable and preferably ceramic mounted. The tuning capacitor should have ceramic insulation and have vanes of ample thickness and spacing.

(*f*) Resistors should be non-inductive, carbon and of adequate rating.

(*g*) Ample RF and AF decoupling and by-pass should be included.

(*h*) Supply voltages should be correct and stable.

(*i*) Valve holder and other components should have insulation most suitable for frequencies required.

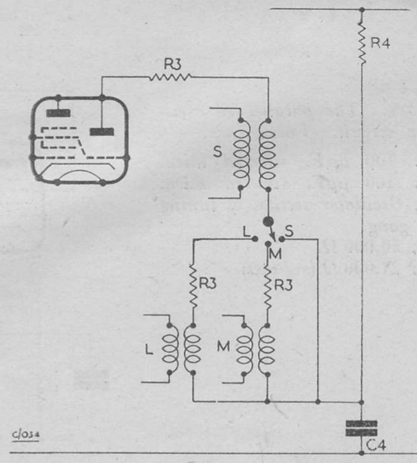


Fig. 3. The coupling coil circuit of a typical three-band receiver.

(*j*) Ample screening of the oscillator stage to be provided.

(*k*) If loudspeaker is to be mounted in the same cabinet, it should not be bolted direct to the chassis but to the cabinet. The tuning gang should have shock absorbent mounting ; or, alternatively, the entire RF and oscillator unit mounted on shock absorbers. This is to prevent the acoustic feedback vibrating the vanes of the oscillator capacitor and thereby causing frequency change and instability. An additional help in this direction is to have extra spacing in the oscillator section of the tuning gang. It is, of course, better to have a separate speaker as is the case in most modern communications type receivers.

TRADE NOTES

U.I.C. The United Insulator Company, Limited announce the appointment of an Area Distributor for Scotland : Louis Grace, 28, Langside Place, Glasgow, S.1. All U.I.C. distributors, of which there are now nine throughout the British Isles, carry full manufacturers' guarantee.

Goodmans. Goodmans Industries, Limited, of Lancelot Road, Wembley, wish to draw attention to their new telephone number, viz., Wembley 1200 (8 lines).

Modifying "Walkie Talkie" Receivers For Use On The Amateur Bands

Some notes on the conversion of these easily obtainable surplus receivers to the amateur frequencies.

By John Bratby

MANY of the Walkie Talkie receivers, which may be readily obtained on the "surplus" market, make a good buy for those who desire a good battery receiver for use on the amateur bands and who have some practical experience in construction.

The receivers now on the market may be classified into three distinct types and cover one band each, viz. : 160 metres is covered by the 68P set, the 68T and 68R sets will take care of the 3.5 Mcs. band whilst, as most readers will already know, the 18 set (either Mark 1, 2 or 3) will tune to the 7 Mcs. amateur band.

Though basically the same, the individual circuits of these sets vary slightly as regards components values and so forth. The valve line-up is, however, the same in each case. The circuit is a superhet and consists of the following stages : firstly, an untuned RF stage. This feeds into a pentode frequency-changer using a cathode injection oscillator. The next stage is a pentode IF amplifier. The resonance curve of this valve has a width of 7 kcs. with an average cut-off of 5 dB/kcs. The final valve is a double-diode-triode used in the conventional second detector/AVC/audio amplifier arrangement. It is of interest to note here that in the audio amplifier circuit, a Colpitts oscillator is incorporated which comes into operation when the audio gain control is set at maximum and this serves as a BFO for receiving CW signals.

The writer recently purchased a 68T receiver, in perfectly new condition, but when first put on test was found to be considerably lower in performance than was expected. At the HF and LF ends of the range covered (3.0—5.2 Mcs. in this case) selectivity was fairly high, but around 3.5—4.0 Mcs. (the frequencies required for the 3.5 Mcs. amateur band) the selectivity dropped off considerably. By altering the R.F. trimmer, below the chassis, the selectivity in the region of 3.5 Mcs. was peaked appreciably and was all that could be desired. In lining up (if necessary) the OSC. trimmer should not be touched as this will upset the calibration of the tuning dial.

The Audio Amplifier and BFO.

Having progressed so far, it was decided to work through the complete circuit and modify, alter, or remove, any circuit not functioning perfectly. Modification began at the audio amplifier. The conclusion had been arrived at that this stage, with its BFO arrangement, could be much more efficient. The snag was that the BFO was in operation with the LF gain control set at maximum with the result that full volume could not be obtained on 'phone signals—a distinct disadvantage when hunting for DX stations on 'phone. It was decided, therefore, to modify the audio stage from its original form (see Fig. 1) to that shown in the complete circuit diagram shown in Fig. 2. The modified circuit had the advantage of giving more gain over the original stage, but it is fair to state that it had the disadvantage of being depleted of a BFO. Since lack of space on the chassis prevented a separate BFO circuit being

BINDING FOR VOL. 1

Many regular readers of *Radio Constructor* will wish to bind their copies in order to make a convenient bound book of the first volume Accordingly, we have made arrangements for binding volumes by our good friend J. R. Dunne, who, as readers will know, has made such a good job of the last two volumes of our companion journal *Short Wave News*.

For those unfamiliar with the procedure we repeat it herewith: first of all, make a parcel of the twelve copies for the year. Then enclose a copy of the index, supplied with this issue. Also enclose in the package your name and address (clearly written in block letters) and a P.O. to cover the cost. For your own benefit, make certain that the magazines are well packed and protected against damage in the mail—use corrugated card if possible.

If, by any chance, your copy this month did not contain an index sheet, we have a few spare copies. Just send along a S.A.E. and we will post you another one.

To those who have not seen the bound volumes of *Short Wave News*, it should be stated that the magazines are bound in a stiff board covering with the name and volume number printed on the front cover and down the spline.

Just one point—some prefer to retain the covers, some like the covers removed. When sending your copies, it should be clearly stated which you prefer. If no preference is stated then the covers will be automatically taken off for binding.

That about covers all the points, with the exception of the cost. This is 8/- post-paid. Your magazines, etc., should be posted to the following address :—

J. R. Dunne,
19, Helmsdale Road,
Streatham, London,
S.W.16

TRADE REVIEW

QSL Cards.

We have received samples of some very attractive SWL cards from Messrs. Wood's of 11, The Butts, Worcester. The cards sent us are those used by several members of the ISWL in Worcester and show the cathedral in the centre and the city heraldry above the circular block of the cathedral. The cards are printed in three colours and are large enough to accommodate quite a large amount of data. We understand from Messrs. Wood's that similar cards for members residing in other cities and towns, and showing appropriate half-tone illustrations, are obtainable. The price of these cards is £5 per 1,000. Though this firm is specialising in the designs mentioned, we are informed that QSL or SWL cards of any design would be undertaken. Enquiries will be promptly dealt with and samples sent on request.

FROM THE MAILBAG

Dear Sirs,

One thing that all short wave and radio magazines have in common is that they fight shy of home-built communication receivers (i.e., super selective jobs with double IF channels, etc.). Everyone will admit that today the chief call in a communications receiver is selectivity, yet the short wave press (who are supposed to be right on top) go on placidly with descriptions of indifferent receivers.

