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The
RADIO Constructor

FOR THE RADIO AND TELEVISION ENTHUSIAST

VOLUME 9 NUMBER 5 DECEMBER 1955

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by
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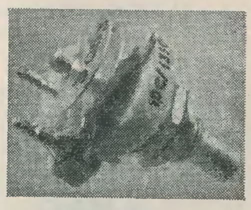

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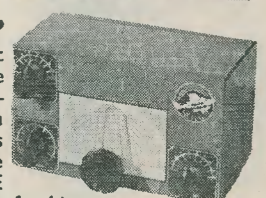

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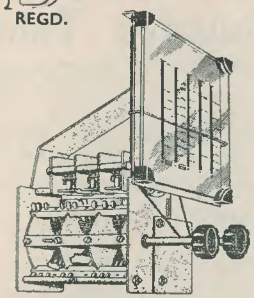

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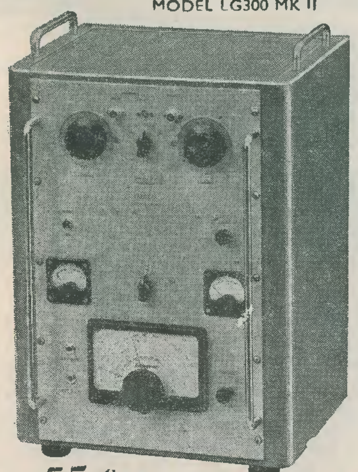

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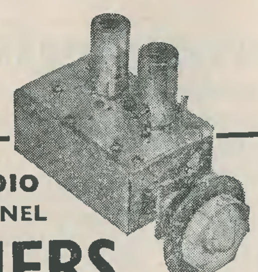

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CONTENTS FOR DECEMBER

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THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included.

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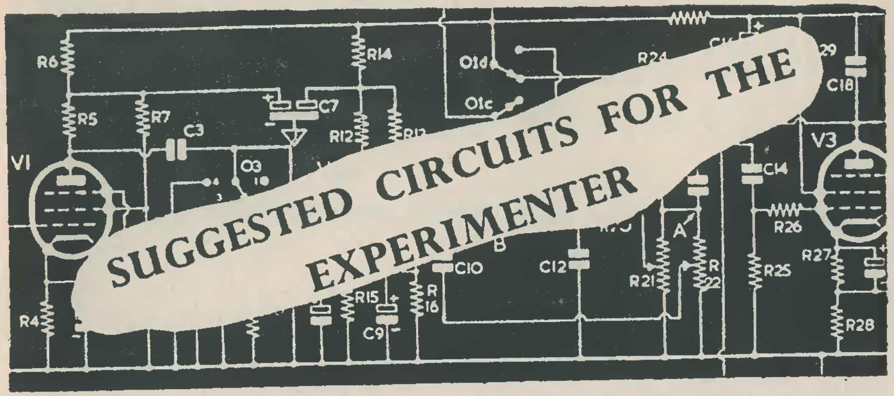

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No. 61. A 60-SECOND KILLER FOR COMMERCIAL TV

THE PUBLIC HAS, IN THE PAST MONTH OR two, had the opportunity of judging the quality of the entertainment made available by the new Commercial television transmissions on Channel 9. At the time of writing, the average viewer's opinion appears to be that the new programmes are well produced and compare very favourably with those transmitted by the B.B.C. On the other hand, whilst the advertisements introduced by the Independant Television Authority were, at their inception, something of a novelty, these are now becoming decidedly unwelcome. A particular irritation is given by the insertion of advertisements into plays. Such irritation is due to the fact that these advertisements tend to disrupt continuity and distract the viewer's mind from the theme of the performance.

It is because of these points that the present Suggested Circuit is now introduced. The purpose of the device described in this month's article is to effectively switch out the televisor during the time that an advertisement is being broadcast. After the completion of the advertisement the televisor then returns to normal operation.

The Circuit

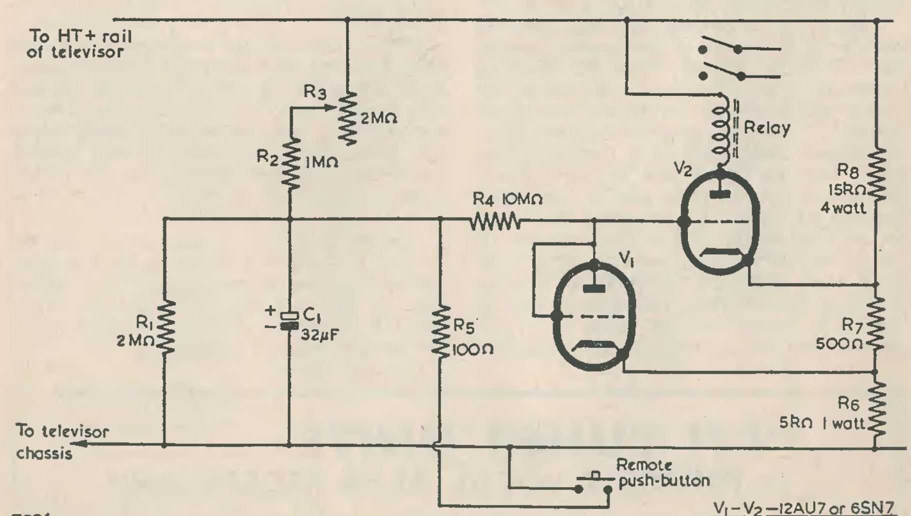
The device is, in effect, nothing more than a very simple electronic timer. It takes advantage of the fact that I.T.A. advertisements always have a duration of a minute, or of multiples of one minute. To operate the device, a button is pressed at the commencement of an advertisement period, whereupon the televisor becomes inoperative until a minute has passed. Should further advertising material appear when the televisor resumes operation, the button is pressed once more, resulting in another sixty seconds free from plugs.

The circuit employed is illustrated in the accompanying diagram. The components in this diagram which affect the duration of the timing cycle are C_1, R_1, R_2 and R_3. C_1 is discharged by pressing the push-button at the commencement of a timing cycle. It then charges up to a predetermined voltage by means of the current flowing through R_2 and R_3. The rate of charge and, hence, the length of the timing period, is controllable by means of the variable resistor R_3. The resistor R_1 is included to prevent the voltage across C_1 from rising to too high a level.

The voltage across C_1 is applied to the grid of V_2 via the 10M Ω resistor R_4. Assuming a 200 volt h.t. rail, the cathode of V_2 is held positive at approximately 55 volts, with respect to chassis, by means of the potential divider R_6, R_7 and R_8. When C_1 is discharged V_2 does not, therefore, conduct. However, when, during a timing cycle, the voltage across C_1 becomes sufficiently high to overcome the delay voltage on the cathode of V_2, this valve conducts; thereby energising the relay connected in its anode circuit.

Since the voltage across C_1 rises to a higher level than that existing between V_2 cathode and chassis, a limiting arrangement is provided by R_4 and the diode-connected triode V_1. The cathode of V_1 has a positive potential 5 volts lower than that at the cathode of V_2. In consequence, the effective diode given by V_1 conducts whenever the voltage at the grid of V_2 becomes less than 5 volts negative with respect to that at its cathode. V_2 cannot, therefore, pass an excessive anode current.

The circuit is intended to obtain its h.t. power from that available in the televisor with which it is to be used. Any available rail voltage between 160 and 240 should give satisfactory results. Current drain at 200 volts will lie between 10mA when the relay is de-energised, and some 13 to 15mA when the relay is energised. The heater supply for the double-triode V_1, V_2 may be obtained from the televisor, or from a separate heater transformer.



E236

Choice of Components

The cycle of operations in the circuit is initiated by pressing the remote push-button. This discharges C_1 via R_5; the purpose of the latter component being to limit the initial discharge current. V_2 ceases to conduct and the relay de-energises, thereby switching out the televisor. As soon as the push-button is released, C_1 commences to recharge, causing V_2 to conduct after a period of time. The relay then becomes energised, and the televisor once more comes into operation.

It will be seen that the success of the timing operation depends upon the delay circuit provided by C_1, R_1, R_2 and R_3. Also, as the timing cycle has to occupy a minute, relatively large values of capacity and resistance are required. For an inexpensive design an electrolytic condenser is obviously called for; even though this is liable to raise complications of its own. Such complications are due to the fact that the capacity of an electrolytic condenser varies according to the voltage across its terminals, and that a condenser of this type has an inherent leakage current. The question of the effective capacity of C_1 is dealt with in greater detail later.

Further complications are introduced by the fact that the relay becomes energised only after V_2 passes sufficient current. However, the anode current passed by V_2 is liable to increase somewhat gradually as soon as the negative potential on its grid, with respect to cathode, falls below the cut-off point. Again, as soon as anode current commences to appear, cathode current begins to flow through R_6 and R_7, raising the positive potential at the cathode of V_2. Because of these points, it can be seen that, although the relay is expected to energise when a certain current passes through its windings, this current may be attained during a gradual increase (after C_1 has a sufficient charge) and not by means of an abrupt increase. The final accuracy of the timing period, therefore, relies upon the ability of the relay to energise at a given current for each operation.

Since it would be bad practice to expect too high a degree of accuracy from the relay in this respect, steps are taken elsewhere to cause the current flowing through its windings to increase as abruptly as possible near the end of the timing cycle. Thus, R_1, R_2, and R_3 are chosen such that the final, charged, voltage across C_1 lies between some 75 to 100 volts (assuming a 200 volt h.t. rail). In consequence of this, when the potential across C_1 approaches the 40 to 45 volts needed to make V_2 initially conduct, this potential is rising at a relatively high rate. To reduce the derogatory effect of the rise in current through R_6 and R_7 as V_2 commences to conduct, the potentiometer R_6, R_7 and R_8 passes a steady current considerably heavier than that which should be needed to operate the relay. These small, but very important points of design should be sufficient to make the device largely independent of the possibly varying current needed to energise the relay.

Finally, to overcome the difficulties of calculating the values of components needed for the timing circuit when the charging condenser is an electrolytic component, the writer decided that his best plan would consist of checking commercial electrolytic condensers empirically in a functional circuit. This was done with several different condensers, and in each case it was found possible to control the charging time comfortably by means of the circuit shown. It should be emphasised, however, that if the condenser employed at the C_1 position possesses a low leakage resistance it may be necessary to increase the value of R_1, or even to remove it from circuit altogether. Such a course was not found necessary with the condensers checked by the writer.

Switching Circuits

Space does not allow a detailed description of the circuits which are switched by the relay. Normally, these should be quite straightforward and capable of application by the home constructor.

To provide an example, one set of contacts, preferably changeover, could be employed for muting the loudspeaker. These would disconnect the speaker from the output transformer, connecting a low-value resistor in its place.

The vision circuits could be rendered inoperative by biasing back the c.r.t. when the relay contacts are in the de-energised position. The circuit required would depend upon the type of modulation employed and could most conveniently be applied to the brilliance network. It would probably be inadvisable for an inexperienced constructor to experiment here.

Alternatively, the whole televisor could be rendered inoperative by a single set of contacts. These could function, say, by switching out the h.t. to the oscillator or, even, just by shorting the aerial coaxial input connections.

Final Points

Before concluding, it should be stated that the relay employed should, of course, be of a type having a high resistance winding which is capable of being energised by a current of a few milliamperes. Such relays are quite easily obtainable at the present time, either as new components or in the form of "surplus" stock.

Finally, it has to be emphasised that the lead to the remote push-button has the same potential as the televisor chassis. In consequence, this lead may be connected to one side of the mains, and the necessary safety precautions must be observed.

IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest based on Letters from Readers and his own experience

Readers may recall that in last month's article we spent some time discussing the basic action of the blocking oscillator, as employed in conventional television timebases. We reviewed the action of the oscillator when used with a modern iron-cored blocking transformer, and paid some attention to the question of a suitable discharge circuit designed to provide the sawtooth waveform required for scanning. We stated also that we would carry on this month with the question of synchronisation.

Synchronisation.

Fig. 1 illustrates a basic blocking oscillator of the type described in the last article. However, we have modified last month's circuit slightly by making two changes. The first of these is that the grid leak, R_1, is now a variable component. The second is that a low-value resistor, R_2, is connected between L_2 and chassis. (We shall ignore the synchronising input for the time being).

It will be recalled that, in the last article, it was pointed out that the length in time of the retrace part of the scanning cycle was controlled (so far as the oscillator was concerned) by the constants (mainly inductance and self-capacity) of the blocking oscillator transformer. At the same time, the length of the "scan" part of the cycle

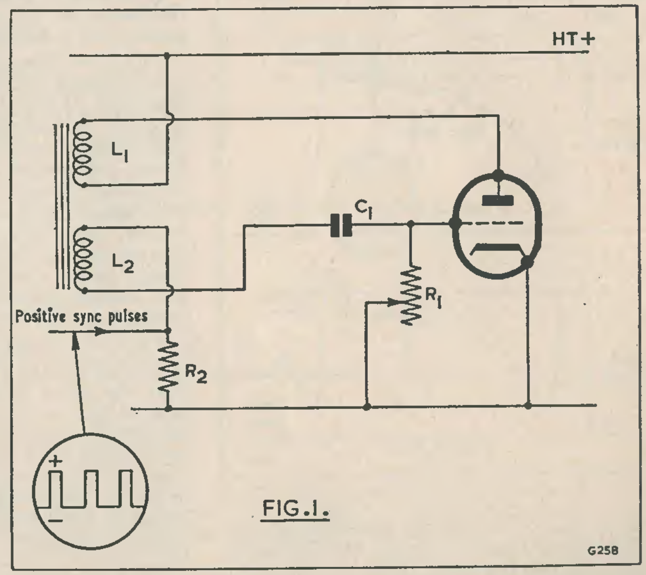


Fig. 1. A simple blocking oscillator. R_2 is a low-value component, and R_1 provides an effective means of obtaining frequency control

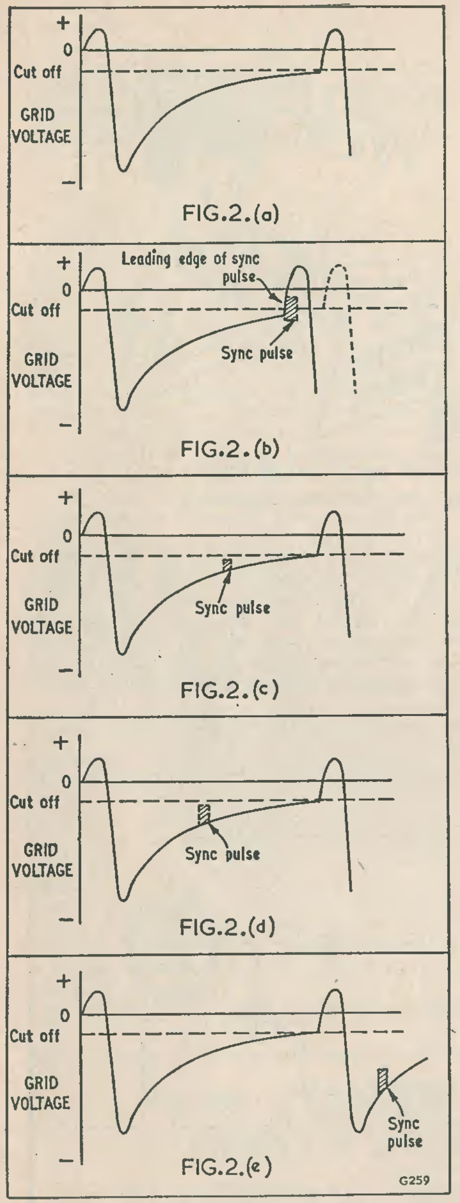


Fig. 2 (a). The voltage appearing at the grid of the triode of Fig. 1. (b) The effect of the synchronising pulse. (c) A sync pulse which is too small cannot provide a reliable lock. (d) Even when a relatively large sync pulse is available, synchronisation cannot be achieved if the oscillator frequency is considerably below the desired frequency. (e) As may be seen here, synchronisation is impossible when the oscillator frequency is too high

was controlled by the time taken for C_1 (Fig. 1), which was previously charged during the retrace period, to discharge into R_1.

If we were to make R_1 variable, it would become possible to vary the length of the scan period. Thus, if we use the circuit shown in Fig. 1, R_1 could be called a "frequency control," since it then varies the frequency at which the retrace periods occur. Note that the retrace period is not, itself, affected by variations of R_1.

Fig. 2 (*a*) shows the voltage waveform appearing at the grid of the triode of Fig. 1 during a complete scanning cycle (assuming that no synchronising circuit is connected). Should we wish to make use of this waveform in a televisor, it will be necessary to synchronise it with the transmitter by means of the synchronising pulses sent out by the latter. If this were not done, the successive scan periods in the receiver would not correspond to those employed in the transmitter camera.

One of the easiest methods of synchronising a blocking oscillator consists of injecting positive pulses into its grid circuit at the requisite moments of time. A suitable method of doing this is that shown in Fig. 1, in which the pulses are passed to the grid via the grid winding, L_2, of the transformer itself. (The resistor, R_2, is included to maintain a d.c. path for the charge and discharge of C_1, and, as was mentioned above, has a relatively low value).

Fig. 2 (*b*) shows the effect of one of these synchronising pulses upon the grid voltage waveform of Fig. 2 (*a*). It will be seen that, whereas in the free-running condition the grid voltage waveform would continue to follow the dotted line of Fig. 2 (*b*), in the case where the synchronising pulse is applied it forces the grid to pass beyond the cut-off region, thus allowing the anode to draw current and initiating the flyback cycle. It should be noted that it is the leading edge of the synchronising pluses which actually commences the initiation.

Fig. 2 (*c*) shows the effect obtained when the synchronising pulse is too small. In this case, the pulse is not able to force the grid beyond the cut-off point and the blocking oscillator cannot be synchronised. It would be possible for a synchronising pulse of this small size to lock the oscillator if the oscillator sawtooth frequency could be varied such that the pulse arrived just before the grid voltage crossed the "cut-off line," but the frequency setting would be critical and unreliable.

Fig. 2 (*d*) illustrates the effect when the scan period is too long (i.e. oscillator sawtooth frequency is too low). In this case, even though the synchronising pulse is large, it still cannot carry the grid sufficiently positive to cross the cut-off point, and the oscillator cannot be locked.

In Fig. 2 (*e*) the scan period is too short (oscillator sawtooth frequency too high). As the flyback period is already initiated by the time the synchronising pulse arrives, the latter has no effect. It is impossible to synchronise a television timebase whose self-running sawtooth frequency is too high.

The waveforms of Fig. 2 show the considerable importance of having, firstly, a

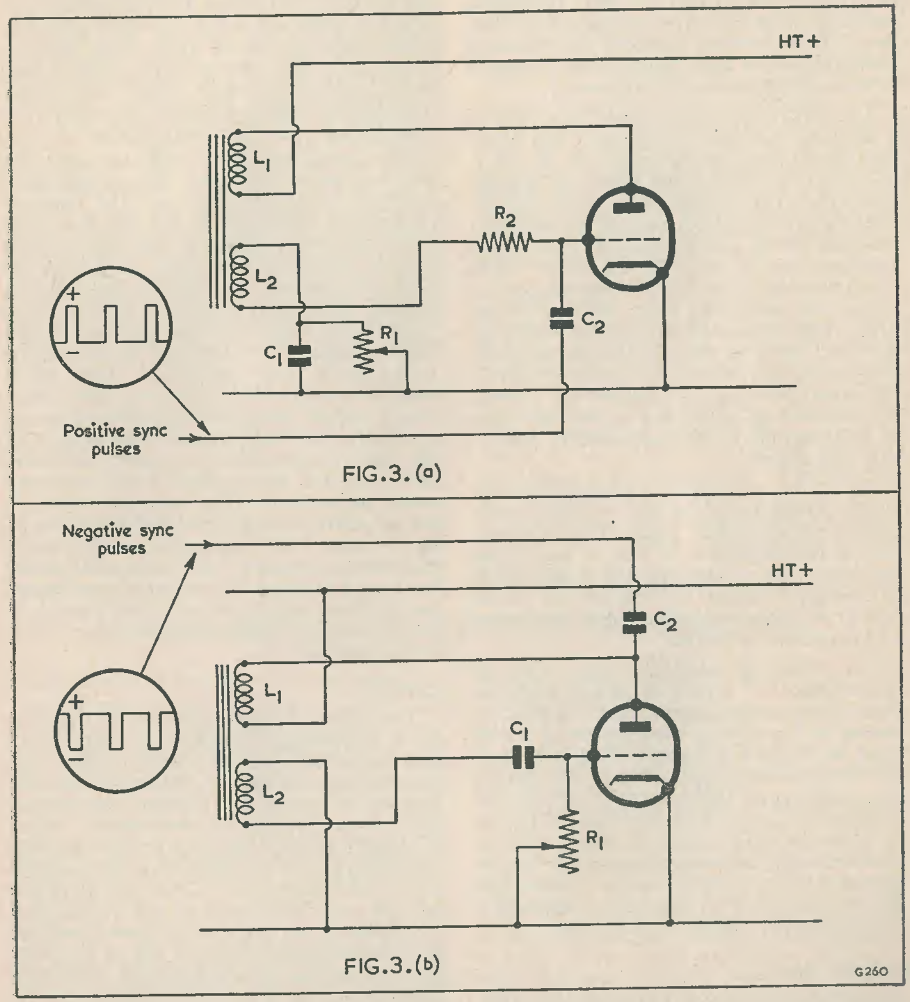


Fig. 3 (a). A rearrangement of Fig. 1. R1, R2 and C1 still carry out the same functions as they did before. (b) Negative sync pulses are effective if they are applied to the anode of the oscillator synchronising pulse which is sufficiently large and which has a sufficiently sharp leading edge and, secondly, an oscillator whose free-running sawtooth frequency is such that it allows itself to be reliably synchronised. It is possible for the free-running sawtooth frequency of a blocking oscillator to alter because of variations in the circuit parameters (valve warm-up, etc.). It follows, therefore, that the synchronising pulse has to be large enough to lock the oscillator during periods of quite considerable change in its free-running sawtooth frequency.

