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CIRCUIT

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and AVC), 6J5 (1st. audio), 6V6

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Short Wave Enthusiasts this month have the opportunity to attend their own exhibition. Organised by the Radio Society of Great Britain, it will be held as usual at the Royal Hotel, Woburn Place, London, W.C.1. Further particulars appear in this issue on page 116. We ourselves will be at Stand 4, and cordially invite you to visit us there.

GATZ

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THE EDITOR reserves original contributions for construction of radio subjects. All material used will be credited. Articles should be clearly written, preferably 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 relevant information should be included. All Miss must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender’s name and address.

COMPLIMENTARY. Publishers, manufacturers, etc., are invited to submit samples or information of new products for review in this section.

A CONSTRUCTOR looks at

THE RADIO SHOW

Report by W. Groome.

Our Editor has decided (wisely, I think) that the usual stand-by report of the Radio Show would not be of much service to readers of 'RC' and, frankly, the writer is delighted to be spared the dull job of compiling such a catalogue.

A few brickbats have to be hurled, but let us forget the past. It is time to consider how far the TV studio becomes a scene of chaos and confusion.

I was at the exhibition in time to see the rehearsal of the opening ceremony. The actual transmission showed the arrival of the Lord Mayor of Birmingham, and he was kept on the stage for a few minutes before the opening broadcast.

Also visible to the public was a TV display of components. The writer took his seat a few minutes before the opening broadcast and was most impressed by the quiet efficiency of the preparation.

The general public was able to see this and other broadcasts through windows on two sides of the studio. Also visible to the public were the studio of the Radio Industry Council, its control room, and equipment for the internal TV and Sound distribution.

Television was the high spot of the show, and the idea of a communal exhibit of television was excellent, for it enabled one to make use of the set unnecessary! Seriously, one could worry about the compensation given for such close viewing as it received at the exhibition.

Close-up shots seem to be almost life size.

The apparatus used to maintain the high frequencies, which would otherwise be lost completely, was on view. It was difficult to detect any fault in a picture which reached the eye without the two half-mile drums of ordinary telephone cable.

By switching the network, it was shown how vast is the difference between the compensated signal and that which crawls through, horribly mutilated, without compensation.

A two-way intercommunication set by Trix is offered for domestic use, particularly as a baby alarm. Any proud father who has £13 17s. 6d. left after paying the nursing home fees may care to invest, but the writer's baby is already in the house.

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The writer suggests that manufacturers should consider the Radio Show as an opportunity of encouraging the amateur movement, and to make a better appearance next year. Does not some form of joint exhibit of components be arranged?

(Our readers will be better catered for at the Amateur Radio Exhibition being held this month. Details appear elsewhere in this issue.—Ed.)

The RAF exhibit emphasised the very great influence of radio and radar in current defence measures, and the demonstrations with scale models made Stand 19 a point of great interest.

The G.P.O. in one of its displays showed, in an understandable manner, the complex nature of ignition interference on TV and the simplicity of effective suppression. It also explained how essential a good aerial is, even these days, if the best reception is to be obtained.

The writer has always been amazed to hear people complaining of background noise, when often the so-called aerial is a few feet of wire at ground level. The G.P.O. renders good service in attempting to educate the public on these matters.

In outside broadcasts of TV, the G.P.O. now use the ordinary telephone system to convey the signal for several miles, if necessary, to the nearest point in the co-ax network. The equipment used to maintain the high frequencies, which would otherwise be lost completely, was on view.

As difficult to detect any fault in a picture which reached the eye without the two half-mile drums of ordinary telephone cable. By switching the network, it was shown how vast is the difference between the compensated signal and that which crawls through, horribly mutilated, without compensation.

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CONVERTING THE TR1196 RECEIVER

by

J. Simmons

of the Radio and Electrical Mart

The receiver portion of the TR1196 lends itself to easy conversion to an all-wave, mains operated receiver, and in the accompanying article details for this are given, with photographic illustrations.

First, it is necessary to remove certain components which are not required. These are as follows: On the top deck, the pre-tuning assembly and Mansbridge capacitor. Underneath, proceeding from the Jones plug end—the phone transformer and Mansbridge capacitors (this gives the required space for the Osmor all-wave coil pack, which just fits nicely here). In the next compartment, remove the Jones plug, which takes up a lot of unnecessary room, and the potentiometer which was used for controlling the cathodes of VR57 and VR53. Also take out V1 valve base (nearest the bakelite plug socket) and the latter with its bakelite strip, which now leaves a useful space for the 16 +16 µF filter capacitor. In the main compartment, remove the microphone transformer, BFO coil, and the volume control potentiometer which is of no use owing to its short spindle length.

As the Osmor coil pack was used for the conversion, the writer decided to use the circuit provided with the pack, with certain modifications which will be explained later.

Valves V1, V4 and V5 were discarded, and all connections removed from the bases of V4 and V5—we have already taken out the holder of V1. V6, the DDT (VR55) was replaced in the socket of V4, and rewired accordingly. The original V6 holder was used for the 6V6 output valve—see cover photo. Next check the resistors and capacitors on the tag strips against those required, and remove any not wanted.

At this stage, the IF transformers need a little attention. It will be seen that the first IF has two leads coming from the top of the can. Only one of these is wanted, so remove the can and snip off that lead which is joined to C21 (100 pf) and R19 (500 k Ω) on the top right looking at the trimmers. C21 and R19 may also be removed, if desired.