Yours faithfully,

T. J. Evans (Monmounth)

(In our defence, we offer a few comments. Firstly, a highly selective 10*-valve communications receiver was described in the "Short Wave News," Vol.* 1, *No.* 3., *and another communications receiver will appear in the next issue of this magazine. Secondly, such receivers are not everyone's "meat"—it is probably a true axiom that the constructors who are capable enough to tackle an elaborate multi-valve receiver have sufficient technical knowledge to design their own circuit. However, we do recognise that a section of our readership is interested in such designs and it is this reason why the receiver is to appear next month. Finally, it is only fair to say that before such an article can appear in print, the receiver must first be built and then written-up. We find that the designers are very reluctant to take up the pen and if we do not get the articles they cannot appear in print! Perhaps Mr. Evans would oblige?* —Ed.).

Dear OM's,

E. J. Clarke expresses the same sentiments as myself. Here we are constructing RX gear with ceramic and polystyrene fittings and finish up by using a valve with a base made of coal dust and tin tacks—or its equivalent! If it is so important to fit high RF insulation, why is it that the Services got down to 80 Mcs. on the RF27 Unit on moulded bakelite formers? The only valves I know of that were fitted with a low loss base were those manufactured pre-war by the original *Hivac* company, i.e., types D210, SW220, etc.

Best wishes,

F. T. A. Randall, G530 (*Barnet*).

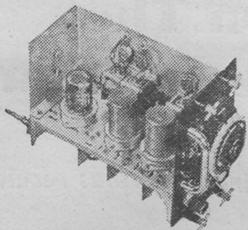
(Also, we would like to add, on certain service gear, EF50's were used, with paxolin valve bases, for operation on as high a frequency as 200 *Mcs.*—Ed.).

E • The Radioman's Shop •
ICES ELECTRONIC EQUIPMENT

BRAND NEW IN MAKER'S CARTON. EX-R.A.F.
5 and 6 METRE OPERATION

THE FAMOUS R.F. UNIT, TYPE 26

Variable tuned from 65-50 Mcs. 5-6 Metres.



R.F. UNIT 27

Variable tuned from 85-65 Mcs. 3.5-5 Metres.

These units enable any mains set that tunes to 40 Metres (7 Mcs.) to be simply converted to a 5 and 6 Metre Receiver. See S.W. Mag. for May. S.W. Listener for July.

With three valves, 2/VR136 (EF54), VR137 (EC52), SM drive capacitors, etc., in metal case, 9½in. x 7½in. x 4¾in. Power supplies required, HT 250v., LT 6.3v.

CLYDESDALE'S PRICE ONLY **35/-** each. Post Paid

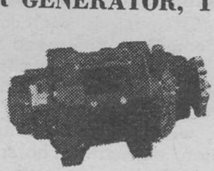
JFS6E. 6-way Jones type Socket, with cable entry cover. For RF Units 24, 25, 26, 27, R1481, R1132, etc.

CLYDESDALE'S PRICE ONLY **3/6** each. Post Paid

6 for 17/6. 12 for 30/-.

BRAND NEW IN MAKER'S CARTONS.

MOTOR GENERATOR, TYPE 29



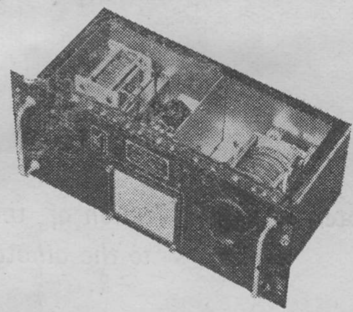
Input 24 volts, 16 amps. Output 1,200 volts, 200 mA. Dimensions 11in. x 5½in. x 5½in. Can be simply connected as a Mains Motor for 200-250 volts, AC or DC. A 1in. shaft is available for driving, when the fan is removed. Very useful for light bench work. Data sheet supplied with each unit.

CLYDESDALE'S PRICE ONLY **25/-** Post Paid

NEW—UNUSED.

TRANSMITTER TUNING UNITS

FOR THAT "TRANSITION VFO UNIT."



Each having Vernier tuning dial. Variable capacitors. Tank coil unit on Ceramic Former, Ceramic Switch, RF Chokes, etc., in metal cabinet 17½in. x 7½in. x 8in., finish black. TU5B. 1,500-3,000 kcs.
TU6B. 3,000-4,500 kcs.

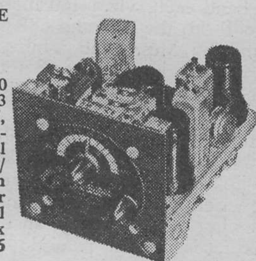
CLYDESDALE'S PRICE ONLY **25/-** each. Carriage Paid

TU 8B. 6,200- 7,700 kcs.
TU 9B. 7,700-10,000 kcs.
TU26B. 200- 500 kcs.

CLYDESDALE'S PRICE ONLY **19/6** each. Carriage Paid

BRAND NEW—6 VALVE

BEACON RECEIVER B.C. 1206B



A midget superhet for 200-400 kcs., with 4 metal 6.3 valves, 6SA7, 6SF7, 6SK7, 6K7, in series for 24v. miniature 3-gang capacitor, dial and knob, V/Control, W/Switch, IF Trans., provision for output and Rectifier Valves on chassis. In metal case. Size only 5¼in. x 4½in. x 4¼in. With 2/25L6 in output stage.

CLYDESDALE'S PRICE ONLY **37/6** each. Post Paid

NEW—UNUSED.

BEACON RECEIVER B.C. 1206B

Exactly as above, but with glass tubes.

CLYDESDALE'S PRICE ONLY **27/6** each. Post Paid

2 BRIDGE STREET, GLASGOW, C.5

'Phone : SOUTH 2706/9

VISIT OUR BRANCHES IN SCOTLAND, ENGLAND AND NORTHERN IRELAND

Modifying "Walkie Talkie" Receivers For Use On The Amateur Bands

Some notes on the conversion of these easily obtainable surplus receivers to the amateur frequencies.

By John Bratby

MANY of the Walkie Talkie receivers, which may be readily obtained on the "surplus" market, make a good buy for those who desire a good battery receiver for use on the amateur bands and who have some practical experience in construction.

The receivers now on the market may be classified into three distinct types and cover one band each, viz. : 160 metres is covered by the 68P set, the 68T and 68R sets will take care of the 3.5 Mcs. band whilst, as most readers will already know, the 18 set (either Mark 1, 2 or 3) will tune to the 7 Mcs. amateur band.

Though basically the same, the individual circuits of these sets vary slightly as regards components values and so forth. The valve line-up is, however, the same in each case. The circuit is a superhet and consists of the following stages : firstly, an untuned RF stage. This feeds into a pentode frequency-changer using a cathode injection oscillator. The next stage is a pentode IF amplifier. The resonance curve of this valve has a width of 7 kcs. with an average cut-off of 5 dB/kcs. The final valve is a double-diode-triode used in the conventional second detector/AVC/audio amplifier arrangement. It is of interest to note here that in the audio amplifier circuit, a Colpitts oscillator is incorporated which comes into operation when the audio gain control is set at maximum and this serves as a BFO for receiving CW signals.

The writer recently purchased a 68T receiver, in perfectly new condition, but when first put on test was found to be considerably lower in performance than was expected. At the HF and LF ends of the range covered (3.0—5.2 Mcs. in this case) selectivity was fairly high, but around 3.5—4.0 Mcs. (the frequencies required for the 3.5 Mcs. amateur band) the selectivity dropped off considerably. By altering the R.F. trimmer, below the chassis, the selectivity in the region of 3.5 Mcs. was peaked appreciably and was all that could be desired. In lining up (if necessary) the OSC. trimmer should not be touched as this will upset the calibration of the tuning dial.

The Audio Amplifier and BFO.