The synchronising (or "hold") control of a blocking oscillator is, of course, that which controls its free-running speed, and, in Fig. 1, is R_1. As the slider of this resistor is brought down from the top end of its track, the self-running sawtooth frequency of the oscillator becomes lower and approaches that of the synchronising pluses. At the point where this frequency equals that of the synchronising pulses, the oscillator "locks in" very noticeably. This particular setting is not reliable, however, because the self-running sawtooth frequency has only to become slightly increased for the oscillator to become unsynchronised again; and so the slider has to be somewhat further advanced to prevent this eventuality.

An alternative method of applying positive synchronising pulses to the blocking oscillator is shown in Fig. 3 (*a*). This is, really, only a rearrangement of Fig. 1, but it has the advantage of applying the pulses direct to the grid instead of through the transformer winding, with its attendant reactances and capacities to chassis.

The blocking oscillator may also be synchronised by means of negative pulses, these being applied direct to the anode, as shown in Fig. 3 (*b*). This method is not so good as that of Fig. 3 (*a*), or Fig. 1, because the synchronising pulses have to initiate the build-up of the magnetic field in the transformer itself, instead of merely having to alter the grid voltage of the oscillator. Consequently, these negative pulses must be provided from a relatively low impedance source, and must be capable of allowing a proportionately higher current flow.

Looking Back

In order to prevent any muddles occurring, it is my practice to number these contributions before I send them off to *The Radio Constructor*. Somewhat to my surprise, I have found that the particular article I am writing now is entitled "In Your Workshop No. 60." I state "to my surprise" because the figure 60 means that I have now been writing this column for five years—and I just hadn't realised that so much time had flown by!

I have been fortunate enough to obtain a great deal of pleasure and instruction from my association with *The Radio Constructor*, and it is this which has made the last five years seem so short. In particular, the articles I have contributed have enabled me to receive many interesting letters from readers. Although some of these have taken me to task for things I have written (or which I have *not* written!), every one has been welcome and all have been studied. Recently, I ran into a patch when I just could not answer each letter until some considerable time had passed; but things are now almost back to normal again.

One thing that has struck me over the last five years has been the considerable solidarity which characterises the amateur constructor movement in this country. This spirit of mutual assistance has always been evident in radio circles, but I think that the common centre of interest has shifted slightly, nowadays, from that which existed before the war. In the pre-war period greater emphasis was placed upon amateur transmission and reception; this being possibly due to the fact that, apart from sound radio, there were fewer alternative outlets for the inventiveness and energy of the home-constructor. (Just think of a time in which the expression "hi-fi" had not even been coined!). The hams are nowadays not as active as they were, and there are so many other branches to the hobby that a considerable number of radio enthusiasts have never touched a key, or even experienced the thrill we used to get when we picked up Schenectady on our very first single 2-volt triode receiver!

Careers

The letters I have received in the past have contained a sizeable proportion of requests from young readers who are beginners in the field of radio and who are anxious to know what steps they should take to make electronics their career. Many of these have been National Servicemen who have been posted to a radio trade during their period of conscription. To speak frankly, I am not really competent to give a great deal of advice on the question of careers because my own experience has led me to a hotch-potch of various jobs in places ranging from Hong Kong to Southern Rhodesia! It is only in the last few years that I have settled down in Great Britain to a more comfortable routine.

What I would like to suggest to National Servicemen who are keen on radio is that they try and obtain as much practical experience as they can whilst they are in the Services. One of the reasons for this is that high-grade test gear and electronic equipment is normally used quite extensively in the radio branches of the Services; probably far more so, indeed, than occurs in some of the smaller civilian businesses. And practical experience with radio equipment is one of the most valuable assets a technician can obtain. I don't know if National Servicemen feel like taking advantage of the educational facilities available to them in the Services, but no harm could presumably result. (I understand that Guardsmen are being taught to count by making smart parade movements in front of a row of placards bearing the numbers 1 to 20. Presumably, there are one or two Educational Officers in the Services who can rise just a little above this level).

About the only other useful advice I can offer to any young person who is going to make radio his career is that it is one of those fascinating subjects in which one never stops learning. In fact, the engineer who decides that he "knows it all" is the engineer who is well on the way to becoming a back-number.

One or two readers have bemoaned the fact that they were not able to continue at school after they had reached fifteen or sixteen years of age. It is true that the qualifications which these readers might have obtained later at school, or at college, would have been of assistance when looking for a job; but such qualifications are by no means essential. There are plenty of really high-salaried engineers in the radio industry these days who have no degrees whatsover. And there are plenty of excellent correspondence courses and night schools which can lead to a degree if the student is prepared to offer the time and work required.

As I said just now, I do not pretend to be sufficiently competent to advise a young man who wishes to make radio his career. However, I feel certain that there are many readers who, from their own experience, would be capable of giving really valuable advice. If so I would be very happy to hear from such readers with a view to publishing their letters in this column. I do feel that, at a period when electronic engineers are in the short supply that they are now, any reliable information which may assist young technicians would also be of assistance to the state of the country itself.

A Short Head

These paragraphs were prompted by the fact that I had suddenly realised that I had been writing "In Your Workshop" for five years. However, I am still a young 'un yet. My colleague Centre-Tap, who started Radio Miscellany in 1947 (Vol. 1, No. 2), has a far earlier connection with the radio press than I can ever claim. The inventive G. A. French has also beaten me, if only by a very short head. His popular feature is headed this month: "Suggested Circuits No. 61!"

PREMIUMS FOR TECHNICAL WRITING

Re-statement of Radio Industry Council's Scheme

Non-professional writers of technical articles dealing with radio and electronics, including specialised applications to any industry, and the editors responsible, are reminded in a leaflet issued by the Radio Industry Council of its premium award scheme, now in its fourth year and nearing the time for judging.

Up to six premiums of 25 guineas each are offered yearly in respect of articles which, in the opinion of the Council's panel of judges, are likely to enhance the reputation of Great Britain in radio, television and electronics.

The 19 awards so far made have happened to be mostly for articles in radio and electronic journals, but it is pointed out in the leaflet that many industries are increasingly using electronic methods of control and production, and articles in the journals serving a wide variety of industries are eligible provided they can be bought by the public on bookstalls or by subscription. Industries specifically concerned are the motor, aircraft, metal-working, woodworking and food industries, with wide uses also in hospitals, clinics and research establishments.

An innovation now announced is that one of the six premiums will be open for articles published in manufacturers' own journals with an overseas circulation, provided that they also can be bought by the public. Articles in privately published journals of professional bodies are not eligible.

Object of the scheme is to encourage a greater flow of articles from within industry, but any writer is eligible provided he is not paid wholly or mainly for writing and is not earning more than 25 per cent of his income from fees for articles or book royalties.

The judges, headed by Professor H. E. M. Barlow, Professor of Electrical Engineering, University College, London, believe that an article, to have maximum impact, should have a non-technical introduction setting out the aims and applications of the techniques described and, if possible, economic advantages; the object being to interest executives and administrators as well as scientists and engineers. Value of the article in making known British achievement, originality of subject, technical interest and presentation and clarity are the criteria.

To enter, copies of the journal or pages have to be sent before the end of the year to the Secretary, Radio Industry Council, 59 Russell Square, London, W.C.1, with a written declaration that the writer is eligible.

Copies of this journal will not be required as from this issue, as we are forwarding the necessary number each month to the Radio Industry Council. Should any writer whose article has appeared during the last twelve months, wish to submit an application, we shall be pleased to supply gratis the necessary copies, subject to these being in stock.—Ed.)

BAND III TELEVISION for the HOME CONSTRUCTOR

PART 6.

by **S. WELBURN**

This month S. Welburn passes some comments on upper-sideband Channel I receivers. He also deals with the problem of setting fine tuning controls correctly, and of injecting i.f. into a Band I Television receiver without additional coils.

NOW THAT THE FIRST MONTH OR SO OF Band III transmissions has passed, we can settle down to seeing how our converters and aerial gear are coping with the new transmissions.

An Achievement

First of all, however, the writer feels that it would be more than fitting at this stage to pass on the warmest congratulations to the technicians and engineers of the I.T.A. who got Channel 9 on the air so promptly and successfully last 22nd September. It was a notable achievement which deserves every compliment. Commercial television is an experiment in this country which, to judge from its performance up to the time of writing, can be assured of considerable success in the future.

In passing, the writer cannot help but comment on the fact that the very first commercial advertisement ever transmitted in a programme in this country was faded in too soon! Those who saw it on 22nd September may remember that we also saw the last few figures (4 and 3) of the film "leader" before we were introduced to the toothpaste which formed the subject of the advt.

Upper Sideband Receivers

Some difficulties have been experienced with the conversion to Band III of one or two vintage televisors (so far as the writer is aware, all t.r.f.) owing to the fact that their r.f. strips are intended for upper vision sideband working. There are probably not very many such receivers in use these days, fortunately. As they stand, these receivers cannot be fitted with a converter for Channel 9 reception owing to the fact that this signal uses the lower sideband for vision. Double sideband receivers should be satisfactory, however.

Upper sideband receivers will also be inoperative when the B.B.C. moves to Crystal Palace, as the new B.B.C. transmissions on Channel I will be on the lower sideband only as well.

It would seem that, if an upper sideband receiver is in use at the time, it might be worth while making an attempt to convert it to lower sideband working at the present time as, apart from Band III considerations, this will enable it to cope also with the proposed new B.B.C. Channel I programme. The conversion might not be simple, unfortunately, and it might be inadvisable for anyone who has not had some experience of television alignment to try to carry it out. A signal generator would be necessary. A Channel 9 converter would also be useful, as it would enable a final idea of the bandwidth and transient response of the converted receiver to be obtained with the aid of the I.T.A. signal.

The conversion would, of course, consist of realigning the vision strip of the t.r.f. receiver to the lower sideband. This would bring the video strip very close in frequency to the sound carrier; with a very strong possibility, in consequence, of sound breakthrough on vision. It seems possible that, with some receivers, the consequent sound on vision would be practically impossible to clear. With other receivers the trouble could perhaps be cleared by fitting additional sound traps.

Whilst adding sound traps can help to clear sound on vision troubles, they can also raise some difficulties of their own. This is due to the distortion that they are liable to introduce to the total response curve. Probably the best type of "add-on" sound rejector is that shown in Fig. 1. This is a simple acceptor circuit and can be connected to any anode in the r.f. strip. Provided that the coil has a reasonably high Q, such a trap can often give surprisingly good results. The value of the series condenser is experimental, although a capacity around 2pF should be satisfactory in most cases. The coil should be screened; and very short leads are essential. Two such rejectors "added-on" to the anodes of two successive valves in the r.f. strip would probably give surprisingly useful results in many instances.

An alternative form of "add-on" sound rejector is shown in Fig. 2. This consists of a tuned circuit in series with the cathode of one of the video strip valves. It functions by reason of the fact that the tuned circuit has a high impedance at its resonant frequency and, in consequence, causes considerable degeneration of gain in the valve at that frequency. The writer's own experience of the circuit of Fig. 2 is that it does not reject as sharp a band of frequencies as does that of Fig. 1, and that it is more liable to upset the response curve of the strip. Nevertheless, the circuit is of use to those wishing to experiment.

Before concluding on this subject it must once again be pointed out that converting an upper sideband receiver to lower sideband working is not necessarily a simple task to carry out, and that it might not always be successful.

The Fine Tuner

Many converters, and all turret tuners, are fitted with fine tuning controls. Occasionally, one finds that these controls are not always quite as easy to operate as one would expect, if really superior picture quality is required.

The reason for this is that many commercial televisors have differing responses in their i.f. strips. With some receivers, for instance, the sound rejection circuits are quite sharply tuned and, unless the fine tuner adjusted such that the sound carrier rests centrally in the sound rejection trough of the video i.f. response curve, some risk of sound on vision is liable to result. In other cases, the fine tuner position for maximum sound rejection may not correspond exactly to the position for maximum volume from the loudspeaker. Again, some video i.f. strips are liable to "ring" slightly at certain frequencies. When the fine tuner is adjusted correctly, this slight ringing sharpens up the image quite appreciably and is not a derogatory factor.

Because of these points, the viewer who is interested in getting the very best picture from his televisor might not be ill-advised to primarily get the "feel" of the fine tuning control with the aid of the transmitted test card. He may then find that he obtains optimum results when he adjusts this control for an easily-repeated set of circumstances. These could consist of, say, a small diminu-

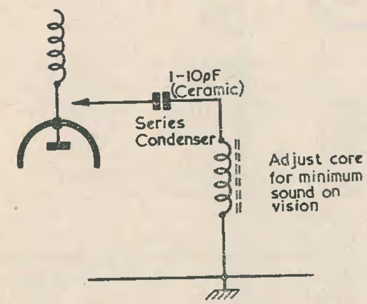


Fig 1

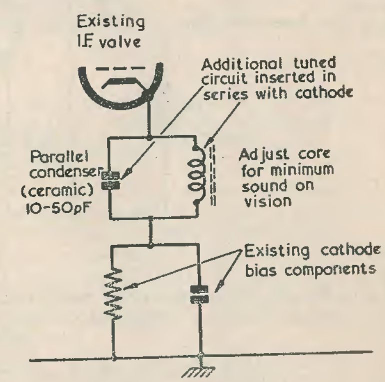


Fig. 2

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Fig. 1. A simple "add-on" sound rejector circuit which may help to clear troubles described in the text. The coil should be mounted in a screening can

Fig. 2. An alternative type of "add-on" sound rejector circuit. This does not usually give such sharp rejection as does that of Fig. 1

tion in sound, the control being turned slightly away from the "maximum sound" position towards that which gives maximum picture brightness. The optimum setting found with the aid of the test card can then quite easily be repeated when viewing a normal transmission.

3Mc/s bars of a normal test card. They may usually be detected by reducing brilliance and, sometimes, advancing the contrast control. Adjusting the fine tuner for maximum attenuation of the pattern will correspond to the setting which gives optimum sound rejection.

Fig. 3

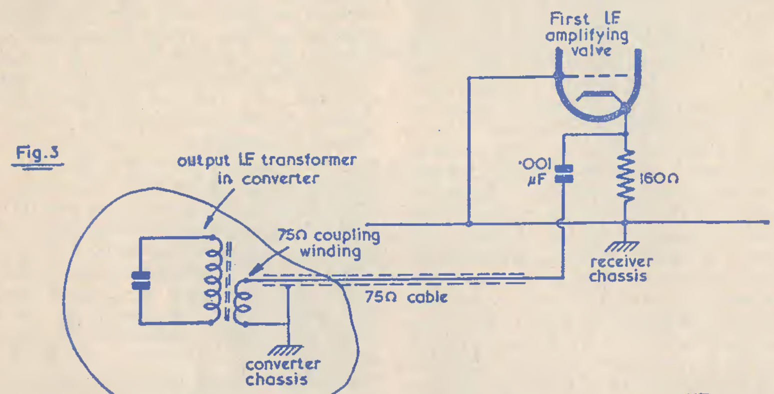


Fig. 4

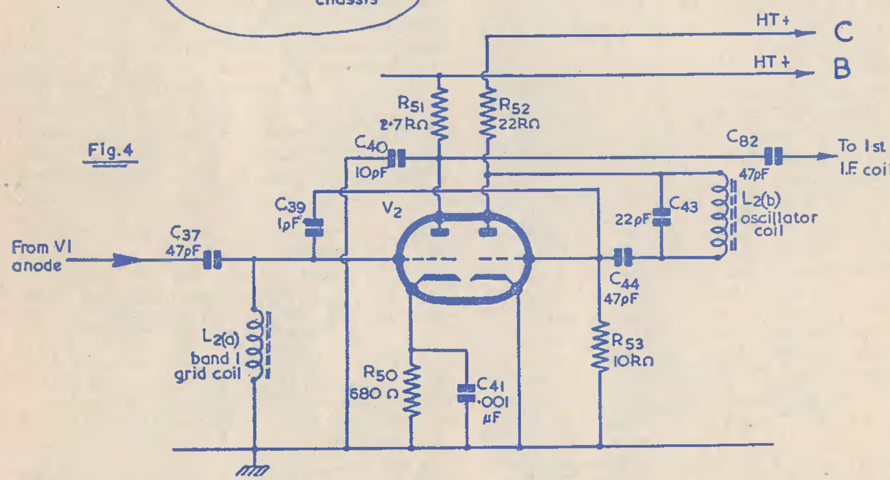


Fig. 3. The basic essentials of a cathode injection arrangement. The impedance of the 0.001μ*F condenser in series with the input can be considered as being negligible at i.f.*

Fig. 4. The oscillator and mixer circuits of the Magna-View receiver

In the case of a receiver with sharply tuned sound rejector circuits, the best position of the fine tuner will be that which gives minimum 3.5Mc/s pattern on the screen. The 3.5Mc/s pattern (given by the sound carrier) shows up as a continual gradation of the individual lines of the picture, these gradations being slightly closer together than the

In the case of an i.f. strip with a slight "ring," the fine tuner position for optimum sound rejection should correspond to that needed for optimum picture; assuming that the i.f. strip has not drifted or been tampered with since it was originally aligned. If there is only a slight discrepancy between these two positions, a compromise may be

reached. Alternatively, should the sound rejection be broad, then it would be best to adjust for optimum picture only. Normally, this will correspond to similar contrast levels for the 1, 1.5, 2 and 2.5Mc/s bars.

Injecting I.F.

Some correspondents have built or bought Band III converters which give an output at i.f. and not at a Band I aerial frequency. They have asked if it is possible to inject the i.f. from their converters into the i.f. strip of a televisor without introducing additional coils into the latter.

a typical i.f. amplifying pentode is some 7.5mA/volt. The cathode input impedance of such a valve would be, therefore, approximately 133Ω. This, paralleled with the 160Ω cathode bias resistor shown in Fig. 3, presents a combined impedance of approximately 73Ω. Not a bad match for the 75Ω cable from the converter!

Unfortunately, it is not always easy to employ the valve shown in Fig. 3 as a grounded-grid stage in a practical televisor without introducing some slight complications. If the grid circuit of the valve is already connected to an i.f. tuned circuit,

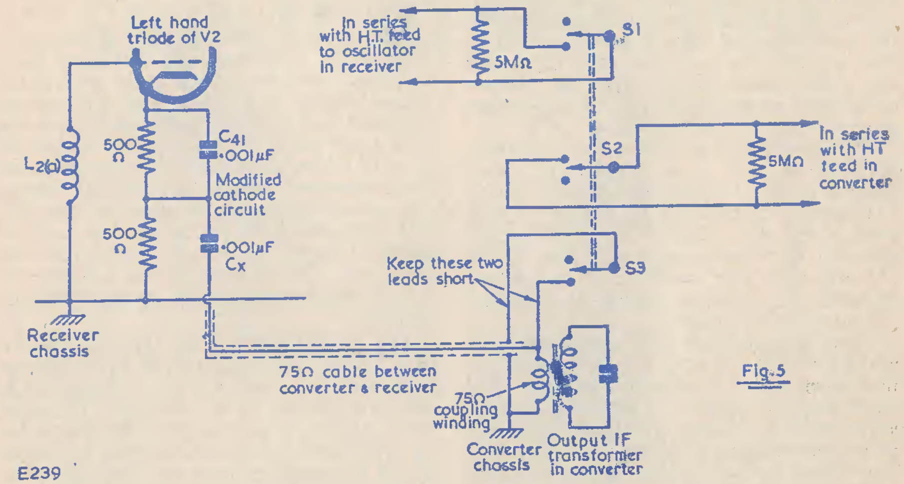


Fig. 5

Fig. 5. Showing how a converter with an output at i.f. may be connected into the cathode circuit of the mixer of Fig. 4. Complete Band I—Band III switching is also shown. S_1, S_2, S_3 *may be provided by a normal wave-change switch*

Such a course is frequently possible by means of cathode injection, and a circuit illustrating the basic idea is shown in Fig. 3. In this diagram the input signal is fed, via 75Ω coaxial cable, to the cathode of the first i.f. amplifying valve in the televisor. It is assumed that this valve is operating as a grounded-grid stage, in which event the input impedance at its cathode is approximately equal to the reciprocal of its mutual conductance.* The mutual conductance of

* This assumption is accurate when μ is considerably greater than unity (which it is in this case), and the anode load is small compared with Ra. The correct expression for the input impedance of a grounded-grid stage is given by: $\frac{Ra+RL}{\mu+1}$, where RL is the anode load.

it would be necessary to short-circuit the grid to chassis for Band III reception.

Rather an elegant solution to this problem may be obtained when the grid of the valve is connected to chassis via a Band I coil. A typical instance is given by the Magna-View circuit.

Fig. 4 shows the frequency-changer circuits of this receiver. As may be seen, the grid of the left-hand triode of V_2 is connected to chassis via $L_{2(a)}$. For i.f. frequencies, coil $L_{2(a)}$ can be considered as a short-circuit, in which case it is possible to inject i.f. into the cathode without any switching at all. A suitable circuit arrangement is shown in Fig. 5. This differs slightly from Fig. 4, in so far that the original 680Ω cathode bias resistor is replaced by an additional 500Ω resistor inserted in series with the 150Ω impedance-reducing resistor. This is done to maintain approximately the same cathode bias as existed before.†

Fig. 5 also shows suitable Band I–Band III switching. Part of this is concerned with h.t. switching and is supplied by S_1 and S_2. (The 5 MΩ resistors shown across the switch contacts are used merely to supply a small amount of h.t. current to the appropriate valves when they are switched out). In this diagram S_1 switches the h.t. supply to the oscillator of the televisor only. For receivers which, unlike the Magna-View, employ the same h.t. supply for the r.f. stage as well as the oscillator, S_1 could switch out this stage as well as the oscillator. Switch S_3 short-circuits the coaxial lead to the receiver when Band I is selected. This short-circuit effectively connects C_x across the 150Ω resistor, and brings the cathode circuit back to practically the same condition as that which existed in Fig. 4.