Now have a look at the bottom coil—a 200 Ω resistor will be noted which has a lead from each side going out through the base plate. The writer is not quite clear as to why this was used, as it is not shown in the original circuit. However, remove the right-hand lead, still looking at the trimmers, and short the resistor by soldering a piece of wire across it. This now gives us the four leads which we need, which should be left wired as shown in the TR1196 circuit, except for the connection from V3 grid to C21.

Next we deal with IFT2 (T3 in circuit). Here again, remove the can cover and, looking at the trimmers, it will be seen that the bottom coil here also has the 200 Ω resistor with the extra lead. This resistor is dealt with in the same way as in IFT1 (T2). The top half of

The Osmor Circuit referred to in the text.
the IFT is normal and should not be interfered with. Only one lead has to be rewired; that is the return half of the secondary going to the volume control, which should be connected as shown in the Osmor circuit.

Now return to the coil pack. This should be placed in the central portion of the compartment, as shown in the illustration, but, before doing so, solder on five leads about 10 ins. long, and an extra lead to Tag 4. Two leads from Tags 3 and 4 are taken through a hole in the deck of the chassis to be soldered to the 2-gang 500 pF tuning capacitor, and the other three leads are passed through into the Jones plug compartment for connection to the frequency changer valve and AVC line as shown in the Osmor coil pack circuit. For the benefit of the uninitiated, the VR57 is a Mullard EK32 octode frequency changer with variable-mu characteristics, and it is essential that the SG (pins 3, 5) should not have more than 80V applied, so that it is advisable to leave it wired to R8, R9 and C12.

The pin connections of the VR57 are as follows:— Pin 1, to chassis. Pins 2 and 7, to 6.3V heater winding. Pin 3, anode to primary of IFT1. Pin 4, G3 and G5. Pin 5, osc. grid to 100 pF and 50 kΩ. Pin 6, osc. anode to 150 pF, 50 kΩ and via capacitor to Tag 5. Top Cap, control grid taken to that section of the tuning capacitor to which the lead from Tag 3 has already been connected. Tag 2 is soldered to a 100 kΩ resistor, the other end of which is joined to a 0.1 μF capacitor grounded to chassis, and a 1 Meg Ω resistor. The other end of this latter is taken to one of the diodes of the DDT, from which a 100 pF capacitor goes to the anode of V3.

Tag 1 is taken via a 0.01 μF capacitor to the aerial socket—this is fitted in the hole left by the removal of the V2/V3 cathode control potentiometer. A 10 kΩ ½W resistor is connected from the aerial socket to ground. The cathode resistors of V2 and V3 (R10 and R17) should be grounded. This completes the mods to the coil pack and V2.

Valve 3 remains as shown in the TR1196 circuit, except where amended as has been described. The grid of V6 is taken to the volume control as shown in the Osmor circuit, and the cathode resistors R34 and R35 should be removed and a 3 kΩ ½W resistor substituted. C37 should also be taken out, and replaced by a 25 μF 12V capacitor. Resistors R33, R32, R30 and the capacitor C34 are removed.

Underneath view of the modified receiver. A three-quarter rear view showing layout above deck is shown in the cover illustration.
The anode of V6 is now taken through a 250 kΩ and a 47 kΩ to HT. From the junction of these two resistors, an 8 µF 330V electrolytic is connected to ground. Also from the anode of V6, a 0.05 µF capacitor is connected to the control grid of the 6V6 output valve, in series with a 4.7 kΩ grid stopper on the grid side. From the junction of these two, a 500 kΩ grid leak is taken to ground. The remainder of the connections to the 6V6 are as shown in the Osmor circuit.

For the power supply, a small 6.3V 1.5A heater transformer may be used, with a selenium 60 mA half-wave rectifier for smoothing. It should be remembered that with this arrangement the chassis will be connected to one side of the mains, and due precautions should be taken. Alternatively, a standard AC power pack may be employed, though this will probably mean the use of an extra chassis.

This now leaves us with only the alignment to do, and the first item is to return the IF's to 465 kcs from the original setting of 460 kcs. It is best to do this with the aid of a signal generator. Should the latter not be available, the Light programme should be tuned in, with the volume set at barely audible level, and the trimmers adjusted for maximum volume, starting with JF12. Re-adjust on the Home or North Regional wavelengths. Before making any adjustments to the trimmers of the coil pack, the Osmor instructions should first be studied.

With the conversion carried out as recommended in this article, the all-wave receiver equal in performance to a high-class commercial set, plus the great advantage of a much lower outlay.

FOURTH ANNUAL R.S.G.B. Amateur Radio Exhibition

The Fourth Annual Amateur Radio Exhibition organised by the Radio Society of Great Britain is to be held at the Royal Hotel, Woburn Place, London, W.C.1., from Wednesday, November 22nd to Saturday, November 25th.

The Exhibition will be opened at 2.30 p.m. on November 22nd by Mr. Hugh Pocock, M.I.E.E., Managing Editor of "Wireless World" and "Wireless Engineer". The Exhibition will open at 11 a.m. on November 23rd, 24th and 25th and will close at 9 p.m. each evening.