Having progressed so far, it was decided to work through the complete circuit and modify, alter, or remove, any circuit not functioning perfectly. Modification began at the audio amplifier. The conclusion had been arrived at that this stage, with its BFO arrangement, could be much more efficient. The snag was that the BFO was in operation with the LF gain control set at maximum with the result that full volume could not be obtained on 'phone signals—a distinct disadvantage when hunting for DX stations on 'phone. It was decided, therefore, to modify the audio stage from its original form (see Fig. 1) to that shown in the complete circuit diagram shown in Fig. 2. The modified circuit had the advantage of giving more gain over the original stage, but it is fair to state that it had the disadvantage of being depleted of a BFO. Since lack of space on the chassis prevented a separate BFO circuit being

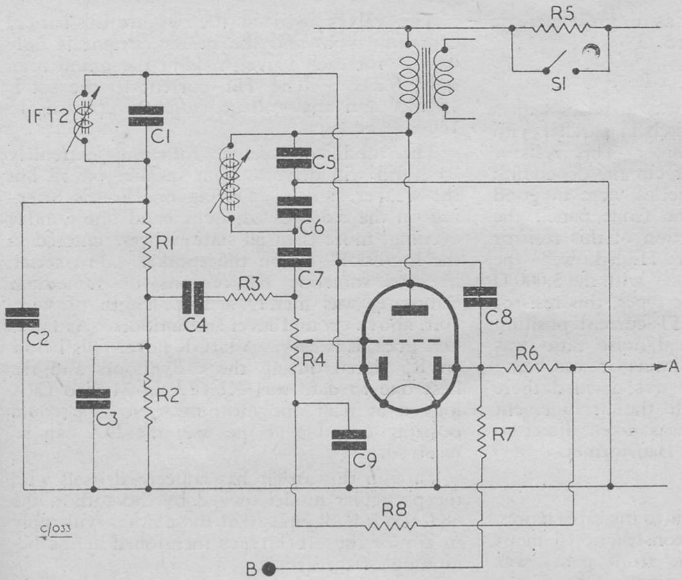


Fig. 1. The original audio amplifier stage of the Walkie Talkie. The modified circuit is shown with the full circuit of Fig. 2. The double-diode-triode is a type AR8, which has a civilian counterpart in the HL23DD.

incorporated, two methods had to be chosen from: (1) A 50,000 potentiometer between the IF screen grid by-pass capacitor and earth, or (2) a piece of wire from the grid cap of V3, the IF amplifier "poked" into the can of its following IF transformer.

Method (1) was attempted, but proved to be unsuccessful due to the IF screen grid being fed and decoupled by the same dropping resistor and by-pass capacitor as the RF valve. The result was that the receiver became extremely unstable when operating on CW. Therefore, method (2) was resorted to and, fortunately, proved very successful. The lead from the grid of the IF amplifier was taken via a switch to the following IF transformer, thereby providing the requisite BFO on/off control. Care should be taken that there is no capacitative coupling between the two wires going to the switch and, if possible, they should be carried out with screened cable. If these precautions are not taken, instability may easily result (when listening to 'phone transmissions).

Experiments are now being carried out using a *Denco* Maxi-Q BFO Unit on a separate chassis and this refinement will doubtlesss be incorporated in the near future.

The AVC.

The set, being fitted with AVC and there being no AVC on/off switch, it was decided to instal one forthwith. On breaking the AVC circuit, however, it was discovered that without any AVC applied the readability of signals was increased although the signal strength stayed the same and fading was no more pronounced. Therefore, the entire AVC circuit was removed. On doing this, the earthy end of the first IF transformer was taken straight down to earth and the grid of the RF valve taken to earth through a 1 Meg Ω resistor.

The IF and Frequency Changer.

The IF amplifier appeared to be working quite satisfactorily and consequently this stage and its associated circuits were not modified in any way.

Since the Frequency Changer circuit is a rather unusual one, no modifications were undertaken there either. Leave well alone!

The RF Stage.

A plunge was taken to improve the RF stage but after trying various refinements it was de-

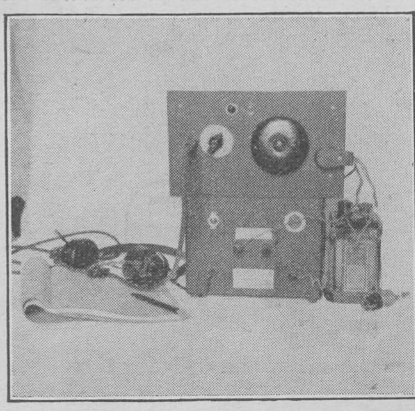


Fig. 2. The modified Walkie Talkie is seen in this photograph resting atop the "surplus" power unit. With the new panel and slow motion drive the unit takes on a pleasing-looking appearance.

cided to suspend operations as no great increase of efficiency could be effected.

The HT Supply.

The HT positive supply was in series with a single-pole single-throw switch in parallel with which was a 5,000 Ω resistor. This resistor could be used in or out of circuit, depending upon whether the HT batteries were in good or poor condition. On the front panel, the switch controlling the insertion of this resistor is labelled "HT Current High-Low," the current naturally being "Low" with the 5,000 Ω resistor in circuit. (In some types, this resistor is 4,700 Ω). On the low HT current position it was found that the signal/noise ratio was slightly better, but as an eliminator was being used for the HT supply it was decided there and then to dispense with the arrangement altogether. The HT lead was taken direct to one end of the headphone transformer.

Constructional Points.

Having modified the circuit to my satisfaction, it was thought that a few constructional items would be undertaken. The front panel was soon removed and a black crackle one of the same size substituted. Provision on the panel of a five-pin plug to take in the power supply leads proved a great convenience. A slow motion dial was substituted for the 6 : 1 ratio drive originally on the receiver, this modification providing ample "spread" and ease of tuning on the 3.5 Mcs. band. Extra bandspread is not really necessary.

As only one pair of 'phones in use at one time is anticipated the double headphone jack originally on the panel was removed; being replaced by a normal single jack. The two switches now on the panel control BFO and LT, the HT switch being on the HT power unit in use. (The latter, by the way, is an ex-RAF unit, giving 120V at 30 mA).

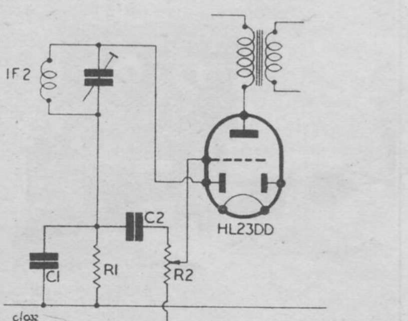


Fig. 3. Showing the alternative audio stage Values are:—

C1 : 100 $\mu\mu F$. *R1* : 100,000 Ω
C2 : 0.05 μF *R2* : 500,000 Ω

The valves used in the set are all battery economy types and the heater current is only 0.05 A for each valve, making the grand total only 0.2 A. The HT current to the set is 15 mA and any voltage from 90 upwards to 150 can be used.

The modified receiver functions extremely well and will drive a 2½in. speaker on all but the weaker signals. During one hour's listening on the 3.5 Mcs. amateur band one Sunday evening, more than 50 stations were entered in the log-book—all on the speaker. The aerial, in case someone has visions of something elaborate, was merely a 15ft. length of wire, 10ft. above ground level and indoors. As far as DX goes, it is easy. VE1GR never falls below an R5 signal during the early hours and the best one to date was XE1PA in Mexico City, logged at 6.30 one morning. No one could possibly grumble at the way the DX can be received.