The circuit of Fig. 5 is a very workable proposition, and it is capable of being applied to any commercial receiver having a frequency-changer circuit similar to that used in Fig. 4. It should be noted that the gain of the mixer is added to that of the i.f. strip when the combination is switched to Band III; this representing an incidental advantage of the scheme.

There is one further small point about the circuits of Figs. 3 and 5 which should be mentioned before closing this subject. This concerns the coaxial lead between the converter and the receiver. This lead should not be greater than some 2½ feet or so in length. The reason for this is that, if it were made longer, it could act as a tuned circuit resonant at Band I frequencies, and would upset the Band I performance of the televisor.

"Converter Type 3"

Before concluding this month, the writer would like to devote some time to a review of two Band III converters.

The first of these is the "Converter Type 3" which is retailed by R. and T.V. Components Ltd. This converter employs an EF80 r.f. amplifier feeding into an ECC81 double-triode frequency-changer. No circuit was available to the writer, but it would appear that conventional circuitry is employed.

The Converter Type 3 is fitted in a small chassis fitted with a tag-strip for connection to h.t. and l.t. supplies, together with tags for the Band III aerial input. No Band I–Band III switch is fitted. The h.t. required is 180 to 200 volts, and the l.t. required is 6.3 volts at 0.6 amps. An adjustable Band I rejector circuit is fitted to reduce breakthrough via the Band III aerial.

The "Univerter"

Also under review is the "Univerter." This is an ambitious and extremely well-designed converter which gives an output at any channel in Band I. The unit is quite complete and self-contained, and it has its own power pack. In consequence it may be fitted to the existing Band I televisor without the necessity of altering any internal wiring. An interesting feature is given by the fact that the a.c. supply to the receiver may be taken through the on-off switch of the converter. Once connected up, the receiver is then switched on and off by the converter switch.

The "Univerter" valve line-up consists of a Z77 r.f. amplifier, a B309 double-triode oscillator-mixer, and a Z77 i.f. amplifier. A U78 is employed as h.t. rectifier. The converter chassis is isolated from the mains by its own transformer. Two of the advantages of the i.f. amplifier stage are that this adds its own gain to that of the converter at Band III, and that the consequent high output available at i.f. reduces Band I breakthrough in poorly screened televisors to a negligible quantity. The i.f. is, of course, the frequency of the Band I channel employed by the receiver with which the converter is used.

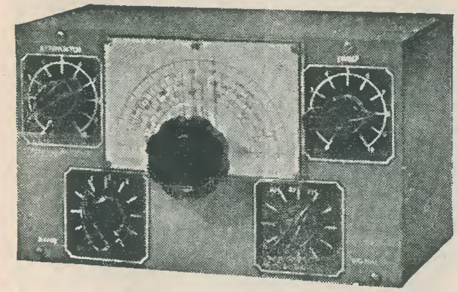
The "Univerter" is available complete in a wooden cabinet. A single control knob on the front switches the converter and televisor on and off, and also selects Band I or Band III.

† A parallel resistor of 150Ω is used here because the cathode input impedance of the triode would be approximately 155Ω instead of the 133Ω given by the previous pentode example.

TWO RADIO SHOWS ANNOUNCED

The Radio Industry Council announces that the 23rd annual National Radio and Television Exhibition ("The Radio Show") will be held at Earls Court, London, from 22nd August to 1st September, 1956, with a preview for overseas and other special guests on 21st August.

The Radio and Electronic Component Manufacturers' Federation announces that its annual private exhibition will be at Grosvenor House, London, W.1, from 10th to 12th April, with—for the first time—a preview for overseas and other specially invited guests on the afternoon of 9th April. Application for admission has to be made in advance to the Radio and Electronic Component Manufacturers' Federation, 21 Tothill Street, London, S.W.1.



BUILD YOUR OWN A.M.—F.M. SIGNAL GENERATOR

PART 2.

by W. PICKERING

Constructional details of a compact and serviceable item of test equipment which can be constructed in the home workshop from standard materials.

In last month's issue we introduced the a.m.-f.m. signal generator, discussing its circuitry and operation at some length. This month we carry on to give full constructional details of this invaluable little instrument.

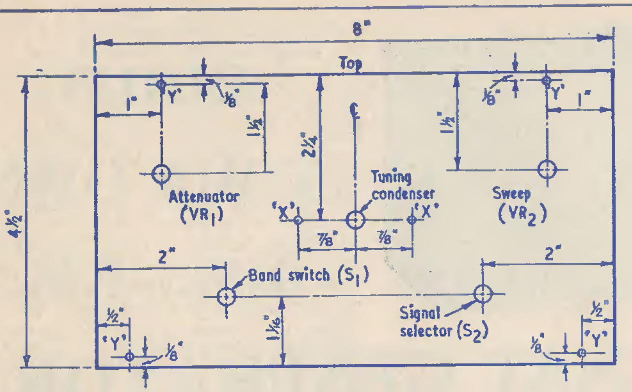
The Chassis and Cabinet

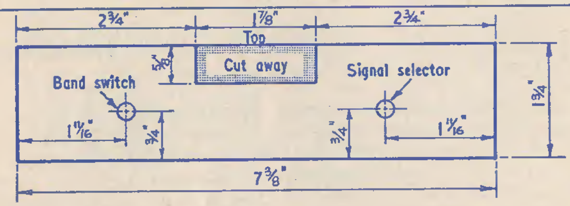
A particularly neat and attractive chassis and cabinet combination is that available from R.C.S. Products, and it was decided to employ this for the construction of the a.m.-f.m. signal generator. The final striking appearance obtained is well exemplified by the photographs which accompany these articles.

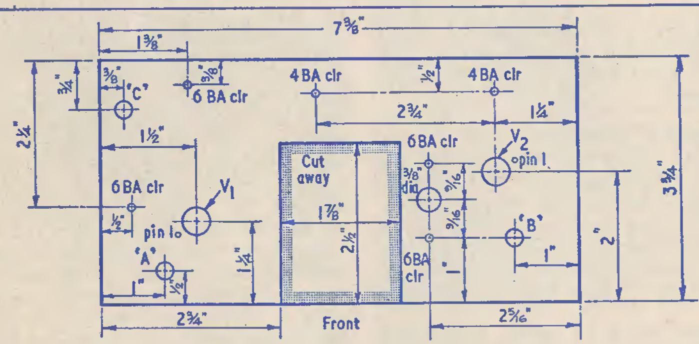
The chassis and front panel, as supplied by R.C.S. Products, are undrilled. The metal working required is, however, quite simple and should only take a small amount of time to carry out. Fig. 2 shows the positions of the bush-mounting holes that are needed in the front panel. This diagram designates each hole by the function of the control whose bush will be fitted to it. For conventional components, the bush-mounting holes should have a diameter of ⅜-in. The aperture for the tuning condenser spindle does not, in practice, accommodate a bush; but a hole diameter of ⅜-in. would still be satisfactory here. The two holes marked "X" on either side of the tuning condenser aperture should be drilled 6-BA clearance, countersunk. These two holes are used, at a later stage of construction, for mounting the tuning condenser; and are intended to coincide with two 6-BA clearance holes on its front mounting plate. When it is mounted, the front plate of the tuning condenser should be spaced by approximately ⅛-in. from the back surface of the front panel, by means of spacing washers. Two 4-BA half-nuts would cope quite nicely here.

Also shown in Fig. 2 are four holes marked "Y", these being positioned close to the top and bottom edges of the panel. These holes are intended for mounting the panel to the cabinet. It will be advisable to use self-tapping screws for this process, since it would be difficult to fit nuts inside the cabinet after assembly. The four holes marked "Y" should, therefore, be drilled out with clearance diameters for the self-tapping screws employed. The panel may then be used as a template for drilling the four tap-size holes in the flanges of the cabinet itself. It is worth mentioning at this stage that, since the chassis is secured to the panel, the only screws needed for mounting the whole assembly into its cabinet are those fitted in the four holes just discussed. In consequence, the fitting or removal of the chassis from the cabinet is quick and simple.

Fig. 2 does not show the holes needed for securing the Perspex scale-cover to the front panel. This point is best left until construction is further advanced.







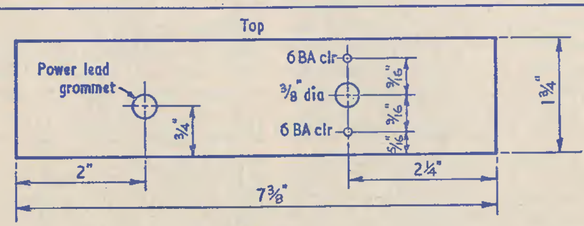


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Fig. 2. Drilling dimensions for the front panel. Fig. 3. The front apron of the chassis is drilled and cut as shown here. Fig. 4. View looking down on the top of the chassis. The letter references are explained in the text. Fig. 5. The rear apron of the chassis, showing the holes drilled for the WA9 coil and power lead grommet

The chassis itself comes next. The depths of the front and back aprons of the chassis as used here should be equal, at 1¾in. It is possible that the rear apron of the chassis, as supplied by R.C.S. Products, may be deeper than the front apron by some ⅜-in.

the position of pin No. 1 of each valveholder is shown in Fig. 4 by a small circle.

The ⅜-in hole shown in the diagram corresponds to the central hole of the WA5 coil, which is later mounted under the chassis. No part of the coil former, itself,

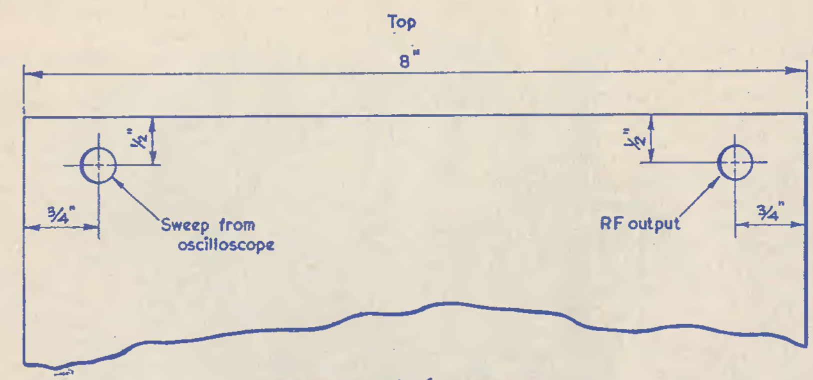


Fig. 6. Showing the top rear surface of the cabinet, together with the positioning of the coaxial socket centres

Fig. 3 shows the dimensions of the bush-mounting holes and tuning condenser cut-out needed in the front apron of the chassis. The left-hand of the two bush-mounting holes corresponds to the "Band-Switch" hole of Fig. 2; and the right-hand to the "Signal-Selector" hole. The chassis is secured to the front panel by means of the bushes of these two controls, when they are later fitted.

Fig. 4 shows the principal holes required in the surface of the chassis. As may be seen, a large rectangular piece of metal is cut away to accommodate the tuning condenser. This is a continuation of the front apron cut-out shown in Fig. 3.

Valveholder hole centres only are shown in Fig. 4. The hole marked "V_1" is intended for a B9A valveholder and should have a diameter of ¾-in. The "V_2" hole takes a B7G valveholder and has a diameter of ⅝-in. The valveholder mounting holes (6-BA clearance) may be marked out by using the valveholder itself as a template. As a guide, locates with this hole, as its main purpose is that of allowing the passage of a trimming tool to the iron-dust core. The two 6-BA clearance mounting holes spaced symmetrically on either side of the ⅜-in hole are for mounting the coil former.

The two 4-BA clearance holes along the rear of the chassis are intended for mounting two of the four five-way tag-strips specified; whilst the remaining two 6-BA clearance holes are employed for the Radiospares transformer. The other three holes, labelled "A", "B" and "C", should be drilled out to take ⅜-in grommets. (The letter references are discussed later in the article). The third and fourth tag-strips, incidentally, are mounted under the outer 6-BA nut and bolt securing V_2 valveholder, and under the forward nut and bolt securing the Radiospares transformer.

Fig. 5 shows the back apron of the chassis. There is little which requires comment here. The ⅜-in hole and two 6-BA clearance holes will be used for the mounting of the

WA9 coil inside the chassis, whilst the remaining hole should be drilled out for the power-lead grommet.

It is finally necessary to drill the rear of the cabinet for the two Belling-Lee coaxial sockets. Their centres are shown in Fig. 6. This diagram also designates the function of each socket.

Wiring

The main components may now be mounted. The tags of the two potentiometers should project upwards. As it is desirable to obtain the maximum possible capacitive swing of the tuning condenser, the trimmer on the front section (that which is used here) should be set to a mimimum value or, better still, removed.

Wiring may next be commenced. This part of the process of construction is extremely simple, as there is an ample degree of space on the chassis. However, the normal commonsense rules of wiring apply, and no component lead should be made longer than is comfortably required. To act as a guide, Fig. 7 shows the positions of the larger components below the chassis. A study of this photograph will also prove of assistance with respect to the positioning of the smaller components.

Above the chassis a little further explanation is required. To enable short and tidy leads to be employed, the wiring runs passing through the chassis to the individual above-chassis components should pass through the grommets specifically positioned for them. Thus, the wiring to VR_1 should pass through hole "A", that to VR_2 through hole "B", and that to the transformer through hole "C". The letter references are those given in Fig. 4.

Fig. 8 illustrates the method of fitting the components which connect to the Belling-Lee coaxial sockets. The soldered connections required at these sockets are made when the chassis is fitted into the cabinet, the requisite joints being readily available by removing the lid of the cabinet. No earth connection to these coaxial sockets is required, as this is provided automatically via the metal of the cabinet itself.

The Scale

All that now remains is the fitting of the tuning condenser scale, and the various Panel-Signs transfers to the front panel. The scale itself is also a transfer, being calibrated after fitting to the front panel. The use of transfers enables an extremely neat finish to be obtained, as may be judged from the photograph of the completed equipment.

A very attractive appearance can be given by covering the tuning scale with a thin sheet of Perspex. The dimensions required for this sheet are given in Fig. 9. The five holes around the edge of the Perspex are intended for mounting screws (preferably self-tapping). After these holes have been drilled, the Perspex may be used as a template for drilling out the front panel itself. It is possible that the extension of the three top screws behind the panel may foul the top flange of the cabinet. If this occurs, the sections of the flange concerned should be cut away, or large "accommodation" holes drilled to take the screws.

A cursor for the tuning condenser is also required. Here, again, Perspex provides an attractive solution, and the arrangement employed in the prototype is clearly visible from the photograph of the complete unit. A fine line is scored along the under side of the piece of Perspex employed here, and is later filled with a colouring material. The Perspex is, of course, fixed to the back of the control knob.

It will finally be necessary to calibrate the tuning scale. One way of carrying out this process would consist of checking the unit against a normal signal generator. However, some constructors will not be able to avail themselves of this facility, and so the prototype calibration has been reproduced to assist them (see Part 1). For ease of presentation, the semi-circular scale has been presented in linear form. The top gradations in this diagram, i.e. from 0 to 100, correspond to the similar gradations on the actual scale itself. (These readers are recommended to refer to Parts 2 and 3 of *The Design, Construction, Calibration and Use of Signal Generators*, by R. J. Stephenson, October and November, 1954 issues of this magazine—Ed.).

Operation

There is little which needs to be explained so far as operation of the signal generator is concerned, this being extremely simple. Nevertheless, there are one or two small points which merit discussion before this article is finally concluded.

The first of these is concerned with the frequency deviation of the signal generator on Range 2. On this range the tuning capacity provided by C_4 is shunted by the fixed condenser. In consequence, the variable tuning reactance offered by V_2 gives less frequency deviation, for a given input sweep voltage, than occurs on Range 1. Normally, this reduced deviation may be made good by simply increasing the sweep drive to V_2 (i.e. by advancing VR_2). If, however, the oscilloscope timebase cannot provide the sweep amplitude required it may be necessary to align at 465 kc/s by

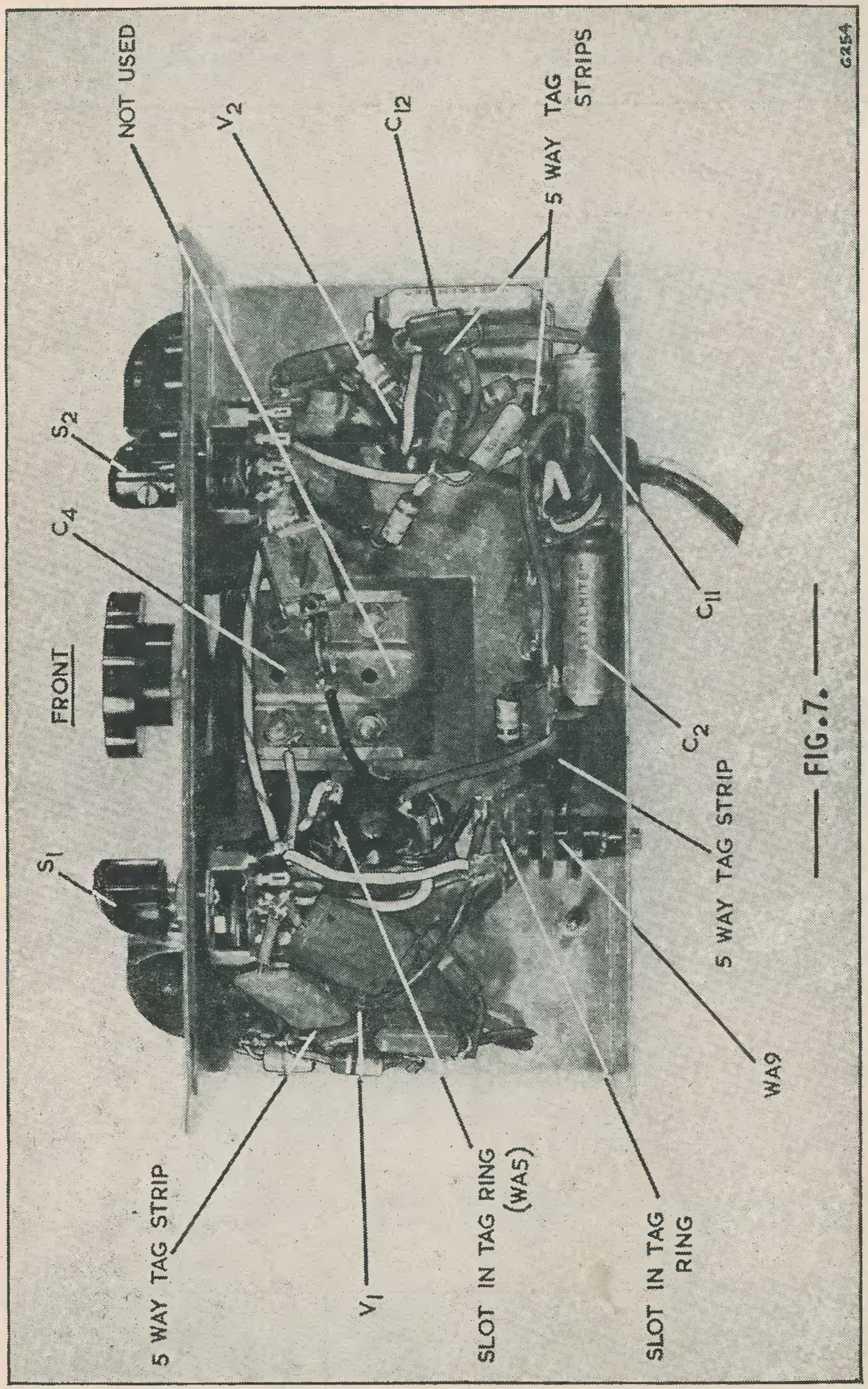


Fig. 7. The layout of the larger components below the chassis

using a harmonic of Range 3. In practice, this procedure should only be necessary in one or two isolated instances and with certain oscilloscopes. all that is necessary is to provide additional attenuation by connecting a small-value condenser between the centre conductor of the screened output lead and the input point

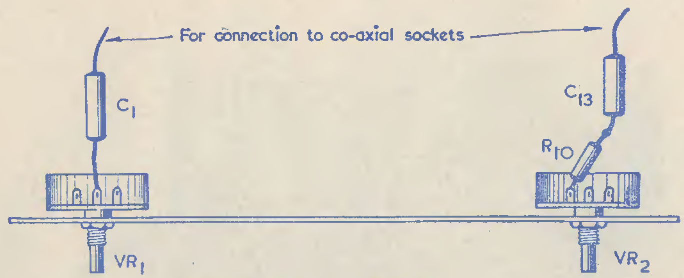


FIG.8.