The following concerns have already booked stands:—Air Ministry; Amalgamated Short Wave Press; Automatic Coil Winder and Electrical Equipment Co. Ltd.; Q-Max (Electronics) Ltd.; C. H. Davis; Decca Record Co. Ltd.; Easibind Ltd.; E.M.I. Sales and Service Ltd.; General Electric Co. Ltd.; Genera Post Office (Engineering Dept.); G.S.V. Marine and Commercial Ltd.; Hillie and Sons Ltd.; Imhof Ltd.; Oliver Pell Control Ltd.; Philpotts Metalworks Ltd.; Salford Electrical Instruments Ltd.; Sangamo—Weston Ltd.; Short Wave Magazine Ltd.; Taylor Electrical Instruments Ltd.; Webbs Radio; Westminster House Brake and Signal Co. Ltd.; Woden Transformer Ltd.

Admission will be by catalogue obtainable at the door (price 1/-) or on application from the Radio Society of Great Britain, New Bridge View Works, Borough Hill, Croydon, Surrey.

TRADE REVIEW

We have received samples of their Duraplugs from W. W. HafTenden Ltd., Pichborough Rubber Works, Sandwich, Kent. These are mains plugs and sockets fitted with standard 2A, 5A and 15A 3-pin connectors. The rubber body and consequent flexibility of the plug enables the plugs to be used with ordinary 2-pin sockets simply by removing the earth pin. All plugs are fitted with a cord grip. The design is such that no metal parts are exposed, and they make ideal floating connectors. Both are obtainable in brown, black or white. The prices are quite reasonable, and we confidently recommend them to our readers. An illustrated leaflet is available on request from the makers.

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OVERCOMING THAT MAINS DROP

A Topical Feature by J. R. DAVIES

SINCE the end of the war, the poorly-regular mains supplies found in various parts of the country have been a source of annoyance to many users of radio equipment. A 230 volt supply that drops to say, 220 volts is not sufficiently bad to cause any trouble; but should it fall below 210 volts, then it is obvious that any electrical appliance connected to such a supply are not going to work at their best.

In addition, the writer has come across cases in England where the nominal 230 volt mains supply, during "peak" periods, has dropped below 190 volts! In one particular case, (in a country town), it was found impossible to get any reliable results from the domestic radio until the load had eased. Particularly was this true of the TV station, when all the local electric ovens in the neighbourhood were in use.

Of course, the fault lies in the fact that new items if one can use components already connected to such a supply are not going to work on hand, or which may be cheaply bought in the surplus market. The auto-transformer, used by the writer was a high-precision transformer. The output, which feeds the equipment in use, is taken from the tap on the transformer. Also in series with the output from the transformer are the contacts of a relay, these "making" when the relay is de-energised.

To ensure that, owing to a rise in mains voltage, excessive voltage is not supplied to the output circuit, a trip switch is incorporated. This consists of a rectifier and a neon stabilizer or similar valve. The rectifier, fed from a pre-set potentiometer connected across the output from the auto-transformer, supplies a fixed DC voltage to the neon lamp via the relay coil. When this DC voltage exceeds a certain pre-determined value, the neon strikes, passing a relatively high current and causing the relay to be energised, thereby switching off the current to the equipment connected to the output. Once it has struck, the neon stays alight and no output is available until the tapping switch housing is given to a higher and safer value. It will be found in practice that the trip circuit is very sensitive and always comes into operation at exactly the same voltage.

The Components Needed

It is obvious, in making up a unit of this type, that there is little point in purchasing new items if one can use components already connected to such a supply are not going to work on hand, or which may be cheaply bought in the surplus market.

The auto-transformer used by the author, for instance, was an ordinary "heater transformer" with a tapped primary which happened to be on hand. The heater winding was used, incidentally, to light a pilot lamp showing that the unit was switched on, but this is, of course, by no means necessary. If the unit were designed for use with say, a television receiver, a larger transformer might be needed. A small transformer should be quite sufficient for a normal radio receiver or similar item of equipment, however.

The relay used by the writer was a high-resistance job, which closed at about 5 mA.
Fig. 1: Circuit of the vari-unit described in this article.

energizing current. The coil winding had a resistance of some 1,000 ohms. These relays appear to be fairly easy to obtain in the surplus market. The rectifier is a small metal component, capable of passing 30 mA, and, in this case, was wrested from the entrails of a long-disused battery eliminator.

The resistors should all have a rating of at least one watt. The average neon stabilizer will strike at about 170 volts or so, so that all that is really needed is some form of potentiometer circuit which will allow this voltage to be applied to the neon after rectification. The potentiometer proper (R2) should be a wire-wound component. The values of R1, R2 and R3 are not very important, but they should be low enough to allow 10 mA or more to flow through the potentiometer network itself. Of course, it would be possible to use one component only; say, a single 20,000 ohm variable potentiometer connected across the whole of the output voltage, but this would make the setting-up of the voltage trip somewhat difficult, and the results might be unreliable.

It will be seen that a fairly large capacitor is used to smooth the rectified DC. This is necessary for two reasons. Firstly, the relay is liable to “chatter” unless the DC is fairly smooth. Secondly, before the neon strikes, this capacitor will charge up to the peak AC voltage applied to the rectifier; whereas, as soon as the neon strikes and begins to draw current, the rectified voltage will drop considerably unless there is a sufficiently large reservoir capacitor to keep this voltage reasonably high. An 8 µF capacitor was found quite sufficient in practice. It is also due to the fact that too much voltage may be dropped when the neon strikes that it is necessary to use low-value resistors for the potentiometer circuit.