Though this article has concerned itself with the particular model owned by the author, the 68T set, it is obvious that these notes will apply to any of the other types mentioned at the beginning of the article.

Footnote.

Since the preparation of this article, various other refinements have been tried out, including a new circuit for the LF stage and the provision of a valve-voltmeter as modulation indicator. The LF circuit gives more gain over the existing stage but accentuates the base rather than "top." This is a distinct disadvantage on communications work. For the benefit of any reader wishing to try this new LF circuit it is shown in Fig. 3.

TO INTENDING AUTHORS

We invite contributions on any subject likely to be of interest to readers of this journal. Top on the priority list are AC/DC gear, small amplifiers, small transmitters and AC receivers. Also, we are in particular need of descriptions appertaining to the conversion of surplus gear. It is hoped to include one such article with each issue and to attain this we want more contributions. On hand are articles dealing with the various RF Units, the 37 Oscillator, the R109 receiver and so forth. Before commencing work on any MSS, please drop us a postcard to make sure that your article will not clash with anything in preparation. Also, we would be pleased to send anyone our standard reference sheet which outlines the style, preferred terms and similar items that we like to adhere to. These leaflets also contain much in the way of hints and tips on writing articles. Any offers?

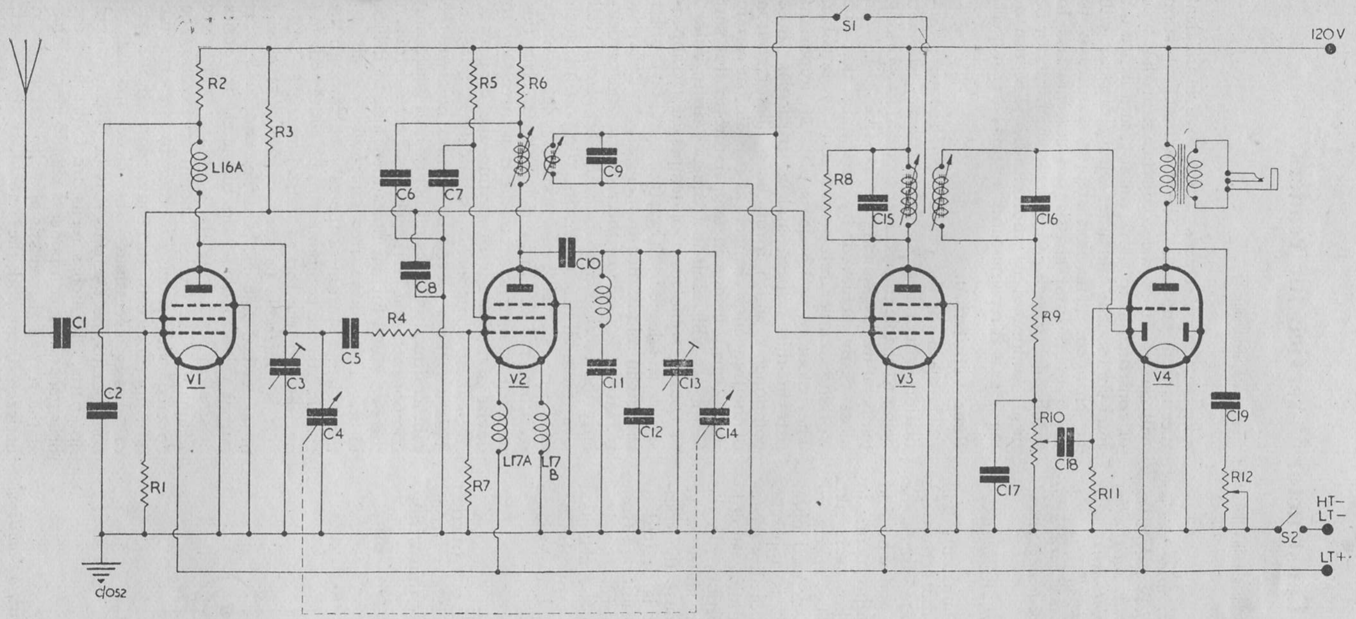


Fig. 2. The complete circuit diagram of the Walkie Talkie as now in use.

Resistors.

R1	1 M Ω
R2	1,000 Ω
R3	50,000 Ω
R4	8 Ω
R5	70,000 Ω
R6	1,000 Ω
R7	500,000 Ω
R8	500,000 Ω
R9	50,000 Ω
R10	500,000 Ω
R11	1 M Ω
R12	50,000 Ω

Capacitors.

C1	100 μμF
C2	0.1 μF
C3	15 μμF
C4, C14	125 μμF (ganged)
C5	100 μμF
C6	0.1 μF
C7	0.1 μF
C8	0.1 μF
C9	90 μμF
C10	80 μμF
C11	0.005 μF
C12	20 μμF
C13	15 μμF
C15	130 μμF
C16	140 μμF
C17	100 μμF
C18	0.02 μF
C19	0.1 μF

Valves.

	Service.	*Civilian.*
V1	ARP12	VP23
V2	ARP12	VP23
V3	ARP12	VP23
V4	AR8	HL23DD

Query Corner

A "Radio Constructor" service for readers

Frequency Instability.

"I recently constructed a communication receiver to a design taken from an American publication, the results proved to be extremely satisfactory but for one fault, the tuning point drifts after quite a short period of time. This effect is most annoying when listening on a crowded band as it means the frequent adjustment of the tuning control. Can you please suggest a cure?"

D. Brent, Richmond.

There is no doubt that most amateurs will at one time or another have come across the effects of frequency drift. There are some who are chronic knob twiddlers, and who find pleasure in making continual adjustments to the tuning dial. The majority, however, take steps to avoid the trouble. The effects of frequency drift are two-fold and depend upon the type of receiver in which it is apparent. In the receiver designed for high quality reception the effect of the signal becoming slightly detuned is generally severe distortion. In the receiver primarily intended for short wave operation frequency drift may cause the complete loss of the signal which it is desired to receive, and any distortion resulting from detuning is of secondary importance.

Causes of frequency drift may be classified under three headings, Poor Mechanical Construction, Poor Ventilation, and Bad Voltage Regulation.

Poor Mechanical Construction.

By this we mean the type of construction in which comparatively large and heavy components are supported by relatively thin wiring, and the use of screens which have insufficient mechanical support. The slightest vibration will cause one of the components in this type of construction to move slightly, and hence the inter-component and inter-wiring capacity will be changed. The first step, therefore, is to use a good stout chassis and screens, and to firmly anchor each component which cannot be firmly supported by short leads. The use of tag boards is recommended in this latter respect.

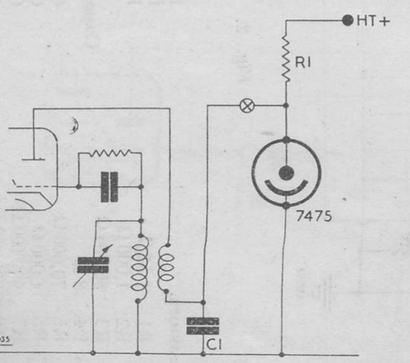


Fig. 1. Typical local oscillator with a stabilised anode voltage supply.

Poor Ventilation.