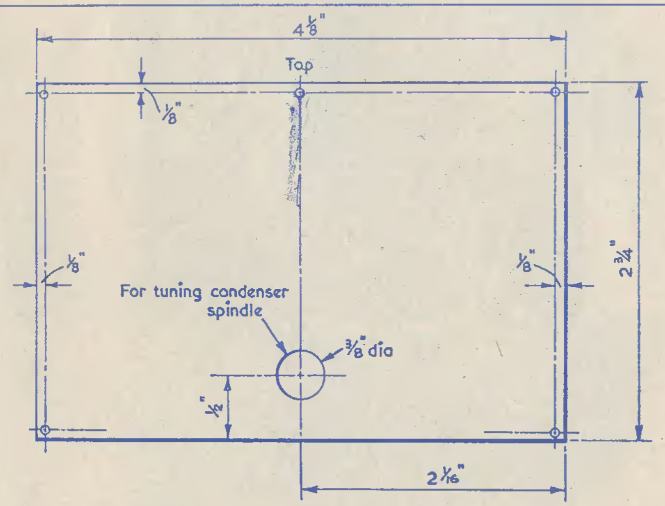


FIG.9.

G255

Fig. 8. The method of mounting the components immediately connected to VR_1 and VR_2. Fig. 9. The dimensions of the Perspex cover for the tuning scale

It is possible, also, that the output of the signal generator may be too great when it is injected into the early stages of a sensitive receiver. Should this prove to be the case, chosen in the receiver. This condenser may be inserted "at the receiver end" of the output lead, and should have a value of approximately 20pF.

Query Corner

Battery Charging

I wish to construct a battery charger that will be suitable for charging both standard 2 volt radio accumulators and also my 12 volt car battery. I find that particularly during the winter months an occasional re-charge to the latter serves towards quicker engine starting on cold mornings. Can you recommend the design of a suitable charger?
L. Nathan, Basingstoke

In the past we have not published very much information on battery charging, in spite of the fact that there are still a very large number of accumulators in use. These are to be found particularly in country districts, where they not only supply radio receivers but also main and emergency lighting circuits. Some of our more advanced readers are also using accumulators to feed experimental transistor equipments where the low impedance of this source of power is often an advantage. The charger described is designed to feed 2 to 12 volt accumulators at charging rates up to 1.5 amperes. The basic design is readily adaptable, however, to other voltages and currents if it is so desired.

Having in mind the need to provide a variable output voltage, there are two methods of adjustment normally employed. One is to simply include a variable resistance in the battery circuit, and the other involves the use of tapping points on the secondary of the mains transformer. For a relatively wide range of output voltages the first method is wasteful of power and for this reason the second has been used in our circuit. The tapping point serves as a coarse adjustment of charging current whilst the small variable resistor acts as a fine adjustment. The rectifier is connected in the standard full-wave bridge fashion, the actual method of making connection to the unit being shown in the inset diagram of Fig. 1. Three tapping points are provided for charging 2, 6 and 12V accumulators. The actual a.c. voltage required into the rectifier for any given d.c. output voltage is given by the approximate formula

A.C. voltage = D.C. voltage × 1.125 + 2.

It should be noted that this formula applies only to the type of rectifier under consideration; the a.c. is stated as the r.m.s. value whilst the d.c. is given as a mean value. The tapping points on the transformer must therefore be made at 4.25V, 8.75V, and 15.5V r.m.s.

Query Corner

We regret that in future, owing to other staff commitments, we shall be unable to undertake the answering of queries except those arising as a result of articles published in this magazine

The variable resistor should be of the wire-wound type capable of carrying a current of at least 1.4 times the maximum mean d.c. current. This means that a resistance able to carry at least 3 amps must be employed.

Construction

Ideally a charger should be constructed on a steel chassis and housed in a steel cabinet, but whatever method is employed it is essential to provide adequate ventilation for the metal rectifier. The makers of these rectifiers state that the air temperature immediately below the unit should not normally exceed 25°C. or 77°F.; occasional short-duration overloads up to 35 C. are, however, permitted. Some careful ventilation is necessary in order to comply with these figures, it being normal practice to make provision for the free circulation of air in a vertical direction over the rectifier. This is best achieved by cutting a slot in the chassis immediately below the rectifier and drilling corresponding ventilating holes in the bottom of the cabinet. Holes are also required in the top of the cabinet immediately above the rectifier. Then, to ensure an unimpeded circulation of air, the cabinet must be raised off the bench by at least an inch to allow air to reach the lower ventilating holes. Lack of cooling is perhaps the main factor in reducing rectifier life, so a little thought in this direction is well rewarded.

It is unlikely that a transformer having the required secondary voltages will be readily available, but it is an easy matter to rewind an existing component to meet the requirements. In selecting a suitable transformer for rewinding it is important that it should be satisfactory in the following ways:

(1) The stack size must be adequate. Allowing for losses and a reasonable safety margin, the transformer must be capable of supplying 35 watts. This means that the products of the various secondary winding voltages and currents of the selected transformer must at least equal this value.

(2) The secondary windings should be on the outside of the bobbin where they can be easily removed without disturbing the primary. This may be ascertained by noting the relative position of the various lead-in wires.

(3) The transformer should preferably not have been vacuum impregnated, as this type is often very difficult to dismantle, the impregnating varnish serving as an excellent glue.

Having selected a suitable component, a test winding of 4 turns should be wound around the bobbin over the secondary. The voltage obtained on this test coil will indicate the number of turns per volt to which the original design was made. Care is required to ensure that the mains supply is fed to the correct tap when making this test. From the results it will be a simple matter to calculate the total number of new secondary turns required and the position of the taps. The core is then removed from the transformer and the secondaries unwound. Before winding on the new secondary, two layers of Empire cloth are placed over the outside of the primary. The whole secondary is then wound on, using 16 s.w.g. enamelled copper wire. It is convenient to make each section finish at the sides of the bobbin, as this enables the taps to be brought out as loops of wire. One layer of Empire cloth is used between each layer of wire.

The appropriate tap may either be selected by means of a heavy duty rotary switch or by three heavy duty terminals and a flying lead terminated in a spade grip. An indicating lamp is connected across the low voltage tap to show when the charger is in operation, and an ammeter is included in the battery circuit to indicate output current.

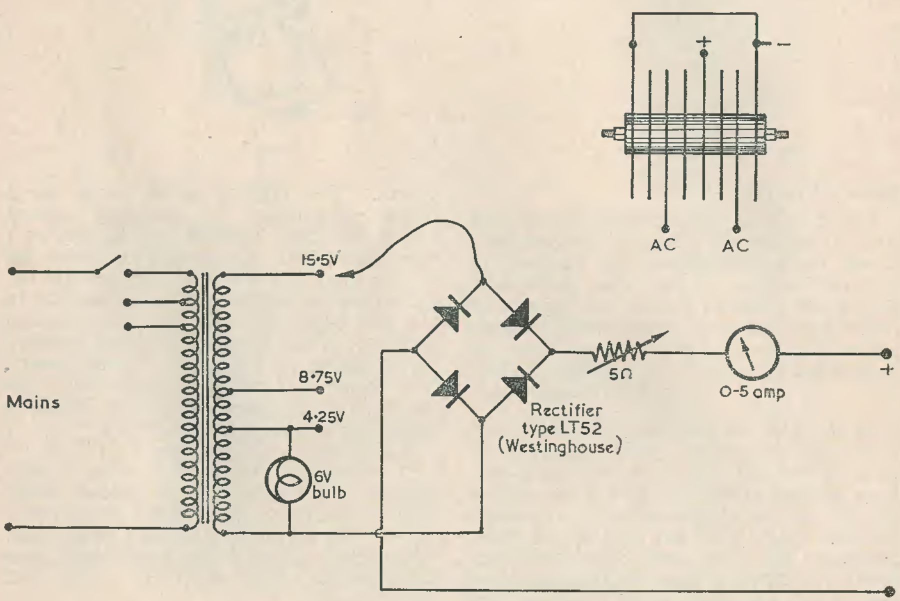


Fig.1
Complete circuit of charger & connections for rectifier

Charging

Finally, a few notes on the care and maintenance of accumulators may be of some assistance.

The electrolyte should be topped up with distilled water to a level just above the plate separator. Acid should only be added if electrolyte has been spilled from the accumulator. With the accumulator connected and the suitable transformer tap selected, the series resistor is adjusted to give the required charging current. Using the specified rectifier this must not be allowed to exceed 1.5 amps. The charging time in hours for a wet lead-acid cell which is completely discharged, but otherwise in good condition, is:

$$\frac{\text{1.2 times Amp-hour capacity}}{\text{Charging current (Amps)}}$$

When the cell is fully charged the specific gravity of the acid will have risen to 1.24–1.3, the exact value for any particular cell being specified on the maker's label. In this condition the on-charge voltage will have reached 2.6–2.75V. At the completion of a charge the plates should be gassing freely, and the positive one will appear deep chocolate in colour, whilst the negative plate should be a light grey. Before returning the accumulator to service, smear a little vaseline on the terminals after wiping them with a dry cloth.

PORTABLE AMATEUR RADIO EQUIPMENT CONTEST RESULTS

The QRP Society's P.A.R.E.C. was organised in the hope of bringing to light some of those interesting or useful pieces of equipment which often lie hidden in the shacks of over-modest amateurs.

It may not have been a conspicuous success in this laudable direction, but it did produce evidence of a different but no less estimable character. It showed very plainly that the section of the radio trade which caters specifically for the amateur has an honest concern for the welfare and advancement of the amateur.

It is the special desire of the QRP Society that most sincere thanks should be tendered to the firms who have proved the point by so kindly providing the prizes for this contest—to *Messrs. Southern Radio of Salisbury, Ltd.*, to *The Teletron Co. Ltd.* and to *Data Publications, Ltd.* To the latter concern, as publishers of *The Radio Constructor*, a further debt of thanks is due for their much appreciated efforts in the capacity of unbiased adjudicators of the contest, an onerous task which they accepted willingly despite the very considerable amount of extra work involved.

The First Prize comprised: (1) a credit note to the value of £2, donated by *Messrs. Southern Radio of Salisbury*; (2) a 12 months' subscription to *The Radio Constructor*, presented by *Data Publications, Ltd.*; and (3) a set of Panel-Sign transfers, also given by *Data Publications, Ltd.*

This prize was won by **Mr. John J. Yeend, G3CGD**, of 30 St. Luke's Road, Cheltenham, for his portable transmitter and receiver. This most excellent piece of equipment is (*continued on page 309*

THE HIGH-Q PRE-SET PUSH-PULL TWO

by J. W. BAGNALL

INNUMERABLE DESIGNS FOR SIMPLE RECEIVERS have been published in recent years. The introduction of miniature valves after the war permitted a considerable reduction in the size of these portable designs. With a few exceptions, however, the circuits have been conventional, either straight or superhet, and often with considerable ingenuity exercised in their layout.

The subject of this article is to suggest a line of experiment which in the opinion of the writer might lead to some fruitful results in respect of simple receivers. First thoughts on the problem led to the conclusion that little has been done about improving tuning coils. Most published designs use commercially available coils which, although efficient enough for general purposes, often do not fit a specific need.

Most of the selectivity in a superhet receiver is provided by the i.f. amplifier. In a t.r.f. receiver the ability to pick out signals of one frequency from all others is determined by the Q of the tuned stages alone. In the early days of radio, coils were rightly considered the heart of the receiver, and were wound on large formers several inches in diameter which resulted in reasonably high Q's. In present-day circuits coils are used which may be only an inch in height and half as much in diameter. They often make use of iron dust slugs and litz wire.

Higher Q

But can we improve even further? Some thought was devoted to increasing the efficiency of tuning coils, and it was decided to concentrate on dust iron "pot-cores." The use of these relatively neglected components enables a coil to be wound combining the twin virtues of high Q and small physical size. A "Neosid" type core as used in this receiver is shown in Fig. 1. This core was obtained on the surplus market for the sum of sixpence

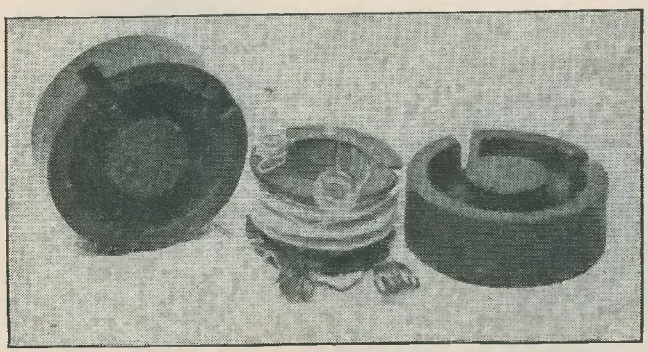
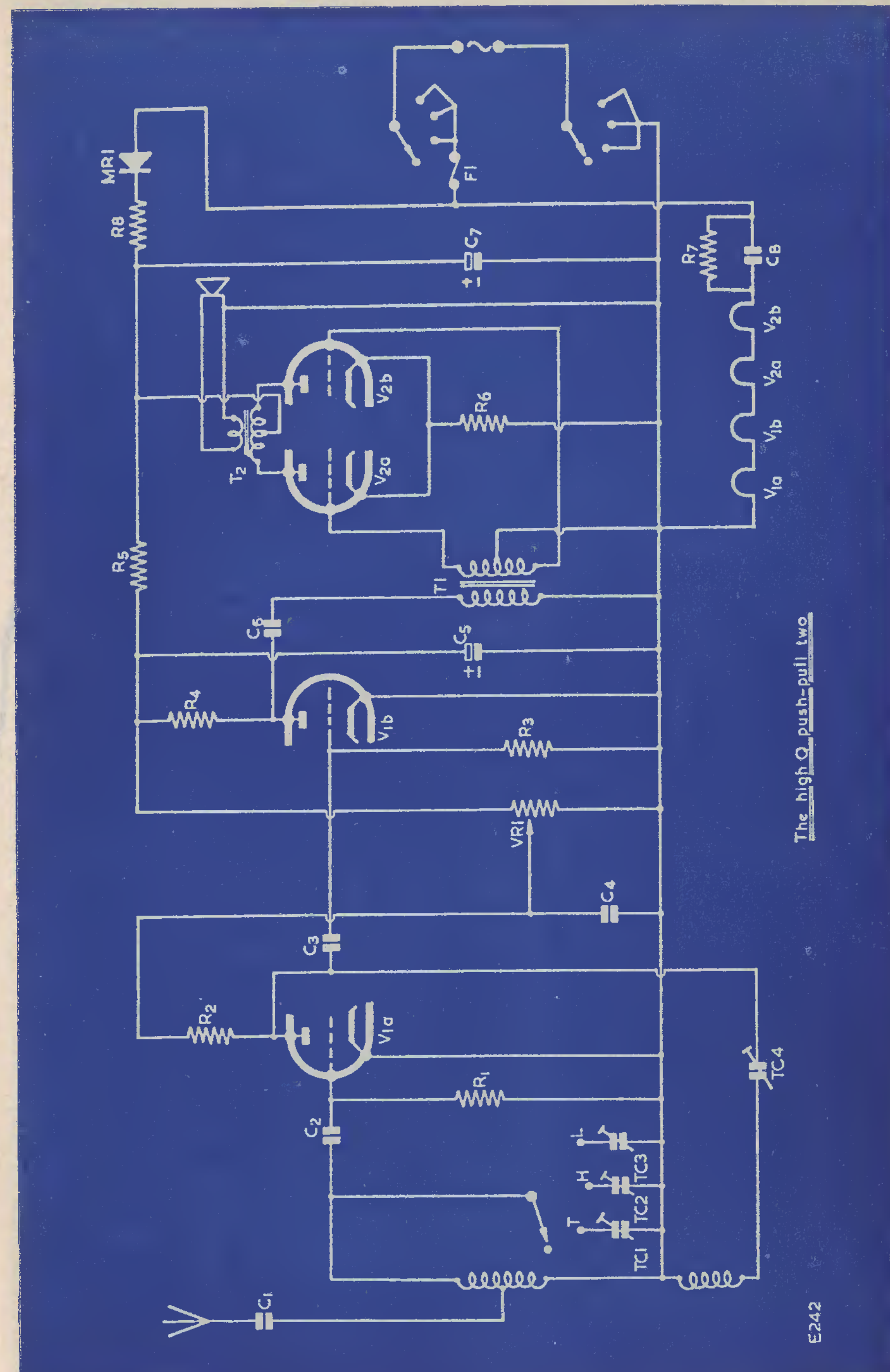


Fig. 1. An experimental coil wound on a Neosid pot core



and measures 1in. in diameter and ¾in. high. The advantage of this type is that the coil is provided with a complete magnetic circuit, which, due to the material used in its construction, introduces a very small iron loss.

The next step was to wind a coil in one of the cores, using enamelled wire and then using litz wire. A series of tests were carried out with the aid of a "Q" meter, the results of which are given below. All tests were carried out at a frequency of 900kc/s with a tuning capacitance of 200pF.

Coil type	Q obtained
Miniature coil with iron dust slug	60
Standard size air cored coil	70
Pot-core using 32 s.w.g. wire	150
Pot-core using 7/45 litz wire	280
Pot-core using 36/47 litz wire	420

A study of the above shows that while there is a worthwhile gain in Q when using enamelled wire, the real increase results from the use of litz wire. For further information on the subject of Q and its importance the reader is referred to an authoritative article by A. Blackburn in the May 1954 issue of this magazine, also to "In Your Workshop," October, 1954.

(Readers who do not wish to undertake winding their own coils will be interested to know that a direct equivalent, necessitating no alteration to the circuit, is available from Osmor Radio Products Ltd. The type number is QA81T, which is similar to the better known QA81 half-cupped coil, but having a centre-tapped tuned winding as specified by the author of this article.—Ed.)

Practical Application

Having obtained a highly efficient coil, the next problem is how to use it. The circuit that is given is simple in the extreme, having a single L/C circuit for tuning which is followed by a detector, a.f. amplifier and a push-pull output stage. The result is a stable circuit which has proved its repeatability, and although only two valves are used there is plenty of "punch"; also, most important, a very reasonable quality output.

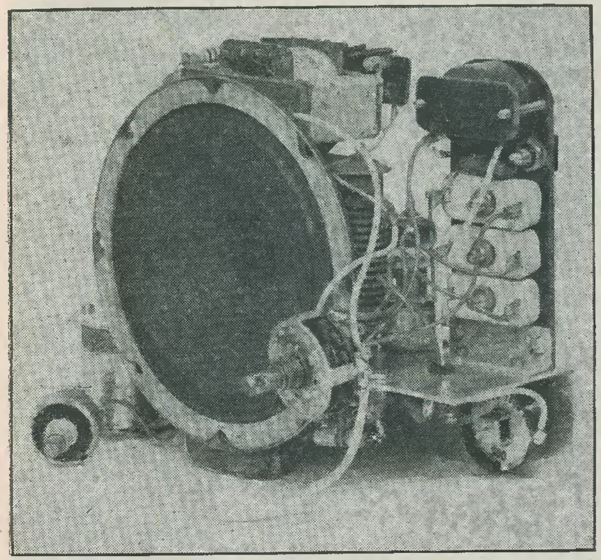


Fig. 2. Front view of the prototype chassis. Note how the coil and preset condensers are mounted on a Paxolin panel.

The Circuit

It will be seen from the circuit diagram that a tapped aerial coil is used, the coil being shunted and tuned by the three switched trimmers which give reception of the Home, Light and Third programmes. These, of course, could be replaced by a single-gang 500pF tuning condenser if desired. The aerial is not taken directly to the grid end of the coil but is tapped down to reduce the loading on the tuned circuit. The triode section V_{1a} is used as a leaky grid detector, reaction being applied to the coil via TC_4. As only two controls were wanted on the front panel the reaction condenser is preset, the gain of the whole stage being varied by altering the h.t. voltage applied. Although there are disadvantages with this method, in practice it works quite well; giving a smooth control of volume, while in the maximum position reaction is automatically applied to obtain full sensitivity.

The Output Stage

The writer must confess that at first this constituted rather a problem. The space available in the case to be used was limited and a series heater chain seemed to be desirable. This ruled out most miniature output valves, and although a 50L6 valve which has a 0.15A heater was tried it still left something to be desired.

Then the thought occurred, why not a 12AT7 valve strapped in parallel? The two sections were paralleled, having their grids joined and anodes connected together while the two cathodes shared a common bias resistor. The anode current flowing in the output transformer is now double that of a single valve, so therefore the power output is also doubled. Now the set really began to work, and the next obvious step was to use them in a push-pull circuit. This mode of operation has several advantages over the more obvious parallel arrangement. The anode currents, since they pass in opposite directions through their respective half-primaries, cancel one another so far as saturation of the core is concerned.

Second harmonic distortion produced by either valve is cancelled by equal and opposite distortion from the other. Two triodes therefore give a greater undistorted output than if connected in parallel. Also, most important, hum on the h.t. line cancels out in the two valves enabling a minimum of smoothing to be used.

The results were now most encouraging, and the design was finalised using a phase-splitting transformer to feed the grids of the output valve. To avoid any possibility of the transformer primary being saturated by direct current flow, it is shunt connected to the anode of V_{1b} via a condenser.

The Power Supply

The h.t. current drain of the receiver is extremely small, being in the region of 10mA, this being supplied by a metal rectifier. Heater current is provided by the condenser C_8. This method of series dropping does not appear to be as widely used as it might. The snag with a dropping resistor is the heat that is produced; in this case it would be around 30 watts. By using a condenser, the reactance of which at 50 c/s is 1,500 ohms, a current flow of approximately 0.15A is produced without the disadvantage of heat inside the small receiver case. The voltage rating must, of course, be adequate to withstand the peak mains voltage, a 600 volt unit being recommended.

Fortunately, there are a large number of these condensers available at very reasonable prices. The resistor R_7 has no connection with the heater current, but ensures that the condenser is discharged when the receiver is switched off. A 500mA fuse is included to guard against condenser breakdown. The used a.c./d.c. precautions should be observed, as one side of the mains is connected to the chassis.