The resistor R4, in series with the neon, is used as the normal neon limiting resistor. The value chosen in the diagram, (10,000 ohms), should be sufficiently useful for most types of neon stabilizer, but a reduced value may be used if necessary.

Obtaining the stabilizer itself should not prove very difficult, as almost any type of neon may be used. That used by the writer was an ordinary neon stabilizer valve, and had two concentric rings for the electrodes. This form of construction gave rise to a bright red glow when the neon struck and it was therefore mounted on the front panel to give a visual indication of the fact that the trip had operated. Such valves as the VR 150/30, etc., would be perfect for a job such as this; but, as they do not glow very brightly when struck, would not be very useful for visual indication. An ordinary bee-hive neon lamp would probably work quite well, although it might not be so reliable in use as a stabilizer valve. It should not be forgotten that most neon bulbs which are used for lighting purposes have series resistors fitted in the base. Of course, it must be remembered that the neon is not used for its stabilizing properties, but because it always strikes at the same voltage.

Finally, let us consider the switch used to select the various auto-transformer taps. It is necessary to use a switch which can not only handle the current required but which will also completely break the circuit between tappings. Thus, should the mains voltage rise sufficiently to operate the trip, turning the switch to the next tapping will automatically break the primary circuit, causing the neon to be extinguished, and thereby putting everything back to normal for the next position.

Setting-up the Unit
To set up the trip circuit, the unit should be connected up as shown in Fig. 2. A load is connected to the output of the unit and is shunted by an AC voltmeter. To obtain a varying mains input, a variable resistor (or similar device) is connected in series with the mains and the input to the unit. The tapping switch and the resistor are then adjusted so that the required trip voltage to be applied to the load. That is to say, if the load were designed for 230 volt operation, the adjustments would be made to apply, say, 235 volts to the output, (as shown in the meter). The pre-set potentiometer is then slowly turned up until the neon just strikes. The setting may be checked by switching off the unit to de-energize the neon and then varying the load voltage between say, 230 and 240 volts to ensure that the trip operates always at the correct voltage.

Fig. 2: Showing how the unit is initially adjusted.

EHT Unit for 7/6

Dear Sir,—Re your article in the October issue entitled “EHT Unit for 7/6” by H. W. Arundel, please allow us to state that this in the store where the notice inscribed “It's Your Birthday, All This For 5/-, Less Valves” was displayed, in connection with the Power Unit type 225. This offer was made for a short time only, as far as twelve months back, in order to clear a dozen or so of the large units which, of course, were minus valves. After this offer ceased, further supplies of type 225 Power Units were much more costly to obtain under M.O.S. Sales. Being uneconomical for us to sell this unit as it exists, for the past twelve months we have employed people to dismantle them and, working out the cost of labour, we find that to make a fair profit we have to market the transformers taken from these units at 7s. 6d. each.

The following data on these transformers may be of interest to readers:

| 10KB/794: Input, 80V 2000 cps. Output, 5000V RMS, 25 mA. |
| 10KB/795/796: Input 80V 2000 cps. Output, 4000V RMS, 25mA. |

We find that a safe limit for the primary voltage is 36, and this is obtained by using a 4.5 µF capacitor in series with the primary in each case. The outputs shown on a 2000 Ω per volt meter are as follows, the reservoir capacitor being 0.1 µF in each instance; 10KB/794 gives 3600V with 0.5 mA load. 10KB/795/796 give 3300V with 0.5 mA load.

In your article it is stated that these transformers are available for about 2s. each. For your information, we do not know of any store which has these transformers to sell at this price. Even at our price of 7s. 6d., we think you will agree that it is an excellent buy, particularly as the insulation of these transformers is 20,000V.—S. Kershaw (Kershaw's Korner, Pershore Street, Birmingham 5.)
Radio Miscellany

WITH so many branches of radio and electronics to occupy the interest of the constructor to-day, it is not surprising that many find it impossible to keep up with so wide a range, and tend towards greater specialisation. Twenty years ago there were, broadly speaking, only three main interests to which the constructor might turn his attention, once his introductory burst of enthusiasm had carried him beyond ordinary receiver design. The receivers of those days, too, were of infinitely simpler design although, of course, quite adequate for their period. The design of a first class modern receiver requires almost as much knowledge of the construction and use of other equipment as of the receiver itself.

The pre-war enthusiast, if he was not greatly attracted by short-wave listening or amateur communication radio, usually turned his attention to high quality reproduction. Despite their considerable numerical strength, the quality fan has perhaps been as fully catered for as the scientific amateur and text books as he deserves. At one time there were several flourishing clubs catering for him, but today he seems to have learned to live without. Yet, who can doubt his importance in the face of the steady demand for high quality speakers, amplifiers, expensive pick-ups and elaborate laboratory equipment.

Many constructors possess an acute ear, or a feeling for music, and to them the problem of sound reproduction with its many complexities becomes so absorbing that they find little interest in other branches of the hobby. Indeed, the quest for a truly balanced and life-like reproduction leaves little time for much else.

Ostracism.