The need for the provision of adequate ventilation cannot be too highly stressed, the aim being to enable the receiver to attain its working temperature as quickly as possible. This is most easily achieved by arranging that the working temperature is as low as possible. The layout of components plays an important part in this respect, and in particular those components which form the oscillator section of the frequency changer, as it is almost certain that a small change in temperature in this part of the set will result in frequency drift; unless, of course, some form of temperature compensation is adopted. Therefore, the first point to bear in mind when deciding upon the layout is that the RF side of the receiver, and particularly the local oscillator should be placed well away from all heat generating components, such as the output valve, the rectifier, high wattage resistors, and the mains transformer. But this in itself is insufficient; and it is necessary to devise some means of getting the heat away from these components as quickly as possible. This may be achieved by cutting holes in the cabinet directly above and below heat generating components, and if the chassis comes between the two holes, further holes must also be drilled in it. This allows free circulation of air up through the bottom of the cabinet, through the chassis past the component to be ventilated, and out through the top of the cabinet.

It is preferable to keep the holes as closely in a vertical line as possible. For a 9 watt output valve a hole of 1in. diameter, or a series of small holes having the same area will prove adequate. The holes should preferably be covered with gauze in order to preserve the neat appearance of the equipment. If the size of chassis necessitates the close spacing of components, heat screens may be placed around hot parts. If such screens are to be used the heat generating components should be mounted at the rear of the chassis and the screen placed between them and the remainder of the set. Adequate ventilation should be provided by drilling holes in the back of the cabinet. The heat screens should consist of brightly polished metal and extend to the top of the cabinet. It is normal to enclose RF valves in screening cans which also act as funnels, thus conducting the heat away from the components immediately associated with the valves. It is wise always to place heat generating components above the chassis and all those upon which heat adversely affects their stability should be placed under the chassis.

Bad Voltage Regulation.

The stability of a receiver is adversely affected by changes in the supply voltage as such a change results in a proportional change in the voltage supply to the valves, which in turn cause a variation in their input capacity and input damping. Unless extremely high orders of stability are required it is normal to consider only the voltage supply to the oscillator section of the frequency changer, as it is this voltage which has the greatest effect upon frequency stability. Figure 1 shows a typical local oscillator with a stabilised anode supply voltage. A suitable neon stabiliser for this application is the Mullard 7475 which has a working voltage of approximately 100 V. The resistor R1 drops the HT voltage to this value whilst the capacitor C1 shunts any RF which might otherwise find its way on to the HT line. Should the local oscillator require less than 100 volts for its normal operation an extra dropping resistor may be included at the point marked "X."

As a general rule, in order to obtain maximum stability the oscillator valve should have a high mutual conductance and should be loosely coupled to its tuned circuit. Also the use of damping resistors, as might be employed to prevent parasitic oscillation should, if possible, be avoided.

Microphony.

"A short wave straight receiver which I recently constructed suffers from microphony, which generally builds up to a continuous howl just at the moment when I have the set working at maximum sensitivity. I have tried replacing the detector valve but with little improvement. Can you suggest further possible cures for the trouble?"

K. J. Powell, Enfield.

Microphony is a particularly annoying form of trouble which is frequently encountered in short wave receivers. It is a form of instability set up by the mechanical vibration of some component, or part of a component such as the grid of a valve. In a straight receiver the trouble can normally be tracked down to the detector stage and in some cases to the RF stage, and it is frequently found that the valve is the faulty component. The vibrations which cause the microphony to commence usually emanate from the loud speaker, and may be conducted to the receiver by the cabinet or bench upon which the two are situated. However, in very severe cases microphony may be set up by sound waves impinging upon the faulty component. Battery valves, because of the difficulty of providing adequate support for their very thin filaments, are one of the main causes of microphony. However, in the less severe cases a great improvement may be obtained by mounting the valve holder on rubber grommets to prevent any vibrations transmitted via the chassis from being passed on to the valve. Further improvement may also be effected by enclosing the valve in a screening can and then packing the can lightly with cotton wool.

So far only the valves have been considered, but they are certainly not the only source of microphony, as it is frequently found that the worst culprit is the tuning capacitor the vanes of which may vibrate when subjected to slight mechanical shock. This produces the same type of howl as does the valve, and the cure is similar. The whole of the capacitor and tuning dial assembly should be mounted on sponge rubber blocks and care should be taken that no rigid connection is made between the assembly and the main chassis. If only the capacitor is mounted on rubber the use of a very flexible drive coupling is essential. It will, of course, be necessary to make a good electrical earth connection to the capacitor and a tag is usually provided for this purpose. In some commercial receivers a sub-chassis containing the RF valves, coils and tuning condenser assembly is mounted on the main chassis, by means of sponge rubber blocks. As the sub-chassis is light compared to the main chassis this scheme is normally quite effective and one which can be readily recommended to anyone contemplating the design of the larger type of receiver.

"Query Corner" Rules

(1) A nominal fee of 1/- will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with the more general interest will be reproduced in these pages each month.

Radio Simplified

Part 4. By A. J. Duley

IN an earlier article we found out the way that rectification was achieved by means of the diode valve. From this start, let us look more closely into valves and their working.

The Triode.

This type of valve has an extra electrode to the diode, this is known as the grid and it is in fact an open mesh electrode placed between the anode and filament. Let us go over the action of the diode and then see how the grid affects the working.

In the diode the cathode is a hot wire emitting electrons, negatively charged particles of matter, that are practically weightless. The negatively charged electrons are attracted to the anode, to which a positive voltage is applied. A current flows from the cathode to the anode (the conventional flow of current is in opposition to electron flow). Current will only flow when the anode is positive, as the negatively charged electrons are not attracted to the anode unless it is positively charged with respect to the cathode. If we insert a fine meshed grid in the space between the anode and filament, or cathode, we can control the flow of the electron stream, this being done by altering the charge on the grid. There exists between the anode and filament a cloud of electrons known as the space charge, and the anode voltage must be great enough to counteract the effect of this space charge on the electrons leaving the filament, since these electrons have the same charge as the space charge the electrons are repelled by this space charge. By varying the potential on the grid the space charge can be modified instead of by the anode voltage alone. The grid, being an open electrode, only stops a very few of the electrons, and when the grid potential is negative, there is no attraction of electrons to the grid. If the grid becomes positive, electrons are attracted to it and there appears a grid current. If the grid voltage is varied, the anode current alters in sympathy, and any resistance in the anode circuit (known as the load) has a voltage developed across it. The design of the valve is such that the load has a large voltage developed across it, and in this way the valve amplifies.

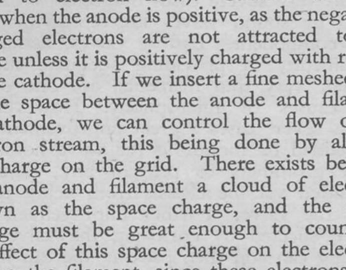


Fig. 1. Characteristic Curve, showing grid input and its relation to anode output.

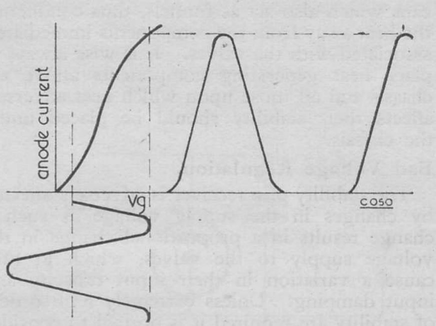


Fig. 2. Biassing diagram for Class "B" amplification.

Mutual Conductance=gm.

This is the ratio of change in anode current to change of grid volts, and is expressed as milliamps/volt. This means that if the anode current rises by 12 mA whilst the grid voltage changes 3 volts, the "slope" of the valve as it is called, is 4 milliamps/volt.