COMPONENTS LIST

C_1	100pF
C_2	68pF
C_3	2,200pF
C_4	0.1μF 350V wkg.
C_5	8μF 350V wkg. electrolytic.
C_6	0.01μF 350V wkg.
C_7	8μF 350V wkg. electrolytic
C_8	2μF 600V wkg. paper
R_1	470kΩ ¼W
R_2	330kΩ ¼W
R_3	220kΩ ¼W
R_4	68kΩ ¼W
R_5	47kΩ ½W
R_6	470Ω ¼W
R_7	1MΩ ½W
R_8	1kΩ ¼W
V_1	12AT7
V_2	12AT7
TC_1	500pF preset
TC_2	500pF preset
TC_3	200pF preset
TC_4	500pF preset
VR_1	100kΩ ½W carbon pot
T_1	Wearite 230 or similar push-pull input transformer
T_2	Push-pull output transformer
MR_1	30mA metal rectifier
F_1	500mA fuse
	3-way 4-pole miniature wafer switch

Construction

The coil former, which is made from bakelite, should be subdivided into four sections, using thin card or celluloid, and 14 turns of wire are wound into each section. The aerial tap should be made at the centre, while the reaction winding is two turns of 28 s.w.g. enamelled wire wound over the earthy end of the coil. Should litz wire be used, some trouble may be experienced in tinning the ends. The best method is to heat the end of the wire with a match until it just turns cherry red, then quickly plunge it into methylated spirit. As the "meths" invariably catches fire, only use a small quantity in a bottle cap or similar container, and be sure to move the main supply well out of danger.

Be sure that the winding of the reaction coil is connected in the correct phase, or the reaction will have the effect of cancelling the signal. It should be noted that the station selector switch is also the mains on/off switch, and as it switches both sides of the mains supplies the set is "safe" when switched off.

No layout diagram is given as the reader will no doubt wish to make use as far as possible of components which he already has to hand. The only points that need to be watched are that the pot-core is mounted at least an inch away from the chassis, otherwise the Q will fall badly; also that the leads from C_2 and R_1 to the grid are kept as short as possible. In the prototype the pot-core and station selection trimmers were mounted on a piece of paxolin, as can be seen from the photograph.

Summing Up

While it cannot be claimed that this receiver will equal the performance of a superhet, given a reasonable aerial very good results will be obtained.

The author feels that the use of pot-cores opens up a wide field for the keen amateur to explore, and hopes that the results obtained with the "Push-Pull Two" will spur him on to investigate for himself its full possibility.

Can Anyone Help?

Requests for information are inserted free of charge in this section; subject to space being available.

G. P. LANGTON, 55 Engadine Street, Southfields, London, S.W.18, wishes to buy or borrow the circuit of the Regentone Eliminator model W.5 200/250 A.C.

* * *

R. RICHARDS, 5 Ridge Road, Hornsey, London, N.8, needs assistance with a model ESPEY 104-TC type SC, which is part of the Test Set I-56-H, and is a combination tester. The resistance ranges are satisfactory, but voltage readings are some 25% high. A valve check included has scale marked "Bad Tube" and "Good Tube," and this may also be inaccurate. The capacitance bridge (up to 10µF) is not functioning. Any assistance at all would be welcomed, especially in obtaining the Manual (it is ex-U.S.A. Services Equipment).

* * *

P. R. CLARKE, "The Walmers," Collington Lane, Bexhill-on-Sea, Sussex, wishes to buy or borrow the circuit of the Charles Concerto Amplifier.

* * *

S. A. WHEELER, 3 River Road, Buckhurst Hill, Essex, needs information on and the circuit of the National N.C.156.1 receiver. The circuit of the N.C.101X receiver would do, as this is the same except that in the N.C.156.1 the 28Mc/s band has been replaced by the shipping band.

* * *

A. VEST, 10 Mavin Street, Durham City, Co. Durham, would like to buy or borrow the circuit and data of the ZC13312 Identification Unit R.D.F. No. 1. The unit is complete with power pack (high cycle?).

* * *

S. D. HOFF, G3AWM, 51 Gwencole Crescent, Braunstone, Leicester, appeals for the circuit and/or alignment data for the RME69 Receiver.

A. GUY, 48B Waterloo Road, Widnes, Lancs, will pay well for any information, particularly valve line-up, on the Admiralty Pattern W1680 Tuner Amplifier B23, frequency range 42–1,000 kc/s in five bands.

* * *

N.Z.72855, A.C.1. RIORDAN, A.A.C.1., No. 14 (F) Squadron, R.N.Z.A.F., R.A.F. Station, Tengah, Singapore 24, F.E.A.F., would like to obtain the circuit and data on the 194 I.F. Unit.

* * *

H. J. STEBBINGS, 33 Wilton Road, Reading, Berks, is anxious to obtain the service sheet or circuit diagram of the Meico 30A Amplifier serial no. 658.

* * *

M. BUTTON, 7 Upper Flowerfield, Nunney, near Frome, Somerset, requires the circuit diagram of the TR1196 receiver, and also details of converting it to tune from 1.5 to 6 Mc/s. He also needs a circuit for a suitable power supply for same, and offers reasonable payment.

* * *

W. TOMPKINS, 17 Snowden Road, Wrose, Shipley, Yorks, needs information on, and/or conversion data for, the type 71 receiver, which is part of the TR1143 Unit Ref. No. 10P/13052.

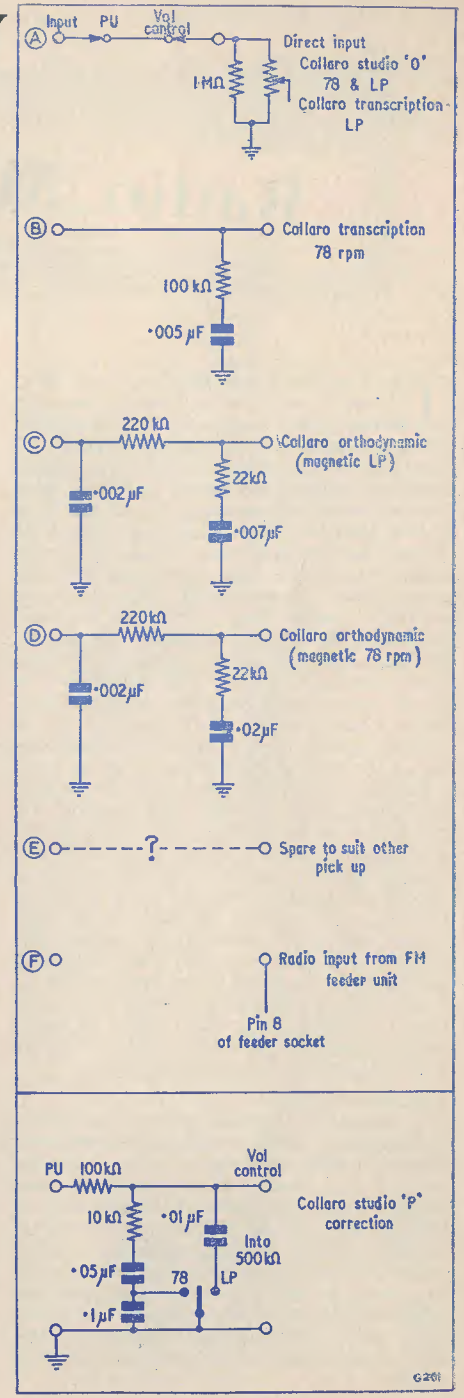
* * *

Appreciation. C. N. BLATHERWICK, G3VU, "Villette," 20 The Drive, Roundhay, Leeds 8, would like to thank all the Good Samaritans (anonymous and otherwise) who wrote in with data and very detailed diagrams of the B2 Tx/Rx, which is plug connections of the B2 Tx/Rx, which is now in working order. Every effort will be made to reply individually, where this is possible.

HIGH QUALITY 10 WATT ULTRA-LINEAR AMPLIFIER

Further Notes

by L. F. SINFIELD



Equalisers

Although it was previously stated that the amplifier was mainly designed for use with crystal pick-ups, there are many who prefer to use magnetic types. For moving coil, ribbon, variable reluctance and similar types, the output is so low that the previous remarks still apply in that a further amplifier stage is necessary, and this should be connected via the feeder socket. However, many other popular dynamic types, such as the Collaro (Orthodynamic) and similar units of other makes, have an adequately high output to allow for compensation. The equaliser has therefore been rearranged to allow for such units. Values are for the Collaro type and are those specified by the manufacturer. Other types would be similar, except that the 0.002µF input condenser may have to be changed, and also an input loading resistor may be necessary.

Another point is that the Collaro transcription type crystal pick-up is now in widespread use, and as this has a wider frequency range than either of the "Studio" types it is preferable to them. Again the correction is as specified by the manufacturer.

For those using the "Studio P" unit the manufacturers' correction is given, and this can be used in place of other correction units. It will be noted that this correction is different from that previously suggested, data for which was taken from published information other than that of the manufacturer.

It is important only to use the correct equalisation values and not to try using a specified network with pick-ups other than the correct one. Often, particularly in crystal types, the pick-up is designed with varying degrees of internal mechanical compensation, and this greatly affects the correction network design.

Radio Miscellany

THE VIOLENT GALES IN EARLY OCTOBER, following so calm a summer, brought down aerials galore both in exposed areas and in the towns. On the outskirts of South London I noticed many t.v. aerials with missing members on my daily journeys, and not a few of them were of comparatively recent erection. The present-day thin wall dural tube seems to snap off with alarming ease, especially at any point where it has been drilled or weakened. Yet my own ex-W.D. non-anodised dural which has been up since 1946 seems to withstand the roughest weather and still looks good for years. That also applies to a 15ft length of 1in dural mast which supports it. Recently, when I added the Band III aerial, I had a careful scrutiny and, apart from a roughening of the surface, it looked as good as ever. I polished a part of it and was surprised to find how little rubbing was required to produce a perfect surface. Yet much of the stuff which goes into many proprietary t.v. aerials scarcely seems to stand up to a couple of seasons. With no signs of deterioration after 9 years of exposure to coal fumes and other chemical impurities (the surfaces were hardly pitted) I am beginning to wonder if it's going to see my time out.

It would be interesting to know how other users of ex-W.D. dural find theirs for longevity—especially those who, early after the war, bought it up at give-away prices.

Cash and Carry

I remember I bought mine at a dump at Kingston. Anyone with greater business acumen would have made a small fortune even if they re-sold at a quarter of later prices. They appeared to have so much of the staff that, at first at least, they were glad to get it off their hands at any price. Apparently nobody wanted to buy it, and when it first came to my knowledge the price was fixed at ten bob for as much as one could carry away. A big advantage for local chaps and those used to hunking bulky loads around!

It was mostly in 15ft lengths, so naturally there was a limit to what you could carry through the gate. Chaps determined to get their money's worth struggled out looking something like ants carrying loads of matchsticks.

If only I had had a little black market petrol my bank balance might look a little more respectable nowadays. There was no basic petrol ration at that time (nor indeed, for some years after) and for me Kingston was rather beyond walking distance; or, should I say, beyond dural carrying distance. Ideas of buying "on spec" for re-sale at an uncertain date did not seem so promising when one remembered anyone else could pick it up just as cheaply if they went to the trouble.

Eventually I went on a borrowed bicycle and consequently contented myself with one load. I well remember the journey, getting there after three stops—twice to recover my breath and once to pump up the back tyre. I lost count of the stops on the homeward journey, and even that was with a comparatively light load; compared with what other people were taking away for their ten bobs, that is.

No Trick Cyclist

True I had started out with the idea of bearing off a magnificent lot, but I put most of if back before I got to the gate. At first it seemed the smart thing to do was to push the narrower gauges inside the fatter lengths. It isn't so clever really. The inside pieces slide out and either trip you up, or if they make their exit from the back end cause you to drop more pieces as you try to recover them.

When a small boy I was once "borrowed" by a conjuror. On the stage he kept producing eggs out of thin air and passing them to me to hold. I recall him pushing them into my arms, and the more I tried to save them from falling the more I dropped. Naturally the audience loved it, and laughed their heads off. I felt that carrying too much dural was likely to produce the same sort of sensation. I certainly didn't want to make myself ridiculous by dropping and picking up lengths of dural all the way home. Dural tubing when dropped clatters noisily and would be certain to attract the attention of everybody within earshot—especially small boys with a penchant for cheap wit!

After a little practice up and down the yard I eventually settled on what I thought to be a "reasonable" load. This was a mere three hundred feet or so, rather less than half the quantity borne off by able-bodied pedestrians. This struck me as most unfair. I protested to the gateman that I ought to be let off with five bob, or even less. But not likely, his instructions were ten bob a load, either for as little or as much as you chose to carry.

Despite the nightmare journey home it was a wonderful bargain—and quite an experience. The price seems almost incredible nowadays when, if you are very lucky, you might get six feet of that quality for the price.

CENTRE TAP *talks about* AERIAL MATERIALS · A POST-WAR BARGAIN · A USEFUL DIARY

The Printed Word

An odd item of news catches my eye. It is published without comment. Council house tenants at Cressing, Essex, are being asked to pay £12 10s. to share a communal t.v. aerial. Frankly I don't think I can make any comment either, but I wonder how much they paid for *their* dural and how much more they will be expected to pay if a gale happens to blow it down?

The tenants might, of course, have found cause for hope by a report in another newspaper which tells of a Tottenham man who has "designed" a new t.v. aerial. It consists of a yard and half of twin wires coiled in a peppermint tin. Then he made a hole for the "inlet" (to let the waves in, I shouldn't wonder) and stuck it on the wall with adhesive tape. This he followed with an improved model using a stronger tin (query —hotter peppermints or to take a bigger inlet hole?)—and put in other inexpensive bits and pieces to eliminate interference. Total cost, four shillings, although it is not reported whether this included the cost of the peppermints.

Incidentally several readers drew my attention to this report, and told me it makes them squirm to see people who don't know any better swallowing this sort of nonsense.

The council house tenants of Cressing must find it wonderfully consoling to read of such an invention which offers them a saving of about £12 6s., or perhaps a shilling or two more—if they don't happen to like peppermints!

Christmas Gift

Recently I had occasion to refer to a wireless diary twelve years old, and found it surprising to note how little it differed in the information contents from the 1956 edition. By a coincidence, the following day a copy of a diary by another publisher (Quinn's Electrical Engineering, Radio and T.V. Diary) of pleasing freshness, came in for review.

This is the first copy I have seen of this particular diary, although it is published by a firm of many years standing. It contains 92 pages of technical information as well as a 16-page coloured map section, general information, a colour map of the British Isles, and the London Underground system. To the radio amateur it is the technical section which is of primary interest, and nearly 30 pages (including seven art paper pictures) are given over to t.v., covering up-to-the-minute developments.

Nor has the practical side been neglected, and essential items such as drill sizes, tapping and clearance, wire gauges and turns-per-inch, etc., are fully covered. Indeed, it is almost impossible to fault the comprehensiveness of this technical section. Apart from valve details it seems to combine all the information one would collect together if one undertook the task of compiling one's own reference book. The diary section is somewhat cramped, carrying a week to a page, although from personal experience I imagine this to be adequate for most users. I use mine only for telephone numbers and "dates." After all, nobody wants a pocket diary for their life story!

This diary is excellent value at 4s. 3d. in leather cloth, leather 1s. 3d. extra, both prices including postage. It is published by H. O. Quinn, Ltd., 151 Fleet Street, London, E.C.4.

By the way, the publishers invite suggestions for additions to future issues. This will prove a bit of a puzzle, except for the highly specialised types.

RADIO—AND CONTROL

PART 2. *by* RAYMOND F. STOCK

The Simple Mark Space

LAST MONTH WE SAW THAT A MOTOR-driven rudder, spring-loaded to one side, would respond to a signal of varying mark-space ratio although in a rather crude (oscillatory) fashion. If the mark-space ratio can be determined by the movement of a steering wheel, a complete (if rudimentary) proportional system results.

Most readers will know a common method of generating a variable mark-space ratio signal by mechanical means, but Fig. 6 has been included for completeness.

The drum D is divided diagonally into a conducting and an insulating portion, and is rotated at a constant speed by motor M.

starboard; what can the rudder do but oscillate in some intermediate position? Obviously if the pulse rate is too slow the rudder will go hard-over alternate ways; but if we increase the rate (revolutions of the drum in Fig. 6) the inertia of the motor and gearing smooths this action out to a degree. The inertia of any practical model also helps here, so that the course might not be as curvilinear as expected. However, Fig. 7 is not intended as a practical circuit, but it does illustrate the very important point in true mark-space control systems, the concept of balance.

In this case we balance a spring tension—varying roughly pro rata to extension—

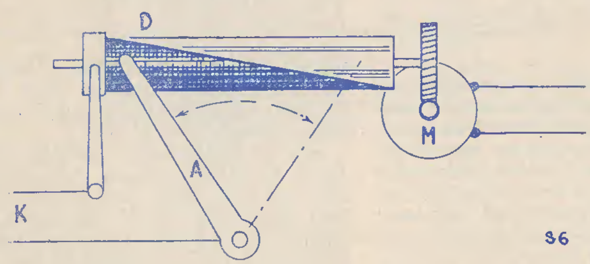


Fig. 6

The transmitter is keyed by two brushes, one in permanent contact with the conductor of the drum, the other, A, capable of an axial movement when a steering wheel is turned. A mark results once per revolution of the drum, its length depending upon the position of the wheel (and therefore the moving brush). Any mark-space ratio between 0 and 100% may be generated, and the ratio at any time is always a function of the wheel position. We can thus convey a continuous index of steering information.

At the receiving end our spring-loaded rudder is torn between two forces; one, the spring, tends to keep it hard a'port (see Fig. 7) and the other, imparted via the motor and gear train, tries to drive it to

against a mean electrical force (averaged out on a time basis).

All useful mark-space systems with any pretensions to proportionality must employ this idea, though the balancing is often done electronically.

Fig. 8 shows what happens when a moving coil meter is connected to the output of a mark-space generator. As the wheel is turned between its limits the pulses vary from 0% to 100% in length and the meter reads between 0 and full battery voltage. If the pulses are too slow the needle will read off an inaccurate square wave, but as we increase the pulse rate the damping of the meter comes into effect and the needle begins to oscillate (decaying exponenti-

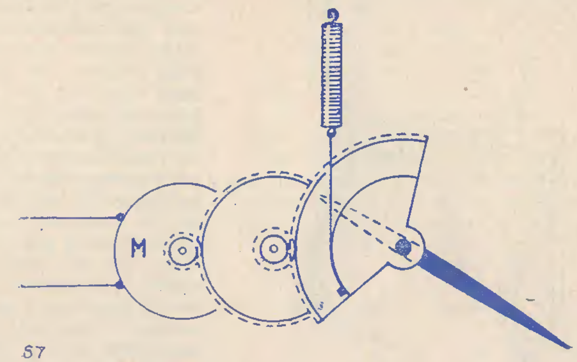
ally, of course) about a mean value. In practice a fast enough pulse rate—say 30 per second—would maintain it apparently quite stationary in any set position.

If the needle could operate a rudder, proportional control would be another problem disposed of!

idea. Obviously the pulse rate should be sufficiently high for the inertia of the moving element to damp out most of the oscillation.

For even moderate sized boats, or for cars, more power is required than this device can economically produce, and ignoring pneumatic and hydraulic methods (both

Fig. 7



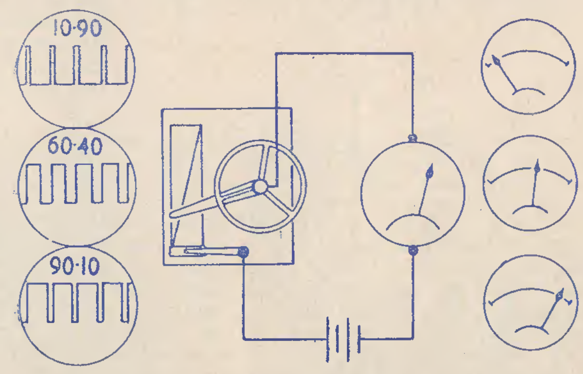
Unfortunately, it can't; we can, of course, build something like a large size meter movement accepting more watts and therefore giving more mechanical power, but such devices are most inefficient at converting energy. Nevertheless, when the utmost simplicity is required, as sometimes in air-

practicable, but rather outside the scope of this publication) it is necessary ultimately to control an electric steering motor.