The perfect reproduction would, of course, be indistinguishable from the original sound, but has any reader ever been deceived that he has been listening to the natural voice of the live orchestra instead of a reproduction? The big grunting boom was selling point No. 1, and manufacturers and salesmen ecstatically cried “Just listen to the bass.” No invitation was necessary really—it simply jumped out and hit you. In fact I was once solemnly assured by a listener that the thirty cycle sound waves from an early moving-coil speaker inspired to violently on the wall of his stomach when he stood facing it, that they produced a feeling of physical sickness!

Even to this day, the public feels that all the best sets should have that “bass” voice. They have learned to live without it, and an inspection of domestic receivers reveals that nine-tenths of listeners use the ‘tone’ control to give maximum bass accentuation, completely oblivious of the top cut entailed.

The manufacturers euphemistically called that position “mellow”, and if a musically minded listener dares to shift the top a chance, the reproduction is immediately condemned as being harsh and shrill.

It would seem that the ordinary listener does not want good reproduction. His ears have, by the continual acceptance of “pleasing” noise, been drugged by distortion and he finds an imagined reality behind what is often a travesty of the original. Listeners have grown to dislike a different “tone” from the one to which they have become accustomed. It is far from infrequent to find extension speakers that are twenty years old, and to have their owners tell you they prefer them to anything else they have ever heard! It is an instinctive dislike of what must truthfully be described as ‘faking’—by the balancing of one imperfection against another. Generally speaking, that is the principle that must be exploited in the search for better quality.

If you have an acoustically good room, plenty of time and a taste for it, you can get years of fun in the quest for high fidelity. Personally I would advise making a start with improved, and simplified, methods of contrast expansion—to put back what the studio took out before you receive it!

Close-Up

Talking of faking, the art (or should it be artifice?) of crooning was surely born in the thick use of the microphone. It is essentially a form of cheating, and for its success it depends upon amplification to gain an otherwise unobtainable effect.

I have never seen the technique of crooning defined, but personally I should describe it as more singing slowly and intimately into the microphone with a few notes thrown in to give it appeal and tenderness. By greatly amplifying the resultant sound, the depth, volume and apparent reality of a rich and strong (but counterfeit) voice is simulated.

If sound reproduction can be debased for such deceit, how much more justified is the radioman’s balancing of two imperfect factors to give a semblance of reality to worthier music?

Plenty of Scope

Personally, I have always regarded the striving after super reproduction as something of an illusion, and it has been a source of mild surprise to me when I think of the trouble and money enthusiasts have expended on getting a little more emphasis at either end of the musical register. I shouldn’t, really. Having been a rainbow chaser most of my life, I know just how much fun it is chasing something that is tantalisingly beyond your reach.

Brilliance

Perhaps it is human perverseness, but many quality enthusiasts go to the other extreme and make all attempts to get that little bit of extra top, even to tolerating a terrific needle hiss on gramophone reproduction. More than once I have been assured “We won’t notice it, after a while.” This strikes me as a funny attitude. If one can adjust one’s hearing not to notice it, surely it would be just as easy to adjust oneself not to notice other imperfections, or to lower the volume if adjusted to give a satisfactory level on the soft passages. With record reproduction, the pianissimo must be at least strong enough to overcome needle noise, and a proportionate fortissimo would not only overload the amplifier, but also damage the record surface.

Many thoughtful enthusiasts have an instinctive dislike of what must truthfully be described as ‘faking’—by the balancing of one imperfection against another. Generally speaking, that is the principle that must be exploited in the search for better quality.

When we get back to earth, we must remember that, even with the most perfect amplifying systems, there are still other factors to be taken into account. Firstly, the acoustics of the average room need to be taken into account, but given that, one still finds that there is a lot of correction to be done to balance the intensity of the pianissimo and fortissimo passages. Both in broadcasting and recording studios the contrast is “compressed”. This is essential while the normal operator is not used to handle the loud passages if adjusted to give a satisfactory level on the soft passages. With record reproduction, the pianissimo must be at least strong enough to overcome needle noise, and a proportionate fortissimo would not only overload the amplifier, but also damage the record surface.

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Directional Aerials

Another excellent type of fixed bi-directional aerial is the V beam, (Fig. 1). This aerial, however, requires plenty of space, especially for operation on the lower frequencies. For instance, to obtain the worthwhile gain of 8 dB on 14 Mcs each leg of the beam would have to be 4 wavelengths long or 279 feet, with an included angle of 50 degrees. This factor prohibits the erection of this aerial in the average garden, at any rate for the lower frequencies. For bi-directional work on the VHF bands, however, it becomes a proposition, and this will be dealt with in a later chapter.

The Rhombic is another type of aerial requiring a prohibitive amount of space. A 3 wavelength Rhombic for 7, 14 and 28 Mcs designed to give approx. 10 dB of gain on 28 Mcs would require a total ground space of 590 feet by 214 feet. This aerial also has possibilities at VHF, as will be seen later.

The Franklin aerial (Fig. 2) or co-linear array is another bi-directional aerial, more suitable for operation on 7 Mcs and lower, because of its high angle radiation pattern.

From a practical point of view, the Franklin aerial is not worthwhile for Amateur work. The gain of a 4 element aerial of this type is only about 1 dB greater than a dipole with driven reflector, and it would have only about half the coverage (i.e. 30° back and front).