Amplification Factor=μ.

One method of keeping the anode current constant when the grid voltage is altered, is to alter the anode voltage, a more negative grid—the anode voltage will need to be raised, and *vice versa*. The ratio of these changes, that is, change of anode volts/grid volts to keep the current constant, is the amplification factor.

Impedance=Ra.

This is a value of the AC resistance of the valve, and is given by:—

$$\frac{\text{amplification factor } (\mu)}{\text{mutual conductance (gm)}} = \text{Impedance (Ra)}$$

The Osram ML4 is listed as follows:—

gm=4.2, Ra=2,860, μ=12.

now $\text{Ra} = \frac{\mu}{\text{gm}}$ or does it?

$2,860 = \frac{12}{4.2} = 2.86$—why the difference ¿

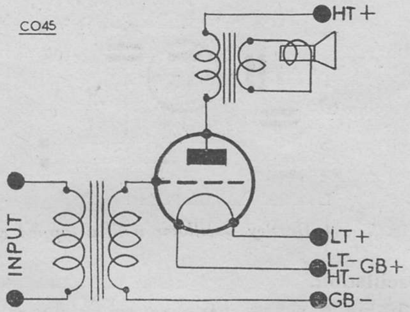


Fig. 3. Circuit diagram for Class "A" amplification.

Mutual conductance is measure in mA per volt, and so for calculation we must divide the mutual conductance by 1,000 to get the figure in amps.

Stage Gain.

The gain of a stage is given by :—

$$\frac{\mu \text{ x external load}}{\text{Ra} + \text{external load}}$$

The ML4 once again has an optimum load (from the makers' tables) of 7,000 Ω. Using the values as before, the stage gain is given by :—

$$\frac{12 \text{ x } 7{,}000}{7{,}000 + 2{,}860} = \frac{84{,}000}{9{,}860} = 8.5$$

If the external load was halved, say, we get—

$$\frac{12 \text{ x } 3{,}500}{3{,}500 + 2{,}860} = \frac{41{,}000}{6{,}860} = 6.0$$

which is much lower. It will be seen that the greater the anode load the greater the amplification—to a point—then the valve becomes starved owing to the potential on the electrodes being too low. This is the reason that makers publish the figure for optimum load. The grid and anode of a valve act as two normal pieces of material, and when an alternating voltage is applied to the grid, a large voltage appears across the anode load, but the grid and anode also act as a condenser so that some of the voltage returns to the grid, this feedback being worst at high frequencies, and as a general valve for HF work, the screen grid valve was introduced. In this valve a grid is included between the control grid and the anode, which is connected to a lower potential than the anode. There exists in this valve a capacity between the anode and the screen and the screen and the control grid. This capacity is much lower than that which exists in the triode.

The pentode was developed, because of a characteristic "kink" which occurs when the anode potential is at a lower level than the screen in the screen grid valve. This occurs because the electrons removed from the anode by bombardment of the filament stream, are attracted back to the screen, which is at higher potential than the anode.

In the pentode, a grid known as the suppressor grid is placed between the screen and anode. This grid is connected to earth, which means that the nearest body to the anode is at earth potential, hence the electrons are repelled back on to the anode.

Beam tetrodes are different from any other valve in the fact that the grids are arranged with the meshes in line, and the electron stream is focussed on to the anode by means of metal plates.

The result of this construction is that the screen current of this type of valve is only a fraction of that of a pentode. The following illustration will probably suffice :—

Osram W21, vari-mu pentode : anode current = 3.6 mA ; screen current = 1.2 mA, so that

$$\frac{\text{screen current}}{\text{anode current}} = \frac{1.2}{3.6} = 33 \text{ per cent.}$$

Osram VS24, vari-mu tetrode : anode current = 4.5 mA ; screen current = 0.5mA so that—

$$\frac{\text{screen current}}{\text{anode current}} = \frac{0.5}{4.5} = 11 \text{ per cent.}$$

This type of valve is used for both RF and AF amplifiers, and its use is very common in both roles in commercial sets.

Operation.

If we take a set of readings of anode current for a valve, keeping the anode voltage constant, and altering the grid bias voltage, we get a graph as is shown in Fig. 1, a typical set of results is given below :—

Grid Bias voltage :	0	—1	—2	—3	—4
Anode current :	0.22	0.15	0.07	0.03	0.005

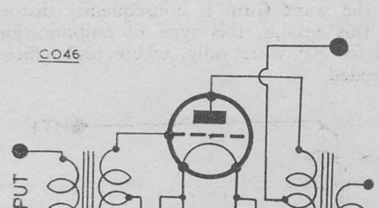


Fig. 4. Circuit diagram for Class "B" amplification.

This curve is known as the Characteristic Curve of the valve, and if we bias the valve in the centre of the straight part of the curve, any small variation in the grid voltage due to the signal will be amplified in the anode circuit as shown in Fig. 1 by the dotted lines. As this part of the curve is straight, no distortion will take place. This position of operating is known as Class A operation.

The point at which the anode current ceases is known as cut-off, and in the above case the cut-off would appear at just over —6 volts grid bias. Fig. 2 shows the biassing diagram for a type of amplification known as Class B. In this type of amplification, it will be seen that only one half of the signal is amplified, hence two valves are used. Circuit diagrams for both Class A and Class B amplification are given in Figs. 3 and 4 respectively.

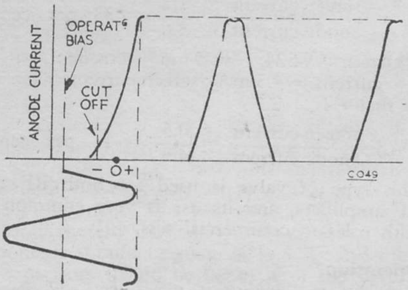


Fig. 5. Biassing diagram for Class "C" amplification.

The system known as Class C amplification is shown diagrammatically in Fig. 4, and the anode current—grid bias curve is shown in Fig. 5. In this system, the entire curve is used, twice the cut-off bias being applied to the valve. The grid is positive at a portion of each cycle and the wave form is consequently distorted. For this reason, this type of amplification is used for RF work only, where high efficiency is needed.

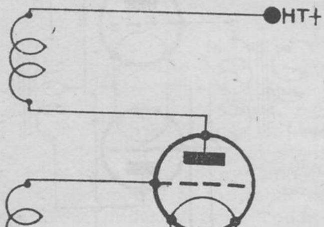


Fig. 6. The circuit of a simple oscillator.

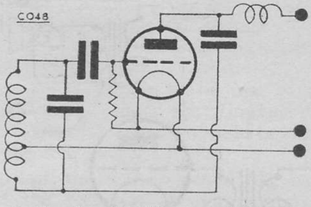


Fig. 7. A Hartley Oscillator with a tapped coil.

Oscillation.

In Fig. 6, we see that a coupling coil is taken from the anode circuit, and placed so that the anode circuit is coupled to the grid circuit. When this happens, and the phasing between the anode and grid circuits is correct, the valve will oscillate. Tuning of the oscillation can be accomplished by altering the frequency of either anode or grid circuits. Several types of oscillating circuits are in common use: the Hartley, shown in Fig. 7, and the Franklin, shown in Fig. 8 give some idea of the variance that exists in many amateur type oscillators.