Follow-up Gear

One line of approach is to use the unit in Fig. 9 and to replace its output lever by a

Fig. 8. Operation of a mark-space signal generator connected to a meter, showing three typical positions



craft, this idea can be—and has been—used. Usually a ring magnet is employed, pivoted within a coil carrying the mark-space signal current; the magnet sets itself to some position where the mean effect of the incoming current pulses is balanced by the torque of a spiral spring. Fig. 9 shows the

contact arm. The latter has a slight free movement between two other contacts; these are mounted on an insulated arm pivoted concentrically with the movement pivot. Fig. 10 illustrates this. The insulated arm A is geared to a motor driven in either direction from the conventional centre-

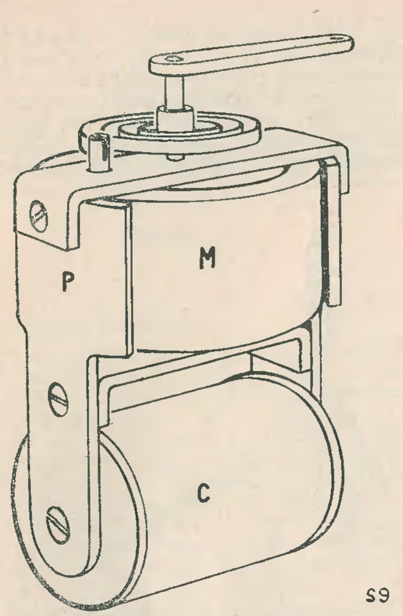


Fig. 9. M is the ring magnet, P the pole pieces of C, the field coil

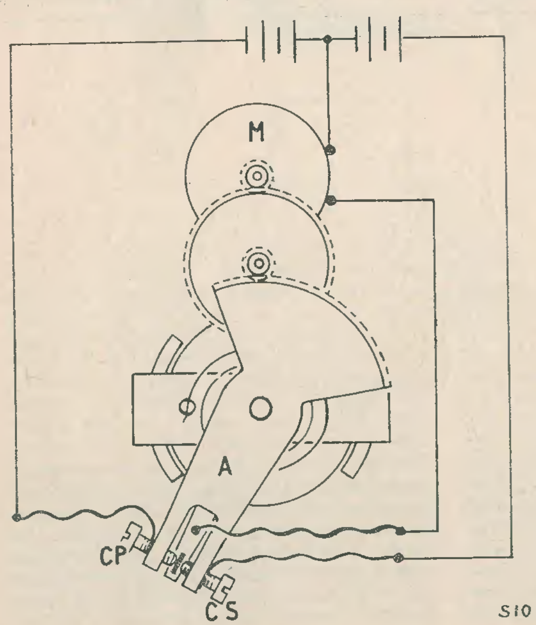


Fig. 10. Connection to the moving contacts is by flexible pigtails or by slip rings

tapped battery, and the two contacts CS and CP. Whichever of these is "made" by the contact arm will energise the motor, and in such a direction as to keep these contacts apart.

Thus the whole device consists of a balancing unit operating a true servo or follow-up mechanism. Output power to the rudder is taken from the insulated arm.

Although this steering unit has also been used by modellers and can give results, its chief purpose here is to carry the story a stage further. Its chief disadvantage, apart from the practical one of poor contact pressure (sometimes solved by use of mercury pots for CS and CP), is its lack of resolution, i.e. inability to follow small changes in mark-space ratio accurately, if at all. Some resolution is lost by friction in the pivots of the movement; more, by the necessity for a practical gap between contact surfaces. Since the arc over which the movement works is restricted to about 45°, any lost movement here is at least as great at the rudder. If someone would produce a meter movement giving two turns full-scale we might get somewhere with this idea!

Fig. 11 is next on the list, and it looks nothing like Fig. 10. Yet it employs the electrical equivalent of our balance-plus-servo mechanism. Being more "electrical" and less "mechanical" it is an improvement.

The receiver relay contacts C are in series with a battery, a relay Rl and a variable resistor. The contacts of Rl control a motor, which deriving its power from the centre-tapped battery will run in either direction according to the position of Rl armature. The motor drives the variable resistor via a reduction gear train.

Let us assume that a signal is being received with a certain mark-space ratio; current pulses are passing through Rl and since their repetition rate is high we can imagine them having a mean or average value in their effect on its armature. We can suppose that owing to the setting of the variable resistor, their result on Rl is just to keep its armature "hovering" between forward and back contacts.

If the mark-space ratio is increased, the average value of the current through Rl is also increased; the armature will be attracted, close the forward contact, and the motor will rotate. Its direction of rotation is such as to drive the variable resistor to a higher value, and at a certain point the increased resistance balances the altered mark-space ratio. Obviously the reverse happens should the mark-space ratio be reduced, and it can be seen that the variable resistor shaft always seeks the point of balance; it is of course connected to the rudder, and thus produces a steering angle proportional to the mark-space ratio.

Once again balance is involved, and examination of Figs. 10 and 11 will show the essential similarity between the pinciples involved, though the method is different.

This variable resistor circuit can be used as a practical design and is, in fact, often employed.

The receiver relay contacts C connect a voltage to the potential divider R_1 and R_2; across R_2 is C_1 which charges up whenever C is closed and discharges through R_2 when C is open. Thus it will be seen that a smoothed voltage appears at X, its value depending upon the length of time for which C is open and closed—i.e. the mark-space ratio.

Voltage X is applied to the grid of a triode, but is in series with the voltage appearing on the slider of a potentiometer R_3. This is connected across a suitable battery.

The motor control relay is now in the anode circuit of the triode, and is connected to the steering motor as before with a mechanical link to the slider of R_3.

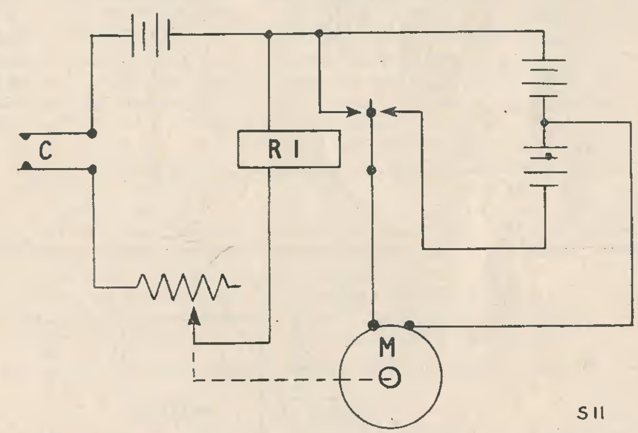
The functioning is fairly obvious; when the mark-space ratio is altered the voltage applied to the grid is temporarily changed. This produces an amplified effect on the relay in the anode line which, as before, starts the motor turning in such a direction as to move R_3 to a new position of equilibrium.

This circuit is not new though it does not seem to be widely used; nevertheless it is capable of giving very good results.

If any readers wish to experiment with it, a simple test rig combining Fig. 6 and Fig. 12 is simply constructed and will give interesting qualitative data regarding resolution, speed of follow-up, etc. Such a rig can be simply made, as it is immaterial whether a radio-link is used and a mark-space pulsing unit can be directly connected to the "receiver" relay.

The more electronically minded reader will have observed that the conventional pulsing drum (of Fig. 6) can be replaced by a multi-vibrator circuit in which the mark-

Fig. 11



Its principal disadvantage is, as before, lack of resolution; as the variable resistor approaches the balance point the error signal becomes very small until at some point—still short of the theoretical null point—the relay drops out. Alternatively the relay may stay in until the variable resistor has been rotated *too* far—in either case the effect occurs because it is impossible to adjust any relay to open and close at precisely the same current value. However good the relay, there is a limit to its closeness of adjustment—therefore the only way to increase resolution is artificially to increase the error signal.

Error Signal Amplification

Fig. 12 shows a circuit which is essentially the same as the previous one but having error signal amplification.

space ratio is controllable by rotation of ganged potentiometers. If this is done, the gear at both transmitter and receiver becomes virtually non-mechanical and is then almost resistance (2,000-3,400Ω) Siemans high-speed relays are recommended in both positions.

A mark-space ratio signal was chosen as an example of a "continuous" system for

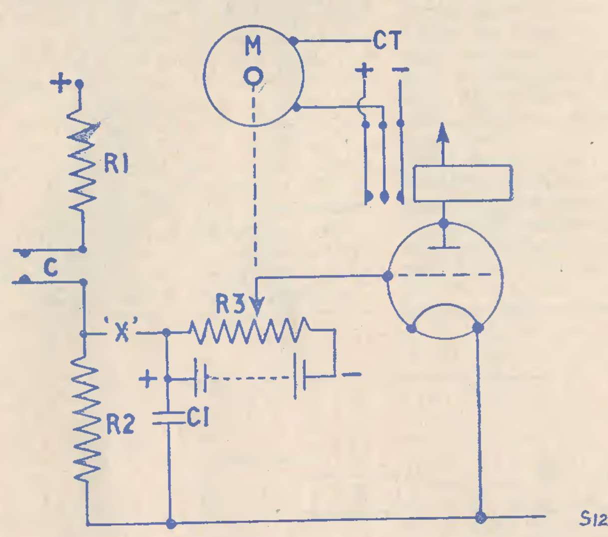


Fig. 12. *Additional stages of d.c. amplification can be used to increase resolution*

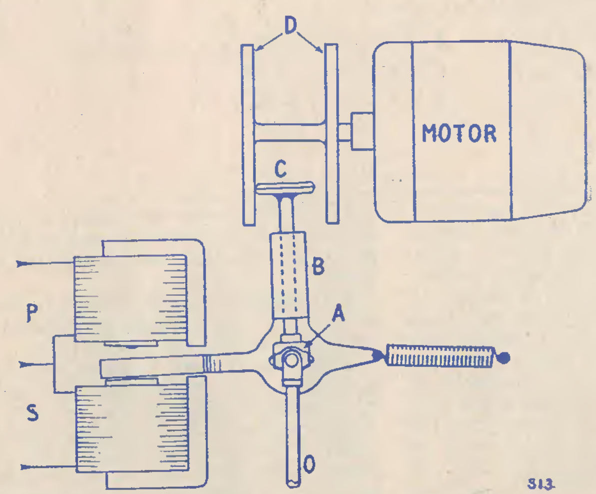


Fig. 13

entirely composed of standard ratio items. Both relays should be capable of following the square wave signal cleanly, and high simplicity. It will be evident, however, that one can vary any practicable characteristic of the transmitted signal provided it can be

interpreted at the model. One could, for example, transmit a train of equal-length pulses having a variable repetition rate; also one can modulate the transmitter with an audio signal whose frequency is tied to steering wheel position, and in this case a type of discriminator circuit is used in the receiver to produce the error signal required. Considerable scope is offered here to those who like experimenting with novel radio circuits.

General Points

Before disposing of the subject of continuous information systems, three points should be noted. Any such equipment can never "lose" information, as sometimes happens in equipment where the *number* of pulses sent is a vital factor. Any temporary loss of radio contact or other malfunctioning is made good when contact is re-established; the importance of this will be more evident when we consider non-continuous systems.

A second point is that these systems are a little wasteful of power (this may not matter in practice) since the same expenditure of energy is necessary to hold the rudder in a given position as to move it. In a practical installation it will be found that the balance mechanism is likely to oscillate or "hunt" about the null point; this is not necessarily a bad thing, since a fast rate of hunting over a limited arc keeps the system sensitive and lively. It is difficult to ensure this type of action, however, as the hunting rate depends chiefly upon the inertia of the moving parts—and the motor armature alone, running at a high speed, stores considerable energy.

The only way out of this difficulty is to use a permanently running motor, and to pick off rotary power by a friction or other clutch having the minimum inertia. Fig. 13 illustrates a piece of gear which can easily be made to produce this effect, while surplus computing equipment often provides this very item.

D are two discs continuously rotating. C is a rubber or plastic rimmed wheel which is carried by its shaft within bearing B. B is pivoted below the flexible coupling A, and is integral with the common armature of two electromagnets. As shown the armature is attracted to one side (circuit S energised) so that wheel C picks up rotation in one direction from D. The spring centres the armature (and C) when neither circuit is energised. Thus, output shaft O can be held stationary or rotated in either direction.

The final point regarding continuous systems is that they require only one radio channel per control. It is necessary, of course, to use a pulse repetition rate of, say, 15-50 p.p.s. to ensure fair resolution, and this precludes the use of multi-channel reed-type radio whose individual channels are unlikely to be able to handle better than 4 or 5 p.p.s. These considerations obviously lead one to examine the possibilities of retaining a single channel radio and varying *two* characteristics of the signal to control two proportional controls.

In our next article we shall have something to say on the possibilities of this idea.

(*To be continued*)

Portable Amateur Radio Equipment Contest

(*continued from page 295*)

already widely known among QRP amateurs following its publication in the R.S.G.B. *Bulletin* of September, 1954. The full description of this entry will appear in due course in the newly inaugurated "QRP Handbook" sheets which the QRP Society are issuing each month to their members and which will enable them, month by month, to build up a complete manual on QRP technique. It will be of special interest at this time of year, as it is known that at least one QRP section is proposing to construct facsimile equipments during the winter with a view to field-day operations next summer.

THE SECOND PRIZE consisted of: (1) a credit note to the value of £1, presented by *The Teletron Co. Ltd.*, whose excellent coils and transformers are becoming increasingly coveted items in amateur construction programmes; (2) a copy of *Data Publications, Ltd.* Data Book No. 6; and (3) a set of Panel-Sign transfers, both presented by Data Publications, Ltd. This prize was won by Mr. Vic Brand, G3JNB, of 137 Surbiton Hill Park, Surbiton, Surrey, for his entry of a one-valve transmitter using a 6C4.

The THIRD PRIZE, a 12 months' subscription to *The Radio Constructor* and a set of Panel-Sign transfers, both presented by *Data Publications, Ltd.*, was won by Mr. Guy Moser, G3HMR, for his entry of a crystal check oscillator.

Each winner will also be presented with a certificate by the QRP Society, these being now in course of preparation.

THE SKYMASTER

by FRANK A. BALDWIN, *A.M.I.P.R.E.*

AMONG READERS OF THIS MAGAZINE THERE has always been a demand for receiver designs, some requiring the normal domestic type, i.e. Medium and Long Wave sets, some the communications variety, and others the unusual type of circuit. From the wide range of types that have been published in the past, a.c. to d.c., t.r.f. to superhets, the unusual—a better term would be unorthodox—design has been in the minority, and understandably so since certain constructional practices have tended to become standardised over a period of time. An example of this is the employment of a double diode triode as the second detector in a superhet, one diode as the signal detector, the other as a.v.c. rectifier, with the triode portion as first l.f. stage. This has, for several reasons, become a commercial practice and has been largely followed by the home constructor.

In the circuit about to be described, we set out to design the unusual or unorthodox receiver and chose, as the basis, the communication type of receiver—although there is no reason why the circuit as such should not be used in a domestic type set. The main reason for the choice of type presented herewith was that the design lent itself to many economies not normally required in the domestic receiver. Of these economies, the absence of a b.f.o. stage, with the saving that this implies, together with the ability to receive c.w. signals at will, is probably the greatest. However, before the unorthodox can be accomplished, it is necessary in these days of standardisation to obtain certain components to a specified design not normally obtainable on the component market. This prerequisite is not, however, normally available to the constructor, and it therefore falls upon designers catering for this field to obtain such components and cause them to be generally available. The particular components in question here are the i.f. transformers, both of which have tertiary windings and are now available to the home constructor. These have been specially produced for us by The Teletron Co. Ltd.—see advertisement. For the remainder of the circuit, standard components have been incorporated and these, together with the type of valves used—some of which may be already to hand—tend to make the design fairly simple, reasonably inexpensive and of excellent performance.

In the "Skymaster" we have tried to keep the design within what may be termed the simple class of receiver and yet, at the same time, include many features normally only available to the more advanced types. The necessity of achieving this is yet another reason for the unorthodoxy of the design.

The Design

The basic design is fairly straightforward, it being the normal 6K8 Mixer Oscillator, 6K7 I.F., 6B8 Detector and 1st Audio, 6V6 Output and 5Y3 Rectifier. The EM34 is not regarded as part of the basic design. A glance at Fig. 1, however, will show that several departures have been made from the normal practice.

In the first stage, the tertiary winding of the i.f. transformer is utilised as a selectivity control, while that of the second i.f. transformer is used as a reaction control. The use of the latter effectively enables the operator to read c.w. signals and, in addition, allows the receiver to be advanced to its most sensitive state at will. This control therefore acts as both b.f.o. and sensitivity control.

The 6B8 has been arranged as a pentode detector, signal detection taking place at the control grid with cathode feedback as reaction. One diode is used for a.v.c. rectification, the signal source being obtained from the 6K7 anode, via C_{17}. The EM34 has been added to the basic design in order to provide some means of assessing signal strengths and correct tuning of the receiver.

Circuit

The first stage is constructed around the 6K8M mixer oscillator valve, the metal type being chosen for preference, although one of the normal glass types would suffice should the metal type be locally unobtainable. The coil pack chosen as being the most suitable is the Roding Laboratories type 30C. This pack covers the frequencies 1.5Mc/s to 28Mc/s in three bands. The numbers shown within the circles on Fig. 1 refer to the coil pack connections; these also being colour coded and shown in Table 1 under.

TABLE 1

Coil Pack Colour Code

(5) Black (6) Yellow (7) Blue (8) Green (9) Red (10) Brown

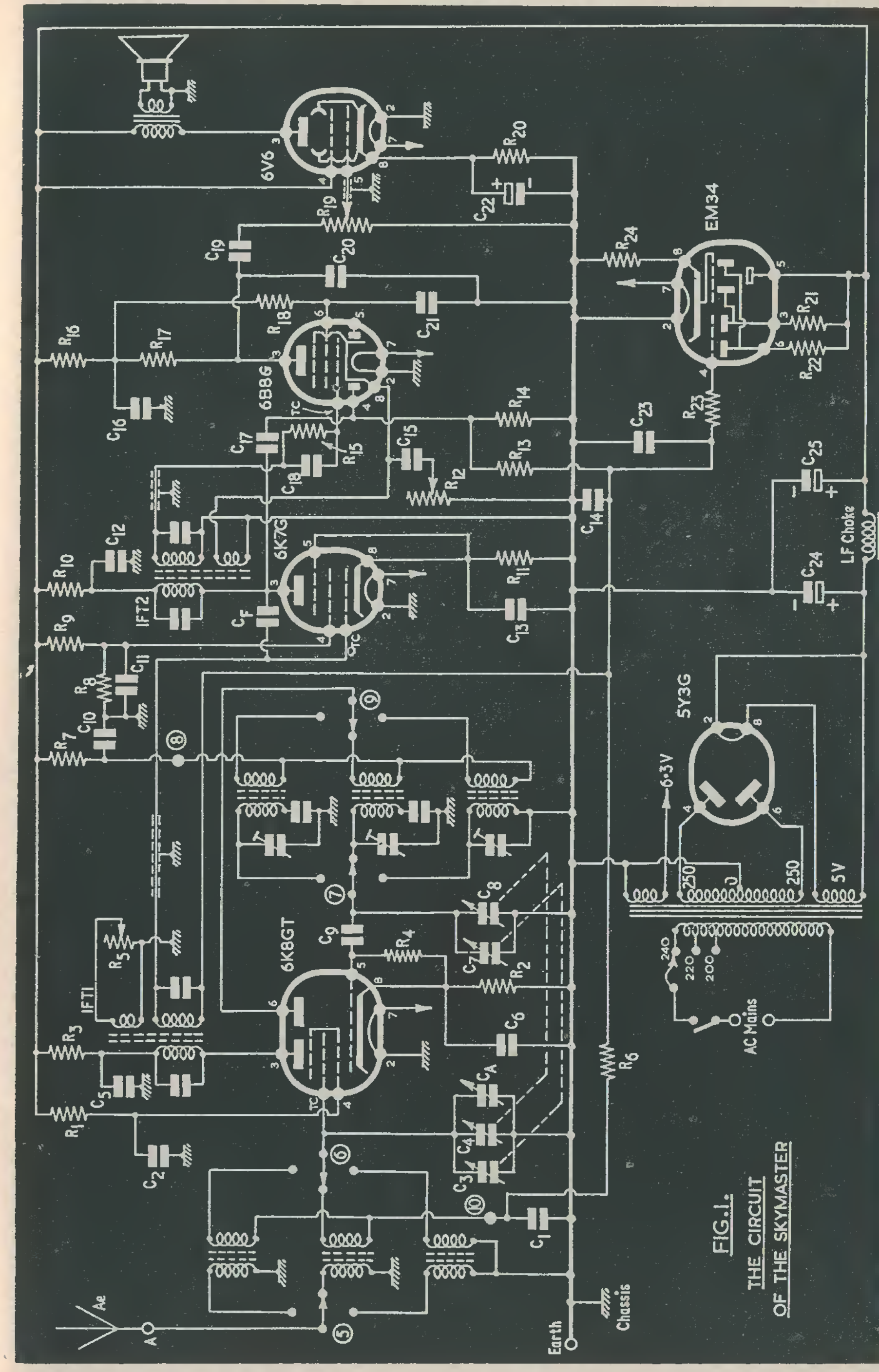


FIG. 1. THE CIRCUIT OF THE SKYMASTER

The variable condensers C_4 and C_7 are the ganged bandset components, while C_3 and C_8 are used as bandspread. C_A is a small 15pF variable condenser incorporated as the r.f. trimmer control, this being very useful in peaking those weak signals most desired by the DX'er. The numbers shown around the valves are the actual base pin connections, TC of the mixer being, of course, the top cap.

The i.f transformer shown in the mixer anode circuit is that supplied by The Teletron Co. Ltd., this being a specially designed transformer having a tertiary winding. This third winding is placed between the normal primary and secondary windings and, by the variation of R_5, the coupling between the latter two windings is variable at will. The less resistance across the tertiary winding, the greater will be the selectivity. The selectivity control is therefore R_5, a 5kΩ potentiometer, although many readers may prefer switched positions in preference to the potentiometer. In this case, a six-way Yaxley type switch would be suitable. The connections to the switch should be as follows—to the *input* from the top of the winding; first position of the switch *output* should be left blank; second, 2.5kΩ; third, 1kΩ; fourth, 500Ω; fifth, 150Ω; sixth, direct to chassis. The other end of the resistors should, of course, be connected to chassis. Thus, in position six, the maximum selectivity will be obtainable.

The oscillator section of the first stage is purely conventional and therefore beginner constructors should find no difficulty in building this stage, the colour coded coil pack greatly assisting in this respect. The selectivity control just discussed could, if desired, be left unwired until the receiver is otherwise completed and functioning; R_5 then being soldered into circuit.