The Lazy 'H' Aerial (Fig. 3)

This is a very popular aerial for 28 Mcs work, although it may be used quite effectively on 14 Mcs. For 28 Mcs operation it may be made rotatable. As a fixed bi-directional beam its gain is approx. 6 dB (4 times the power) and if fitted with reflectors, this gain is increased to approx. 9.5 dB (8 times the power). The stacking of the elements vertically produces radiation at the low angles (the vertical radiation pattern is shown in Fig. 4), which makes it a particularly suitable type for operation on the two higher frequencies, 14 and 28 Mcs. The fitting of reflectors, while increasing the gain as stated, also limits the coverage, and it becomes necessary to rotate it a full 360 degrees in order to cover the horizon. Owing to the difficulty in supporting
the elements, due to the length they attain on 14 Mcs, the ‘Lazy ‘H’ is normally only used on 28 Mcs (and higher) as a rotary aerial. Fig. 4a gives optimum dimensions, reflector spacings, and lengths for operation on 28 Mcs.

Feeding the Lazy ‘H’

It will be remembered that we fed the dipole at a low impedance (or current) point. The Lazy ‘H’ aerial contains 4 half wave dipoles which are fed at the ends (high impedance or voltage point). Any attempt to use low impedance feeder would result in absolute failure to obtain a match. We could, of course, forget the stub (Fig. 3) and feed in half way along one of the lower elements. This would radiate, but there would be an unequal distribution of voltage and current, and this would result in lowered efficiency.

A simple and efficient method of feeding this type of aerial is to use our old standby, the 100 ohm balanced feeder, and fit a matching transformer. For our purpose of the moment, (i.e. to feed a Lazy ‘H’) we require a 600 ohm spaced feeder to give an approximate match to this aerial. Our transformer, then, has to be of an impedance equal to the ‘Geometric Mean’ between 600 and 100 ohms, i.e. 245 ohms. A length of 300 ohm ribbon feeder will thus do the job, with a standing wave ratio of less than 1.25:1. When using 300 ohm feeder as matching sections, it should always be remembered that the ‘velocity factor’ enters into the question, and for this particular feeder this value is approximately 0.8. This means that your quarter wave section has to be 0.8 of a quarter wave.

Connections and lengths are shown in Fig. 5. The loss factor of 100 ohm BA.3 feeder at 28 Mcs. is only of the order of 2 dB per 100 ft.

The Sterba

Sterba ‘curtains’ consist of arrays of half-wave elements stacked vertically, the ends being terminated in quarter wave sections as shown in the typical example given in Fig. 6. This particular one may be fed direct with 300 ohm feeder. For a multiple array as shown in Fig. 7, feeding should always be done at the centre, and the method adopted for feeding the Lazy ‘H’ will be satisfactory. The loss factor of 100 ohm BA.3 feeder at 28 Mcs is only of the order of 2 dB per 100 ft.

Simple Beams

The simple dipole (or half-wave aerial) may be turned into a beam, or one-way aerial, by placing a slightly longer length of wire or tubing at a critical distance from it (normally ½ wavelength) (Fig. 8). This, due to the phase change it produces, acts as a reflector or—a far better way out of this difficulty is to increase the impedance of our beam and thus make it to suit our feeder. This may be done by the simple method of ‘folding’ the driven element (Fig. 9). By the ratio of the size of the folded portion to the main radiator, and the spacing between them, we shall see how the impedance of the driven element may be adjusted to suit almost any type of feeder.

Commencing next issue . . . . . . . . . .

MAGNETIC SOUND RECORDING

FIG 6. SIMPLE STERBA CURTAIN WITH OPTIMUM DIMENSIONS FOR 28 Mcs OPERATION

FIG 7. MULTIPLE STERBA CURTAIN DIMENSIONS FOR 28 Mcs AS FIG 6

FIG 8. SIMPLE DIPOLE PLUS PARASITIC REFLECTOR (OR TWO-ELEMENT BEAM)

FIG 9. FOLDED DIPOLE IMPEDANCE AT X IS GOVERNED BY SPACING S & WHEN CONSTRUCTED FROM TUBING BY RATIO OF SIZE OF RADIATOR A TO FOLDED PORTION B'
TELEVISION

Picture Faults

Part eight of a series, illustrated by photographs from a Televisor screen by courtesy of Mr. John Cura.

Part 8 — The CRT Tube

As the most expensive individual component, the safety of the cathode ray tube is foremost in the minds of all constructors, when testing or adjusting a television. However, a few simple precautions will render any possibility of damage fairly remote, and a little careful thought as to what procedure to adopt is very worth while.

Firstly, handling the tube must be carried out with extreme caution. As a rule, CRT's are fairly robust — they have to be to withstand the high external air pressure which they are subjected to. But they are hardly safe from rough treatment and have several weak points. These are the neck, base, air seals and anode pins. It is advisable to wear goggles or glasses, when handling them, to protect the eyes. A cut from flying glass may not be a serious matter, but the possibility of eye damage is a different proposition. Always lift the tube with both hands, and never by the eye. The neck. It may be left standing face down on some soft material when removed from the receiver, but if it is to be left out for some time, it should be replaced in the original carton. If these points are carefully noted, an accident is very unlikely to occur.

Electrical damage is generally confined to the electrode assembly. Starting with the heater, and working towards the screen, the following faults and their causes are detailed.