When an oscillator is tuned to a definite frequency, odd things such as rise in temperature of resistors, vibration of condenser vanes, changes in electrode voltages, all tend to make the frequency drift, and to remedy this, some stabilising equipment is necessary. This usually takes the form of a quartz crystal. A slab of this material is held between two copper plates, and an electrical impulse will cause the crystal to vibrate, the frequency of the vibration depending on the thickness to which the crystal is ground. For very close control, the crystal is enclosed in an oven, the temperature of which is kept constant by means of a thermostat.

The Franklin oscillator is suited to amateur construction because of its simplicity, and this type of circuit eliminates the use of a crystal. From Fig. 8, it will be seen that the circuit is essentially that of a two-valve amplifier, the output of which is fed back to the input via a capacitor. The circuit LC governs the frequency at which the valve line-up operates. The values of the two condensers must be

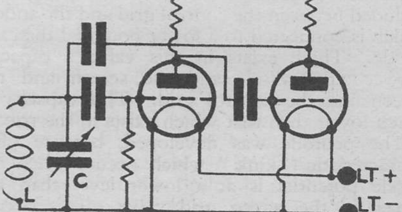


Fig. 8. The Franklin Oscillator.

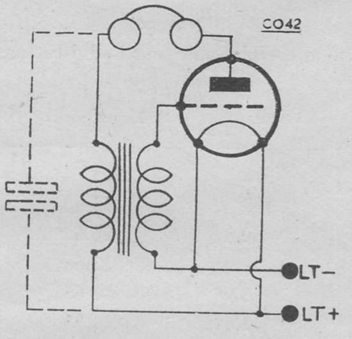


Fig. 9. The LF Oscillator.

very low, orders of 5 $\mu\mu$F are often used, and the circuit components must be rigidly mounted if stability is to be maintained.

Having gone through these fundamental ideas, let us see where the various types of circuits are met.

The Audio-Frequency Oscillator.

This is probably the most simple piece of equipment that can be constructed, as it can be made with just a triode valve and an ordinary inter-valve transformer, the circuit is shown in Fig. 9. The transformer is used to provide feedback between grid and anode and reversal of the connections to one transformer winding may be necessary to provide correct phasing. The circuit may be broken in the 'phone leads, and the oscillator used for morse practise, otherwise a continuous note is emitted, the frequency of which may be varied by connecting a condenser as shown by the dotted lines. The circuit shown works from a single battery, but a normal HT/LT circuit may be used.

Reaction Circuit.

The circuit shown in Fig. 10 is one often met in " straight " detector circuits, the action is as follows. Suppose that the point A is at a negative potential, caused by the connection of the HT lead producing a magnetic field in the reaction coil, and this inducing a voltage in opposition in the grid coil. With A negative the current in the valve begins to drop off, and the current in the reaction coil starts to drop, and a positive potential is induced at point A. This causes the current in the valve to increase and the process is reversed again.

In the next article, we will look into the difference between superhet and straight receivers, and the types of valve used in superhet work.

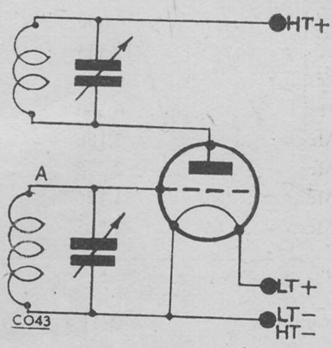


Fig. 10. A "straight" reaction circuit.

EUREKA RESISTANCE WIRE CHART

S.W.G.	Diameter in inches.	Turns per inch.	Inches per ohm.	Ohms per yard.	Ohms per lb.
10	.128	8	692	.05	.35
12	.104	10	450	.08	.80
14	.08	12	268	.13	2.3
16	.064	15	174	.21	5.6
18	.048	20	97	.37	17.8
20	.036	26.5	55	.66	56.2
22	.028	34	33	1.10	153.6
24	.022	42.5	20.3	1.77	403
26	.018	51	13.7	2.64	900
28	.014	62	9.2	3.91	1,970
30	.012	75	6.5	5.57	4,000
32	.010	85	4.9	7.25	6,950
34	.009	100	3.6	10.12	13,174
36	.007	120	2.4	14.84	28,308
38	.006	150	1.5	23.80	72,856
40	.005	190	.98	37.18	177,744

REACTANCE TABLES

Reactances of Capacitances (Xc) and Inductances (XL) at useful Audio and Radio Frequencies.

Xc in Ohms at	2 μF	4 μF	8 μF	12 μF	16 μF
50 cs.	1,592	796	398	265	199
100 cs.	796	398	199	133	99.5
500 cs.	159	79.6	39.8	26.5	20
1 kcs....	79.6	39.8	19.9	13.3	10
5 kcs....	15.9	7.96	3.98	2.65	2
10 kcs....	7.96	3.98	1.99	1.33	1

Xc in Ohms at	10 μμF	25 μμF	50 μμF	75 μμF	100 μμF
100 kcs.	159,000	63,600	31,800	21,200	15,900
450 kcs.	35,333	14,133	7,066	4,711	3,533
1,600 kcs.	9,960	3,984	1,992	1,328	996
2,500 kcs.	6,360	2,544	1,272	848	636
5 Mcs.	3,180	1,272	636	424	318
7 Mcs.	2,272	908	454	303	227
14 Mcs.	1,136	454	227	151	113.6
20 Mcs.	795	318	159	106	79.5

XL in Ohms at	2 H	4 H	6 H	8 H	10 H
50 cs.	628	1,256	1,884	2,512	3,140
100 cs.	1,256	2,512	3,768	5,024	6,280
500 cs.	6,280	12,560	18,840	25,120	31,400
1 kcs.	12,560	25,120	37,680	50,240	62,800
5 kcs.	62,800	125,600	188,400	251,200	314,000
10 kcs.	125,600	251,200	376,800	502,400	628,000

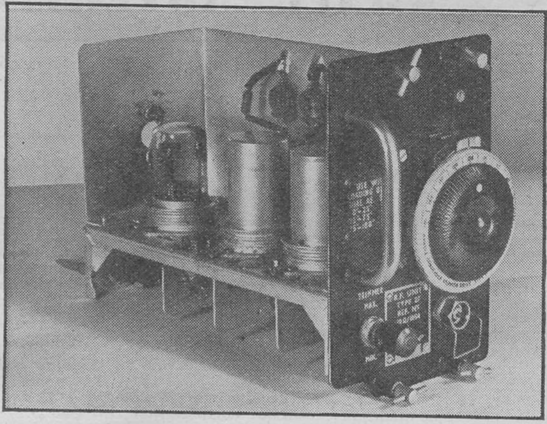
XL in Ohms at	20 μH	40 μH	60 μH	80 μH	100 μH
100 kcs.	12.5	25	37.7	50.3	62.8
450 kcs.	56.5	113	179.5	226	282
1,600 kcs.	200	400	600	800	1,000
2,500 kcs.	314	628	942	1,256	1,570
5 Mcs.	628	1,256	1,884	2,512	3,140
7 Mcs.	879	1,758	2,637	3,516	4,495
14 Mcs.	1,758	3,516	5,374	7,032	8,790
20 Mcs.	2,512	5,024	7,536	10,048	12,560

Component Review

•

R.F. Units

•



WE have received, from Messrs. Universal Electrical Instruments Corporation (138, Grays Inn Road, London, W.C.1), samples of the now famous series of RF Units, viz.: RF24, 25, 26 and 27. The receipt of these samples prompted us to write a review of them since many readers, particularly those outside of large towns, may still be a little hazy on exactly what these units consist of and what their applications are.