I.F. Stage

This is built around the 6K7G variable-mu r.f. pentode. The lead to the grid of this valve, the top cap, should be of screened cable—the metal sheath being bonded to the chassis. The valve itself should be enclosed within an octal screening can. The screen grid h.t. supply is via R_9 which, together with R_8, forms a potential divider network, C_{11} being the by-pass component. The specified values of these two components should be adhered to if maximum results are to be achieved in this stage. The condenser C_F shown on the circuit diagram connected between the grid and anode is merely a positive feedback device consisting of a small length of PVC covered wire soldered to the anode and placed in a position near the grid so that reaction occurs. Having achieved this, the wire should then be moved slightly away from the grid until oscillation ceases. In this condition, once correctly adjusted, the i.f. stage is at its most selective state. A hole must, of course, be drilled through the chassis and suitably fitted with a rubber grommet in order that the feedback wire may be placed near the grid. All this should be carried out after the receiver has been completed and initially lined up. An i.f. gain control has not been incorporated into the cathode line, as this would make the receiver rather difficult to handle in conjunction with the reaction circuit about to be described. The value of R_{11} has been carefully chosen to give optimum results with the valve employed.

In the anode circuit a similar i.f. transformer to that in the mixer-oscillator stage is used. The secondary winding is connected between chassis and the grid of the following stage via C_{18} and R_{15}, these latter two components being the grid leak and condenser across which rectification of the applied i.f. signal takes place. The tertiary, or third, winding is used as the reaction feedback coil, R_{12} being the actual reaction control.

Detector/1st L.F. Stage

The 6B8G performs several functions in this receiver; it not only acts as the detector and first l.f. stage, but also as the b.f.o. and as a.v.c. rectifier; thus, from a single valve we obtain our greatest saving in both cash and space.

Reaction is obtained, as previously mentioned, by the variation of R_{12}, and judicious use of this ensures that the receiver is in its most sensitive state when operating just below oscillation level. By varying R_{12} so that the receiver goes into oscillation, we are able to read c.w. signals with ease, and therefore we have the advantages of a beat frequency oscillator stage. One of the diodes is connected to the i.f. stage via C_{17} and acts as the a.v.c. rectifier, the resulting voltage being taken via R_{13} to the a.v.c. line. The remaining portion of the valve is used as first l.f. amplifier, the signal being fed into the following stage via C_{19}. The anode h.t. supply is via R_{16} and the load R_{17}, C_{16} being the by-pass component. C_{20} has been inserted to filter out any residual r.f. that may still be present.

Output Stage

The well-known 6V6 output beam tetrode was chosen for this stage. The audio gain control is R_{19}, the lead from this to the grid of the 6V6 being screened cable, the metal outer of which should be earthed to the chassis in order to avoid hum troubles. Cathode bias is obtained from R_{20} and C_{22}. The speaker transformer should be mounted under the chassis in order that the speaker output leads may be terminated on the chassis wall to a paxolin strip fitted with the usual plugs and sockets. In this way the speaker may be mounted outboard, thereby avoiding possible vibration trouble from the speaker cone. Some three watts of audio is available from the output stage—more than adequate for the average "den."

The speaker transformer itself may either be of the multi-ratio type as specified or one of the standard types marketed as 6V6 matching transformers.

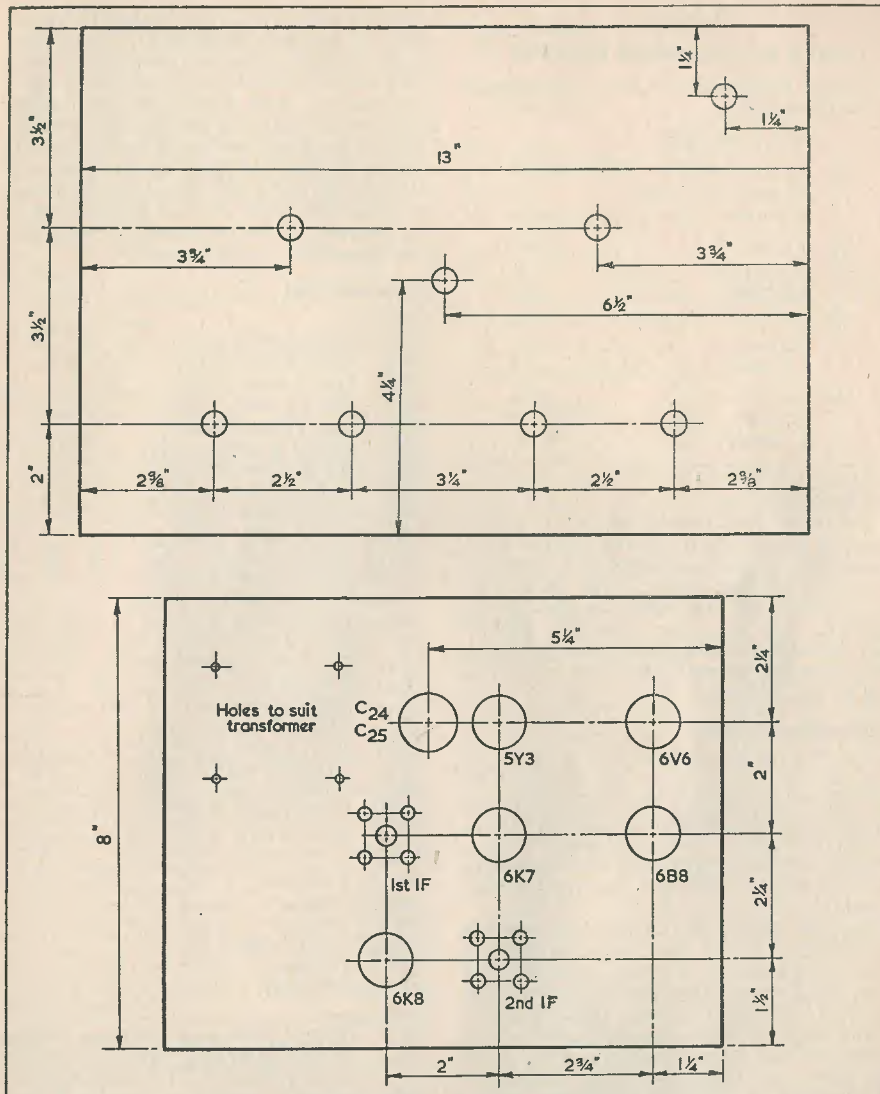


FIG.2. PANEL & CHASSIS DRILLING GUIDE (See text)

Magic Eye

The Mullard EM34 is used as the tuning indicator, this being mounted on the front panel so that the two "shadows" are easily and clearly visible. The circuit of this stage is perfectly normal except that the cathode resistor R_{24} has been inserted to obtain feedback and therefore greater sensitivity.

The "magic eye" can easily be added to the receiver at a later date and need not necessarily be included at the outset.

Table 2

Voltage Readings (Meter 1,000Ω/V)

No signal conditions—R_5, R_{12} and R_{19} at minimum setting.

H.T. line—205V

V_1	Anode, Mixer	200V
	Anode, Oscillator ..	75V
	Cathode	8.5V
V_2	Anode	200V
	Screen	95V
	Cathode	Nil
V_3	Anode	40V
	Screen	50V
	Cathode	Nil
V_4	Anode	190V
	Screen	205V
	Cathode	9.5V

Power Pack

The on/off switch shown in the a.c. power input is ganged to the audio gain control R_{19}. The mains transformer is a standard type 250-0-250V at 90mA, 5V at 2A, 6.3V at 4A, or similar. The power rectifier is the 5Y3GT. The l.f. choke, together with the two associated condensers, ensures that a ripple-free h.t. supply is delivered to the h.t. line of the receiver.

Constructional Notes

The front panel drilling guide is shown in Fig. 2, and the controls are mounted as follows: left to right at bottom, Bandswitch, Selectivity, Reaction and A.F. Gain; centre, Aerial Trimmer. Top right-hand corner, "magic eye" aperture. The two remaining controls are: left, Bandset, and right, Bandspread.

Both the Bandspread and Bandset controls are directly driven and no slow motion devices are included. The two dials associated with these controls are the Panel-Signs 4in by 2¾in full vision transfer types available in the No. 2 set. Both cursors are made from Perspex sheet, cut to size and scribed down the centre, the mark thus made being filled in with Indian ink. The remainder of the controls are also used in conjunction with suitable Panel-Sign transfers as the finger plates.

Constructors of the "Skymaster" will find that it performs very well over the entire wave-range and, for its price, is a good investment for those requiring a general purpose short wave receiver. In any event, many readers having other types of home constructed or commercial receivers will no doubt be interested in the i.f. transformers. These may be purchased and incorporated into these sets as a modification with a view to greater selectivity. An additional i.f. stage could be inserted, using an i.f. transformer similar to I.F.T.₁, the two secondaries being taken to earth through a common 5kΩ potentiometer, and greatly increased selectivity would result. Care would, however, have to be taken to avoid instability. It must be pointed out here, though, that only receivers having a 465 kc/s (plus or minus the usual variation) i.f. may be modified in this manner, as the only components available are wound to that frequency.

Component List

Resistors

R_1 22kΩ ½ watt ±10%
R_2 100Ω ½ watt ±10%
R_3 1kΩ ½ watt ±10%
R_4 47kΩ ½ watt ±10%
R_5 5kΩ Potentiometer
R_6 100kΩ ½ watt ±10%
R_7 22kΩ 1 watt ±10%
R_8 100kΩ ½ watt ±10%
R_9 470Ω ½ watt ±10%
R_{10} 1kΩ ½ watt ±10%
R_{11} 100Ω ½ watt ±10%
R_{12} 1kΩ Potentiometer
R_{13} 100kΩ ½ watt ±10%
R_{14} 1MΩ ½ watt ±10%
R_{15} 1MΩ ½ watt ±10%
R_{16} 4.7kΩ ½ watt ±10%
R_{17} 33kΩ ½ watt ±10%
R_{18} 100kΩ ½ watt ±10%
R_{19} 500kΩ Potentiometer
R_{20} 270Ω ½ watt ±10%
R_{21} 2.2MΩ ½ watt ±10%
R_{22} 2.2MΩ ½ watt ±10%
R_{23} 1MΩ ½ watt ±10%
R_{24} 270Ω ½ watt ±10%

Valves

6K8GT Brimar
6K7G Brimar
6B8G Brimar
6V6GT/G Brimar
5Y3GT Brimar
EM34 Mullard

Condensers

C_1 0.05μF, 350V wkg, TCC type CP35N
C_2 0.01μF, 650V wkg, TCC type CP45W
C_3 25pF variable, H. L. Smith & Co.
C_4 500pF variable, H. L. Smith & Co.
C_5 0.01μF, 350V wkg, TCC type CP45N
C_6 0.05μF, 350V wkg, TCC type CP35N
C_7 500pF variable (ganged with C_4)
C_8 25pF variable (ganged with C_3)
C_9 100pF Ceramic
C_{10} 0.1μF, 350V wkg, TCC type CP37N
C_{11} 0.01μF, 350V wkg, TCC type CP45N
C_{12} 0.01μF, 350V wkg, TCC type CP45N
C_{13} 0.005μF, 175V wkg, TCC type CP31N
C_{14} 0.05μF, 350V wkg, TCC type CP35N
C_{15} 0.01μF, 350V wkg, TCC type CP45N
C_{16} 0.01μF, 350V wkg, TCC type CP45N
C_{17} 100pF Ceramic
C_{18} 0.0003μF Mica, TCC type M2
C_{19} 0.05μF, 350V wkg, TCC type CP35N
C_{20} 100pF Ceramic
C_{21} 0.1μF, 350V wkg, TCC type CP45N
C_{22} 25μF, 50V wkg, TCC type CE16DE
C_{23} 0.05μF, 350V wkg, TCC type CP35N
C_{24} 16+16μF, 450V wkg, Electrolytic
C_{25} 16+16μF, 450V wkg, Electrolytic
C_F See text
C_A See text

Coilpack
Roding Laboratories, type 30C

I.F. Transformers
The Teletron Co. Ltd., type N/S (I.F.T.₁), N/R (I.F.T.₂)

Mains Transformer
Ellison type DT149

L.F. Choke
Electrovoice type 101J, H. L. Smith & Co. Ltd.

Panel, Chassis and Cabinet
L. J. Philpot, G4BI

Valvebases
McMurdo

Dials, etc.
Panel-Signs Sets 1 and 2

Perspex
H. L. Smith & Co. Ltd.

Miscellaneous
Stand-off insulators, wire, nuts, bolts, screened cable, tag panels, etc., H. L. Smith & Co. Ltd.

Valve Screening Cans
H. L. Smith & Co. Ltd.

Control Knobs
H. L. Smith & Co. Ltd.

Output Transformer
Multi-ratio type, H. L. Smith & Co. Ltd.

CLUB NEWS

Details for insertion in this section should reach us not later than 7th of the month before publication

EAST KENT RADIO SOCIETY

The East Kent Radio Society still meets fortnightly at 8 p.m. at "The Two Brothers," Northgate Street, Canterbury. Films, lectures, sales, swap nights, etc. New members welcome, also visitors in district. Hon. Secretary: Mr. D. Williams, Llandogo, Bridge, nr. Canterbury, Kent.

THE SLADE RADIO SOCIETY

Headquarters: The Church House, High Street, Erdington, Birmingham 23.

Next Meeting Dec. 9. "Wires and Cables Associated with Telecommunication Equipment" by Messrs. R. Blackburn and F. G. Taylor of British Insulated Callender's Cables Ltd.

December 23. Exhibition of Members' Equipment, including entries for the Enterprise Trophy.

Club Station Programme

The Club Station at the Church House is open every day of the week for the use of members. The following programme of instructional classes has been arranged:

Every Monday evening at 8 p.m.—"Station operation and procedure."

Every Tuesday evening at 8 p.m.—"D.F. receiver design and operation."

Every Wednesday evening at 8 p.m.—"Morse practice and equipment design."

December 16th. A Course of Instruction for Members intending to sit for the Radio Amateurs' Examination.

Full particulars of the Society and its activities may be obtained from the Honorary Secretary: Mr. C. N. Smart, 110 Woolmore Road, Erdington, Birmingham 23.

Visitors to the Society's meetings, which commence at 7.45 p.m. prompt, and to the Club Station, are cordially welcome.

SOUTH MANCHESTER RADIO CLUB

Ladybarn House, Mauldeth Road, Fallowfield, Manchester 14.

The majority of the members who took the R.A.E. course held during the past winter were successful in passing the examination, and already there are several new call signs amongst the group members. Any person wishing to take part in a similar course at the above headquarters should apply immediately either in person on meeting nights or by post to my address. Hon. Secretary, M. Barnsley G3HZM, 17 Score Street, Bradford, Manchester 11.

BRITISH AMATEUR TELEVISION CLUB—BIRMINGHAM

A meeting of amateurs interested in television transmission was held at Burlington Hall on 16th Oct. M. Barlow, of the BATC Chelmsford group, attended and with the aid of tape recordings and cine film gave a talk on the progress of the amateur movement in this field. It was decided to form a group in Birmingham and anyone interested in joining should get in touch with Mr. G. Flanner, 194 Aston Brook Street, Birmingham 6.

STOKE-ON-TRENT AMATEUR RADIO SOCIETY

Meetings continue every Thursday night at 7.30 p.m. The club TX is now almost ready to go on the air and members are looking forward to the first QSO.

A Morse oscillator has been constructed and Morse lessons are given at each meeting. Three society members are taking the Morse test in January.

Forthcoming lectures include oscilloscopes, amplifiers, communication receivers and an electronic key. A. Rowley G3JWZ (Sec.), 37 Leveson Road, Hanford Stoke-on-Trent.

EAST BERKSHIRE COLLEGE RADIO SOC.

Royal Albert Institute, Sheet Street, Windsor, Berks.

The winter programme includes various lectures, film shows, technical visits, junk sales, etc. Further details of these arrangements will be made in the monthly news sheets.

A course of lectures and Morse instruction will also be given for those members wishing to sit for the R.A.E. of the City and Guilds.

Hon. Secretary: Mr. F. Rickards, A.M.I.P.R.E.

SWINDON AMATEUR RADIO CLUB

At our first meeting, Mr. R. Reynolds G3IDW, was elected Chairman and Mr. G. R. Pearce G3AYL/ZL1AKL, was elected Hon. Secretary.

Weekly classes of instruction for the amateur radio licence examination are being held at the College, Swindon with Mr. G. R. Pearce G3AYL/ZL1AKL, as instructor. Hon. Secretary: G. R. Pearce, G3AYL, 102 Kingshill Road, Swindon, Wilts.

THE BRADFORD AMATEUR RADIO SOCIETY

All meetings are held at Cambridge House, Little Horton Lane, Bradford, and full details may be obtained from the Secretary, Mr. F. J. Davies, 39 Pullan Avenue, Bradford 2.

GARDEN MASTS

by SIMEON EDMUNDS, *A.M.T.S.*

It is sometimes impossible, owing to technical or structural difficulties, or perhaps the unreasonable attitude of the landlord, to erect a television aerial in its usual position on the chinmey stack, and as a rule the only alternative is a tall garden mast, suitably guyed and fitted on a baseplate.

Masts and Couplers

The most commonly used material for such a mast is light alloy tubing of the type used for scaffolding (not steel scaffolding tubes, which are too heavy and unwieldy). This is normally obtainable from any builders' merchants and is usually sold in 15ft or 20ft lengths. 20ft is seldom high enough for an aerial, and it is therefore necessary to join two or more lengths together, various kinds of coupling devices being available for this purpose. The type favoured by the writer is an internal sleeve which fits tightly into the mast sections and is secured by bolts passing right through mast and sleeve. A connection thus formed is quite as strong as, and much neater looking, than any of the couplers commonly employed in scaffolding work.

Where they provide sufficient height, two 15ft lengths coupled together are recommended, as rearing from the ground is in this case a fairly simple matter. A 20ft and a 15ft length together are the maximum that an amateur is advised to use, while two 20ft lengths are the most that it is normally possible even for experts to rear from the horizontal without special tackle.

Bases

A substantial base or footing is absolutely essential, and wherever possible this should be of concrete with a short stud cast into it over which the bottom of the mast will fit. Alternatively a metal cup may be let in, and the mast dropped into this. If cementing is not possible, an iron base plate with a projection bolted to the centre may be used; in this case resting on a foundation of stones or rubble rammed well down.

Guy Wires

For masts consisting of more than one section, two sets of guy wires are essential, and four wires per set should always be used where possible. The upper set should be fitted as near to the top as possible (just below the tips of the lower aerial elements), and the bottom set just above the coupling between the mast sections. Proper mast bands should be used, and prevented from sliding down by bolts through the mast upon which they may rest. The lower mast band can rest upon the upper fixing bolt of the mast coupling. A spot of grease on each bearing surface makes the turning of the mast to the correct bearing much easier.

Good quality clothes line is suitable for guys, and these should be spliced to the eyes in the mast bands. The lower ends cannot be spliced until the mast is in position.

The guy wires are best anchored by eye bolts, either let into concrete blocks or screwed into any convenient solid objects of sufficient strength. Stakes driven into the ground are not sufficient and are certain to work loose in a very short time.

Each eye bolt should be as far from the foot of the mast as is practicable, and preferably not less distant than half the mast height. A separate rigging screw is required for each guy wire. The type with the hook at one end and an eye at the other is most suitable.

Rearing

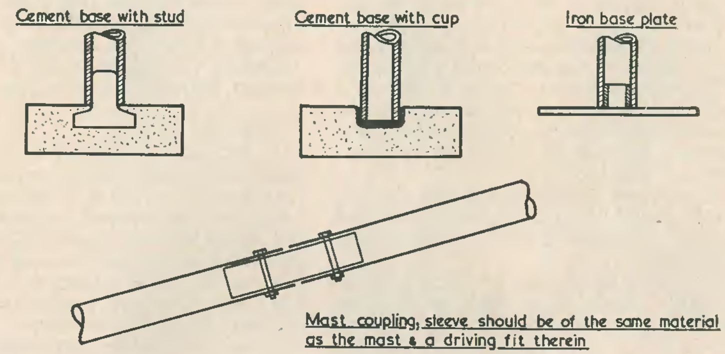
When the aerial and its feeder have been fitted and ample lengths of guy wire spliced to each mast band, the assembly is ready to be reared into position. First see that the feeder cable is tightly secured to the outside of the mast with either good insulating tape or rubber cable clips spaced not more than 18in apart. Do not run the feeder down inside the mast as the "slapping" thus caused makes an unbearable noise and may also damage the cable.

For the actual rearing operation, muster as many helpers as you can (at least 4 are desirable) and see that they understand clearly what you intend to do before commencing.

One man is required at the foot of the mast to stop it from kicking out, and one at each pair of guy wires on the "pulling" side. The fourth man lifts the head of the mast and pushes it up to arm's length, while another, armed with a short ladder or a forked pole, stands beside him ready to continue the pushing when the mast head begins to rise. As this happens, the fourth man, still pushing, walks towards the foot. The men at the guy wires, of course, pull in steadily as the mast rises.

When it is nearly vertical, the mast is steadied by the man at the foot, and the two "lifters" are then free to haul in on the other two sets of guy wires. With the mast as nearly upright as it can thus be made, the guy wires are hitched temporarily to their respective eye bolts, and the mast then rotated until the direction of the aerial is correct. The rigging screws may then be spliced, one at a time, to the guy wires and hooked into the eye bolts. Final adjustments of tension will now ensure that the mast is secure and upright.

A word of caution: Take things steadily, and do not attempt the job on a windy day.



E210

The Editor and Staff wish all our Readers
a very Merry Christmas
and a
Happy and Prosperous
New Year

DESIGN CHARTS FOR CONSTRUCTORS

No. 1—Power, Voltage, Current and Resistance Chart

by HUGH GUY

THIS IS THE FIRST OF A SERIES OF DESIGN charts to be published every month to enable the amateur to avoid too much of the tedious calculation associated with almost any circuit construction. Some of the charts are already well known, and are included so that a complete series is ready at hand, while others have been especially devised for *Radio Constructor* readers.