Heater and Cathode

On installing a new tube, check most carefully that the heater supply is of the correct voltage. Tubes of British manufacture, may, have heater voltages of 2, 4, 6.3, or 10, and doubtless in the future other heater voltages may appear.

The heater voltage must be correct. If exceeded, the cathode may lose its emission rapidly, and if under-run, the pictures given will be of very poor quality, at the least. Cathode disintegration will arise when the heater is under-run, and large portions of the cathode area will lose the ability to emit electrons. If the tube is operated with heater, bias and EHT supplies, but without focusing potentials in the case of electrostatic tubes, and magnetic fields in the case of magnetic tubes, then an image of the cathode will be seen on the screen. This should be evenly illuminated, and be free of large dark areas which show non-emitting areas of the cathode. When the electron beam of the tube is normally focused, no indication of cathode disintegration is likely to be obvious, unless the deterioration is so serious as to affect the brilliance of the picture as a whole. An excellent example of a cathode image, where there has been some disintegration, is shown in Fig. 1, the dark areas showing the degree of deterioration when compared with the total area of the image.  

This type of cathode damage may also appear when the CRT is reaching the end of its life; in this case, the heater supply may not be at fault and the effect may be attributed to "fair wear and tear". In electrostatic tubes, where iron burn does not normally determine the end of useful life, cathode disintegration will. The image will frequently become considerably reduced in brilliance, and may show as a negative picture when the brilliance control is increased beyond the usual setting. It may not be possible to obtain a cathode image with electrostatic tubes, due to interference of the wide cathode beam by the electrode assembly.

Modulator Grid

The modulator grid of the CRT, and the other electrodes further from the cathode, seldom have faults of their own. Adequate insulation is provided in the construction, and they are mechanically strong. There is the possibility, however, of small particles of screen or cathode material falling into the small gaps between electrodes, and causing short circuits. This is most likely to happen between the modulator grid and the cathode, the latter being almost completely enclosed by the cylinder which forms the grid. Small particles of cathode material falling into this cylinder do not easily escape, and may bridge the electrodes, causing the grid potential to rise to that of the cathode, with subsequent lack of control of brilliance. It frequently becomes apparent when the receiver is first switched on, and after some minutes, the expansion of the elements forming the electrode system allows the fault to clear, and the tube then operates normally. If the fault becomes persistent, and ceases to clear after the televisor has been on for some time, the tube must be considered a loss. It may possibly be salvaged by drastic treatment such as "flashing" between the electrodes concerned, or by gently tapping the tube to dislodge the bridging material. From experience, this latter method seldom has the desired effect, and is somewhat dangerous; precautions should always be taken to protect...
one's person if it is resorted to.

"Flashing" may consist of the small current provided by a "megger," applied to the electrodes, or at the other extreme by discharging a charged capacitor through the fault. By this method, the power dissipated may be controlled by the size of the capacitor, and the voltage to which it is charged. In all, this procedure should only be adopted if it is considered that the tube is unusable, and nothing will be lost if further damage is done.

In magnetic tubes, a similar fault can appear if the heater/cathode insulation breaks down. This may not matter if the heater is supplied from a separate heater winding on the mains transformer, but if operated from an earthing winding, the bias voltage on the tube may be removed, showing as lack of brilliance control. The modulation will disappear in the case of cathode modulation of the tube. A cure may be effected by providing a separate heater supply for the tube from another transformer. In electrostatic televisors, the CRT heater is usually provided separately, and here it is advisable to see that the heater is maintained at the same DC potential as the cathode. This may be obtained by either direct connection between the two, or by joining together via a 1 Megohm resistor. It must be borne in mind that, with negative HT supplies, the heater winding for the CRT will require adequate insulation to withstand the high voltage at the heater of the tube.

A fault may occur in electrostatic televisors which have a "floater" heater winding, which, is not connected in any way with the cathode circuit, due to static discharges between the heater and the cathode. If the constructor is unaware of the possibility of this occurring, the effects can be very disturbing, and quite elusive when it comes to curing the fault. It may produce short crackling sounds in the sound receiver, and thin black horizontal lines on the screen. This may be intermittent, and frequently disappears when the receiver has been in use for half an hour or so. Connection of the heater to the cathode, as mentioned previously, will remedy the trouble.

"To be Continued"

**QUERY CORNER**

A "Radio Constructor" Service for Readers

The No. 18 Receiver

I have a No. 18 receiver which is providing good results on the 6—9 Mcs wave range, but I would like to extend the coverage of the receiver to take in the medium and long wave bands. Can you please suggest the necessary modifications?

B. Goodacre, Fife.

In its original form the No. 18 receiver consists of a four stage superhet using three RF pentodes (ARP12) and one double-diode triode (ARP12). Taking the valves in the order in which they are used in the receiver, their respective functions are untuned RF; Frequency Changer, IF amplifier, and detector with AF amplifier. The last valve feeds a pair of low impedance headphones via a step down transformer, and by virtue of a tuned feedback circuit it can also be used as a BFO to facilitate the reading of morse. One of the peculiarities of this receiver is the frequency changer, which is a standard RF pentode used in a filament coupled oscillator circuit. For this purpose, chokes are included in the filament leads to the valve, and it is this part of the circuit which presents the main stumbling block when the receiver is modified to cover an extended wave range, as the filament choke have to be switched.