In all the units, the valve sequence is the same, that is RF stage, Mixer stage and Oscillator. In the 24 and 25 Units the valves are all VR65's whilst in the other two Units the valves are VR137 (Oscillator) and VR136's. The approximate frequency coverages of the Units are as follows:—

RF24—15-30 Mcs.	RF26—50-65 Mcs.
RF25—40-50 Mcs.	RF27—65-85 Mcs.

The main difference between the various units, apart from frequency coverage, is that the 24 and 25 Units have a 5-position switch for "spot" frequencies, whilst the 26 and 27 have a 3in. slow motion drive incorporated. It will be seen, then, that the latter units form a convenient method of extending the range of one's existing receiver and that with suitable modifications the 24 and 25 units can also be adapted for use as VHF converters.

The overall dimensions of the RF Units are 4¼in. x 6in. x 9½in., so that they certainly make a compact addition to the shack equipment. The only controls and terminals are (1) the slow motion drive or switched capacitors; (2) aerial terminal; (3) aerial trimmer; (4) power supply—at rear. The models supplied with a slow motion drive have a plug-in dial lamp holder attached.

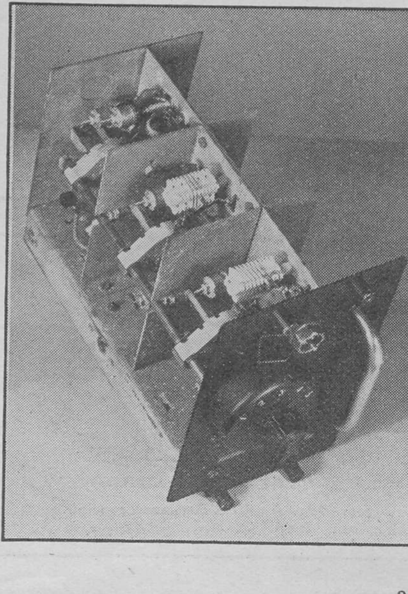
Of the actual components, little need be said, apart from the observation that they appear to be of the usual high grade associated with ex-WD gear.

For those wishing to use these units as VHF converters, it should be noted that the IF output is 7.7 Mcs. This output, and power supplies (6.3V, 1.8A, and 250V), is taken from the "Jones' Plug" at rear of chassis. When coupled to the existing receiver it is necessary, of course, to tune the receiver to approximately 7.7 Mcs.

Messrs. U.E.I. state that all these models are obtainable, in slightly used or in brand new condition.

For those who feel they need guidance in the conversion of these units, we would like to take this opportunity of mentioning that articles on the subject will be appearing in the pages of *Radio Constructor* in the near future.

W.N.S.



SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 3d. per word, minimum charge 3/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 1/6 will be made. Terms: Cash with order. All copy must be in hand by the 10th of the month for insertion in the following month's issue.

PRIVATE

SALE. Switch units, three switches in bakelite box Panel mounting, $3\frac{3}{8}$ x $1\frac{1}{4}$in. slot. 1/- each. Insulated covered terminal blocks, two-way, large, $2\frac{1}{4}$ x $1\frac{1}{4}$ x $1\frac{1}{2}$in., 2/6 doz. Small: $1\frac{3}{8}$ x 1 x $\frac{3}{4}$in., 1/9 doz. Spring biassed key switches, four makes, four breaks, 9d. each. 2in. rotary beam element stand-off insulators, to fit $\frac{1}{2}$in. rods, 2/- doz. Valves: Type 53, 59, 46, 47, 210, 83, ACHL and SP61's, 4/- each. 12J5, 1852 and 6SG7, 6/6 each. Meters: Ferranti 0-10v. AC., £1. 0-200 mA RF, 5/-. 20K 100w. resistors, 5/-. $3\frac{1}{2}$in. Celestion speaker in mike stand, 15/-. 4 mfd. 1,500v. wkg capacitors, 5/6. 2 x 4v., 3a fil. trans. high voltage insulation, 14/6. 200 mA, 10H., choke, 7/6. Selection large ceramic stand-offs; SAE for details:—Ben Raithby, G8GI, School House, Helpringham, Sleaford, Lincs.

SALE. Valves to clear: EF50, VR136, VT105, VT52, VR53, VR54, VR55, VR57, VR116, VR99A, HL22, Pen. A4, Pen. B4, MH4, at 2/6 each. 7Q7, 7R7, PT15, VS110, 4074A, 6L7, 6Q7G, 6SN7, 12E1, at 3/6. Pair 801's, 10/-. Transformers: 750-0-750v. 250 mA with 4v. 3A winding, 43/- c.p. 300-0-300v. 150 mA, with two 4v. 3A fil., 10/-. 600-0-600v. 250 mA, with 4v. 2A, 4v. 6A, 4v. 3A, and 4v. 4A, all c.t., 30/-. 4v. 3A c.t., 4/6. 5in. speaker in b.c. cabinet, 10/-. Large G.P.O. type brass key, 5/-. 4 mfd., 1,000v. d.c. wkg capacitors, 5/-. 2 mfd. ditto, 2/6. Cyldon .0001 split stator, 5/-. Ditto single section, 2/6. "Stonehaven," Horncastle Road, Boston, Lincs.

TRADE

COPPER WIRE. Enamelled, Tinned, Cotton, Silk-covered. All gauges. Screws, nuts, washers, soldering tags, eyelets. Ebonite and laminated Bakelite panels. Coil formers. Covered wires, earphones, etc. List S.A.E. Post Radio Supplies, 33, Bourne Gardens, London, E.4

VALVES—10,000 in stock. Most types available. Send for valve list, enclosing S.A.E.: Ransom, Bond Street, Brighton.

SMITH FOR RADIO. All types of components supplied. "Q" Coils, Valves, Transformers, etc. Quick Service. Send for requirements C.W.O. or C.O.D. Send stamp for list.—98, West End Road, Morecambe.

QSL's and G.P.O. Approved Log Books. Samples free.—Atkinson Bros., Printers, Elland.

FLASH!

AMAZING NEWS. At last we can supply the well-known Eddystone "640" Communications Receiver at the very low price of £27/10/0. Brand New and fully guaranteed for 12 months. Hire-purchase terms are available. Write NOW—Southern Radio and Electrical Supplies, 85, Fisherton Street, Salisbury, Wilts.

★

We have the finest stock of British and American radio books in this country.

Write or call for complete list—

THE MODERN BOOK COMPANY (Dept.RC)

19-23 Praed Street, London, W.2

"You'll probably get it at

Smith's of Edgware Road"

The Book on how to make it,
The Material to make it with,
The Components to put in it,
The Equipment to test it with,
The Cabinet to put it in.
(AND a fair deal!)

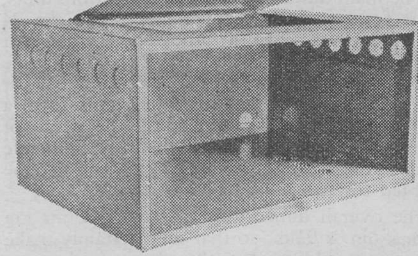
H. L. SMITH & CO. LTD.

287-9 EDGWARE ROAD, LONDON, W.2

Near Edgware Road Met. and Bakerloo
Phone PAD. 5891 :: Hours 9-6 (Thurs. 1 o/c.

METAL WORK

with a Difference !



This is an example of gear which can be made to YOUR OWN dimensions and layout.

For full details and address of nearest agent, contact—

L. J. PHILPOTT (G4BI)

(E. J. PHILPOTT)

Chapman St., Loughborough Tel.2864
Leics.