It is therefore recommended that they be carefully assembled or filed to form an ever-ready and invaluable aid to radio servicing and assembly.

This month's chart gives on one graph the four basic Ohm's Law relations between power, voltage, current and resistance. These are:—

$$W = I^2R = V^2/R = VI$$

$$V = IR = \sqrt{WR} = W/I$$

$$I = V/R = \sqrt{W/R} = W/V$$

$$R = V/I = \sqrt{W/I} = \frac{V^2}{W}$$

These relations show that it is possible to determine any one property by knowing two of the other properties. This is the way in which the chart works also. One vertical scale, for example, is calibrated in values of current in milliamps, and its associated horizontal scale is calibrated in standard 10% values of resistance, ranging from 100Ω to 1MΩ. These two scales are linked by the slanting power or voltage lines which give values of power ranging from 1/16 watt up to 100W. These values conform, at least for carbon resistors, to the normal range of wattages in which the standard resistors are available.

Turning the chart round, we see that the other vertical scale is calibrated in values of voltage ranging from 4V to 4,000V, while its associated horizontal scale is calibrated, as before, in standard 10% resistance values.

The chart finds its principal use in enabling the estimation of the wattage at which a particular resistor should be rated, given either the current flowing through it, or the voltage across it. This is a case frequently met with in practice, and is illustrated below.

Example 1

The anode load of a triode is 22kΩ, and the valve is drawing 3mA. What is the minimum permissible wattage of the load resistor? The chart shows that the intersection of 3mA on a horizontal line and 22kΩ on a projected vertical line occurs between $\frac{1}{8}$W and $\frac{1}{4}$W. Therefore the higher value, of $\frac{1}{4}$W, would be used, allowing a slight safety margin.

Example 2

A 330kΩ, $\frac{1}{2}$W resistor is one of several resistors forming a bleeder network across an e.h.t. supply. What is the maximum voltage which may be dropped across it?

Turning the chart round in relation to the previous example, and locating the $\frac{1}{2}$W power line, we see that it crosses the 330kΩ line at just above 400V and therefore 400V could be dropped, as a safe maximum.

Notice that the voltage scale reads downwards for increasing voltage, the 4000V value being at the bottom of the vertical scale.

To solve voltage and current relationships requires an additional step. Suppose, for example, we wanted to know what current flowed through a 5.6kΩ resistor when 200V was applied across it.

The voltage/resistance part of the chart shows that the wattage lies between 5 and 10 watts. A pencil dot is made at the exact intersection and through this dot a rule or straight edge is laid parallel to the other power lines. The intersection of this line and the 5.6kΩ vertical line from the other resistance scale will give the current on its appropriate scale.

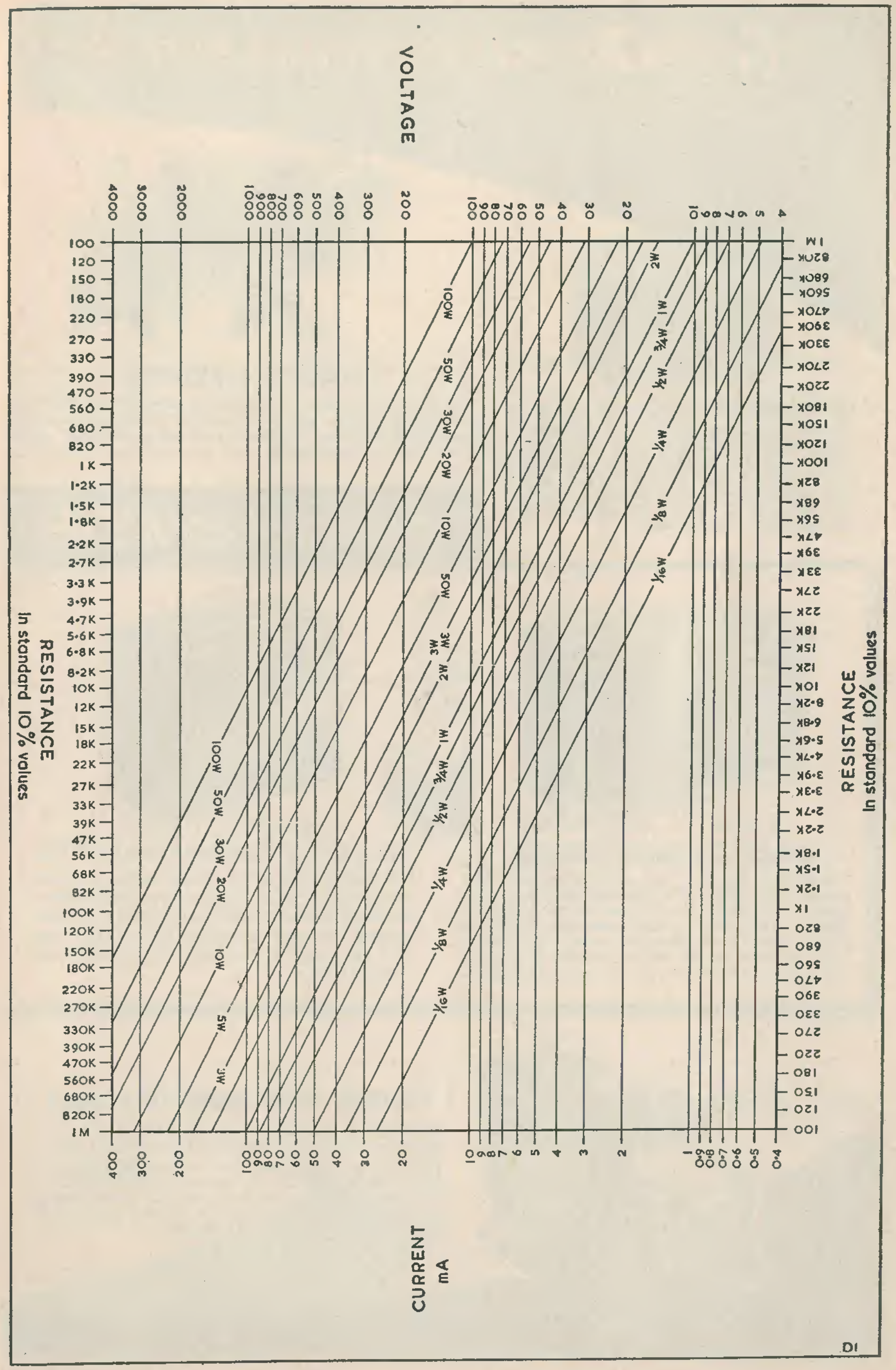
This current is seen to lie midway between 30 and 40mA and, bearing in mind that the scale is logarithmic, the current is interpreted, accurately, as being 34.7mA.

Verifying the precision of this result from the formula I = V/R shows that $I = \frac{200}{5.6}$ or 35.7mA. The error introduced by the graph is therefore less than 3%, and since the components themselves have a 10% tolerance, this result is more than reliable.

However, the graph is intended primarily for the wattage part of resistance calculations, since such calculations are inclined to be a trifle more involved than straightforward voltage and current problems; involving, as they do, squares and square roots.

To this end, therefore, the provision of a chart calibrated in standard values of resistors is a very useful aid to the constructor.

Next month: Parallel Resistance Combinations.



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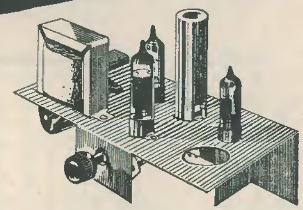

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Two models, Midland or London. Suitable for any televisor complete with own A.C. power supply, tested and ready for use. Switch operated for Band I or Band III. Price **£7 . 7 . 0.** *Plus packing and postage 3/6*

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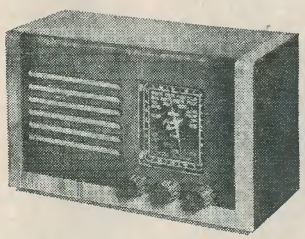

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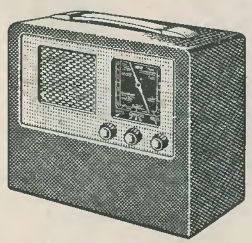
may be built for **£7 . 19 . 6,** *plus 2/6 packing and postage.* **2 BAND TRF RECEIVER** may be built for **£5 . 15 . 0** *plus 2/6 packing and postage.* These two receivers use the latest type circuitry and are fitted into attractive cabinets 12″ × 6½″ × 5½″ in either walnut or ivory bakelite or wood. Individual instruction books 1/– each, post free



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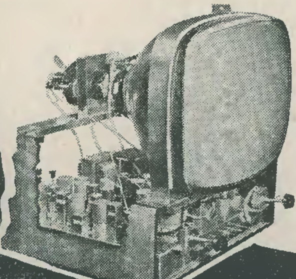

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DESIGN 1. 13 channels, may be built for **£34 . 9 . 7** (plus cost of C.R.T.), *packing and carriage extra.*
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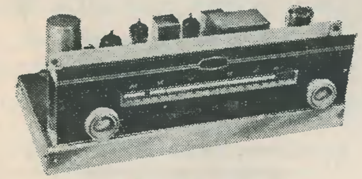
The Televisors may be constructed in 5 easy stages. Send for the **Instruction Book at 3/6 post free,** which includes full details of both designs.



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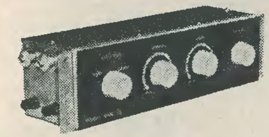
Complete with built-in power supply, ready for use. 5-valve permeability tuned circuit, switched output for gram. or FM. Cash **£13 . 15 . 0** or on H.P. terms, deposit **£4 . 11 . 8** and 10 monthly payments of 20/4. Magic eye ready to plug in 19/– extra. *Plus postage and packing* 5/–
These units have been "soak tested" for 24 hours before calibration to eliminate frequency drift.



PRE-AMPLIFIER & TONE CONTROL UNIT
Suitable for use with the "Williamson" or any other quality amplifier. Two switched inputs with preset volume controls, bass and treble tone control, output volume control, fitted into a steel box 10″ x 3″ x 3″, silver hammered finish with black perspex panel engraved in silver. Power requirements 6.3V 0.9A and 250V 5m/A. Completely wired and tested, **£5 . 5 . 0,** *packing & postage* 2/6

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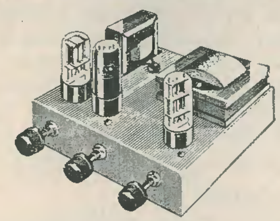

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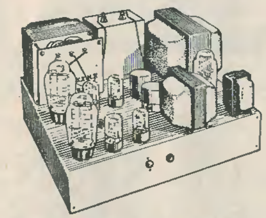

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may be built for **£15 . 15 . 0** *plus 7/6 packing and carriage,* or on H.P. terms, deposit **£3 . 18 . 9** and 12 monthly payments of **£1 . 1 . 8.** Absolutely complete and all components are guaranteed to author's specification. May be supplied completely wired and tested for cash **£20 . 0 . 0** or on H.P. terms, deposit **£5 . 0 . 0** and 12 monthly payments of **£1 . 7 . 6,** *packing and carriage* 10/–

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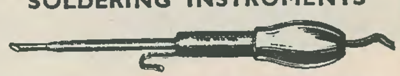

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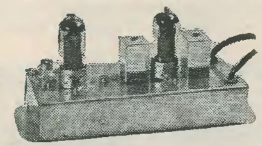
BAND III CONVERTER KIT



Complete kit of parts for "W.W." and "Teletron" Converters, including Teletron or Osmor Coils, two EF80 valves, drilled chassis and wiring diagram. Suitable for T.R.F. and superhet receivers. Power required: 200-250V, 20mA, 6.3V, 0.6A. Band coverage 42-68Mc/s. 45/-. Post and packing 2/-.

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Teletron and Osmor Band III Coils 15/- per set with circuit. Post and packing 6d.

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1T4	7/6	6J5GT	6/6	12K7GT	8/6	EF39	7/6
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3V4	7/6	6K8G	8/-	5763	7/6	EF85	11/6
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5Y3GT	9/6	6Q7GT	8/6	9006	5/6	EF92	4/6
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6AM6	7/6	6SK7	8/-	DF91	7/6	EZ35	8/-
6AL5	6/6	6SL7GT	8/-	DL63	8/6	KT66	11/6
6BE6	8/-	6SS7	6/9	DL94	7/6	UI42	9/6
6BW6	8/-	6V6G	7/6	EB91	6/6	PL81	12/6
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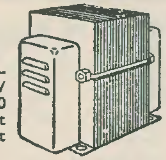
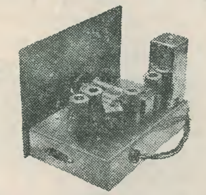


Fully shrouded—standard 200-250V primary. 280-0-280 at 80 mA, 6.3V at 3 amp., 5V at 2 amp.

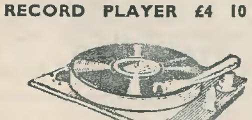
TELETRON BAND III CONVERSION KIT
Complete kit of parts to make this very successful converter includes valves prepared chassis, coils, etc. Price £2 5 0 plus 2/6 p. and p. Coils only 15/- per set.

THE CLEVELAND FM TUNER



This tuner is based upon the very successful circuit published by Data Publications. We have made up models at all branches and will gladly demonstrate. Stability is extremely good and making and aligning most simple. Cost of all parts including valves, prepared metal chassis, wound coils and stove enamelled scale, slow-motion drive, pointer, tuning knob, in fact everything needed, is £6 12 6. Data is included free with the parts or is available separately, price 2/-. Extra for fringe area model 20/-.

RECORD PLAYER £4 10 0



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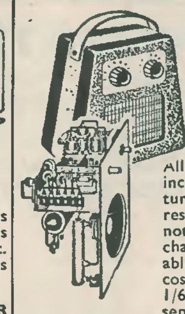

Build yourself a handy midget 3-valve mains receiver giving powerful reception over medium waveband. All component parts, including valves, coils, tuning condenser, resistors, etc., but not loudspeaker, metal chassis or cabinet (available if required) will cost you only 22/6 plus 1/6 post. Data available separately 2/- post free

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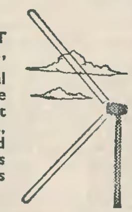
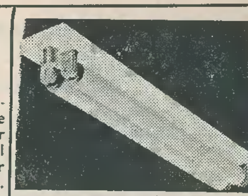


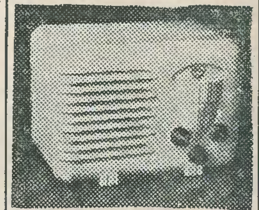
Known as the Folded 'V' this is directional, signal strengthening and noise reducing. Complete kit including alloy elements, plastic centre piece, and fixing bracket. Mounts anywhere. Price 8/6 plus 1/6 post.

WIRELESS WORLD BAND III KIT

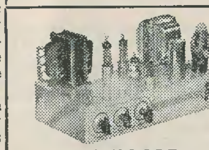
One of the most successful circuits for Band III conversion was published in the *Wireless World*, May 1954. We consequently offer a complete kit of parts, including the specified EF80 valves, wound coils, drilled chassis, in fact, everything including a copy of the circuit diagram. Price only 42/6, post 2/6 extra. Mains components if required, 25/- extra. Ready to work 59/6. Mains model 79/6.



THE TWIN 20
This is a complete fluorescent lighting fitting. It has built-in ballast and starters—stove enamelled white and ready to work. It uses two 20-watt lamps. Price, with two tubes, 39/6. Post and insurance 5/-. Extra 20-watt tubes, 7/6 each



MAINS—MINI T.R.F.
Uses high-efficiency coils—covers long and medium wavebands and fits into the neat white or brown bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything, £4 10 0, plus 3/6 post.



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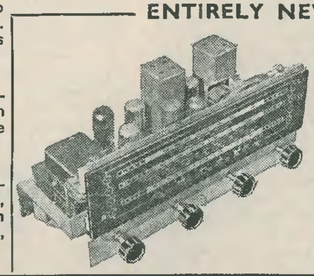

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Teletron Mk 2 coil set		17/6
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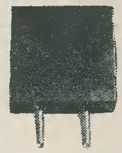

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(*continued on page 326*)

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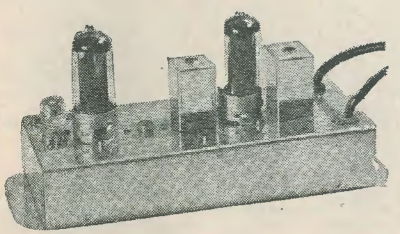
BAND 3 CONVERTERS



Teletron Mark I Converter Kit. Complete kit o parts, including coils and valves, etc., **£2 9s. 6d.** post 6d.

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Both these Kits include all resistors, condensers, valves, valve bases, coil sets, pre-punched chassis with bottom screen, wiring instructions, circuit diagram and alignment instructions.

Mark I Coil Set, complete with wiring diagram, circuit and alignment instructions, **15/–**, post 3d.

Mark 2 Coil Kit, complete with wiring diagram, circuit and alignment instructions, **17/6**, post 3d.

Chassis, pre-punched with bottom screen, **3/9**, post 3d.

AM/FM Signal Generator (this issue). Cabinet, chassis and panel, as specified, **10/6**, post 6d.

Teletron "Skymaster" I.F. Transformers, type N/R, N/S, **7/6** each.

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12"	... ...	£6 0 0
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Post, Packing and Insurance 10/–

Wireless Marketing Co

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Established 1926 — *Telephone PAD 1903*

SMALL ADVERTISEMENTS

(continued from page 325)

PRIVATE

FOR SALE. Goodmans Audiom 50 12 inch loudspeaker, £4 10s., and Collaro 3RC/522 auto-changer, 3 speed, £6 10s. Both in good condition and boxed. B. Price, 489 Nottingham Road, Basford, Nottingham.

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COILS, COILS, COILS. We can supply coils for all frequencies, r.f. chokes, etc. Send SAE for circuits and data. The Teletron Co., 266 Nightingale Road, London, N.9.

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GOVERNMENT SURPLUS ILLUSTRATED CATALOGUE No. 12, containing over 400 items of electrical, mechanical and radio equipment for experiments, etc., price 1/6, post free. Arthur Sallis, 93 North Road, Brighton, Sussex.

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(continued on page 327)

SMALL ADVERTISEMENTS

(continued from page 326)

TRADE

BUILD YOUR OWN TV and learn about its operation, maintenance and servicing. Qualified engineer-tutor available whilst you are learning and building. Free brochure from E.M.I. Institutes, Department R.C. 58, London, W.4. (Associated with H.M.V.)

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Chassis at the following prices. These are in aluminium of 18G.

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10 x 7 x 2½	...	9/–	10 x 8 x 2½	...	9/6
12 x 8 x 2½	...	10/6	10 x 9 x 2½	...	11/–
14 x 8 x 2½	...	13/9	14 x 9 x 2½	...	14/–
16 x 8 x 2½	...	14/9	16 x 9 x 2½	...	15/6

Suppliers of technical publications. A full range of components, by well-known manufacturers, are stocked, Mullard, Brimar, Cossor, T.C.C., Dubilier, Erie, R.E.P., Wearite, Elstone, Morganite, etc. High stability 1, 2 and 5 per cent resistors available from stock or to order.

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1R5	8/6	6G6G	4/–	25L6GT	10/–	EF54	4/–
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1A3	4/6	6J5M	7/6	80	9/6	EF91	6/–
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3Q5GT	9/6	6O7G	8/6	954	3/6	EZ40	8/6
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5Z4G	8/6	6SL7GT	7/6	CBL1	10/–	PL81	12/6
6AB7M	6/–	6SN7GT	7/6	CV286	7/6	PL82	9/6
6AC7M	6/–	6SS7M	6/6	CV287	7/6	PY81	10/–
6AG7M	10/6	6SJ7M	8/6	DL33	9/6	PY82	9/6
6AK5	6/6	6SQ7M	10/6	DAF96	9/6	TZ40	30/–
6AL5	6/–	6U5G	7/6	DF96	9/6	SP61	3/–
6AM6	6/–	6V6GT	7/6	DK96	9/6	UCH42	10/6
6AO5	9/–	6X4	7/6	DL96	9/6	UL41	10/6
6AT6	8/–	6X5GT	7/6	EA50	2/–	UY41	8/6
6AU6	8/6	6Z4	5/–	EAF42	9/6	VS110A	4/6
6B8M	7/6	7B7	9/–	EBC3	10/–	VR105/	
6BA6	8/6	7C5	9/–	EBF80	11/6	30	7/6
6BE6	7/6	7C6	9/–	EB91	6/–	VR150/	
6BJ6	7/6	7Y4	8/6	ECC81	10/6	30	7/6
6BR7	11/6	12A6M	7/6	ECC82	10/6	VT62	10/–
6BS7	7/6	12AU7	8/6	FCH35	10/–	W77	5/–
6BW6	7/6	12BE6	7/6	ECH42	10/–	X66	7/6
6C4	5/–	12J7GT	9/–	ECL80	11/6	Z77	6/–
6CH6	6/6	12K7GT	9/–	EF37	7/6	220P	3/–
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Drilled chassis, FM manual, all components, nuts and bolts, etc., and 5 valves (for two IF stages): EB91, 6BA6 (2), 12AH8 and EF91, **£6 7s. 6d.**, or with Denco dial and drive **9/–** extra.

Power Unit Type 247. Input 230V 50c/s, output 6.3V 3 amps AC, 580V 200m/A DC (service rating). Fitted 5U4G, 2,4mfd 1kV wkg. block condensers and heavy duty shrouded choke. In smart grey stoved louvred case 8" x 9" x 11". Weight 30lb. **Brand new** and a gift at only **49/6** each, carriage paid.

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