Perhaps the most convenient method of adapting the receiver for general all-wave reception is to re-arrange the valve complement as follows:—Frequency changer, IF amplifier, detector and first AF amplifier and output pentode. The provision of an output pentode enables very satisfactory loud speaker reproduction to be obtained from local signals—the output valve replaces the RF amplifier on the chassis. The simplest method of modifying the frequency changer is to change the ARP12 for an Osram X14, and use it in conjunction with a standard coil pack or plug in coils. Fig. 1 is the circuit diagram in its original form of the first two stages whilst Fig. 2 indicates the modifications necessary to the frequency changer in order to incorporate the X14. Th
conversion is perfectly straightforward; the only possible trouble which could occur is that of squeaking, and this may easily be overcome by increasing the value of the stopper resistance R1 in the oscillator grid circuit. Fig. 3 indicates the circuit diagram of the additional output stage. The lead which is taken from the anode of the AR8 to the grid circuit of the output stage. However, as the majority of short wave listening will be with headphones this is no serious disadvantage. We feel confident in saying that, for the constructor who does not mind spending a certain amount of time in modifying this receiver, it is certainly a good buy at its present ex-Government price, and provides a useful portable for either general or field day use.

Time Constant

I understand that when a capacitor is charged through a resistor the voltage across the capacitor rises gradually to its maximum value; please inform me of the method whereby the value of this voltage may be determined after any given time?

S. A. Roberts, Hillingdon.

Readers who may fear that we are about to delve into a treatise on the use of mathematics in radio calculations are assured that this is not the case and should take heart and read on. There are many problems which cannot be solved without recourse to math, but does not leave space for the construction of a formula. This may appear a little formidable at first sight but a worked example should help to clarify matters. The diagram Fig. 4 shows a capacitor which is connected via a resistor to a battery. Now, before the battery switch is closed the capacitor holds no charge, and hence there is no voltage across its terminals. When the switch is closed a current flows around the circuit, and because initially there is no charge on the capacitor this current is limited only by the resistor. The value of this current at the instant of closing the switch may be simply calculated by means of Ohms law, \[ i = \frac{V}{R} \]

where \( V \) = battery voltage, \( R \) = value of resistance (ohms), \( C \) = value of capacitance (farads), \( e \) = base of Napierian logs = 2.71828.

This may appear a little formidable at first sight but a worked example should help to clarify matters. Assume that \( V = 1000 \) volts, \( R = 1 \) Meg ohm, and \( C = 1 \) uf, then at the instant when the switch is closed the current will be

\[ i = \frac{1000 \times 10^3}{1 \times 10^6} = 1 \text{mA. by Ohms Law} \]

However, as a charge builds up across the capacitor the voltage across it increases, and therefore the voltage across the resistor decreases. At any particular instant these two voltages will add up to the battery voltage, thus as one increases the other will decrease. Also, as the voltage across the resistor decreases the current in the circuit will fall until it finally reaches zero. At this stage, the capacitor is fully charged and the voltage across it equals the battery voltage. Reference to Fig. 5 shows how the current in the circuit, and also the voltage across the capacitor, changes with time immediately after the battery switch is closed. Now the problem is to calculate the value of either of these parameters at any instant of time after the closing of the switch, and this entails the use of a simple formula.

At any time, which we will call 't' seconds, after switching on the circuit is governed by:

\[ i = \frac{v}{e} - CR \]

\[ i = \frac{1000}{2.71828} \]

Since \[ \frac{v}{e} = 1 \text{mA} \text{ and } CR = \frac{1}{10^6} \]

Working out by means of logs we obtain

\[ \log i = \log \left(1 - 0.5 \log 2.71828 \right) \]

\[ i = \frac{0.5 \times 2.71828}{1} \]

Thus the voltage across the capacitor when the current is at this value may be determined by subtracting the voltage which appears across the resistor at this instant from the supply voltage, thus \( Vc = 1000 - 800 = 200 \) volts.

Calculations of this type are particularly useful when working out the component values of a time base, as the majority of these oscillators operate on the principle of a capacitor charged via a resistor. Finally, it is interesting to note that the value of \( CR \) is known as the time constant of the resistance-capacitance combination, and is the time in seconds required for the voltage across the capacitor to reach 63.2% of its final value.
WHAT IS THE I.S.W.L.?

1. The International Short Wave League (I.S.W.L.) is an organisation of short wave listeners, amateur transmitters, and others interested in short wave radio communication.

2. Its objects are to encourage, in every way possible, friendly intercourse and understanding between peoples of every country, through the medium of the most popular of all international codes, the Morse Code.

3. Membership is open to anyone, of whatever race, creed, or colour, provided there is a genuine interest in short wave radio and a desire to foster the aims of the League.

4. The membership fee consists of an annual subscription of 2s. 6d., or its equivalent. There is no entrance fee.

5. Contests, set listening periods, and special broadcasts are regularly arranged, in order to further the aims of the League.

6. Organisation consists of an HQ (Headquarters), Country, County, and Town representatives, and local I.S.W.L. Groups. These latter are the essential units of I.S.W.L. activity, as they stimulate and keep together local I.S.W.L. members.

7. Many free services are available to help members to get the best out of their hobby. Amongst these is a QSL Bureau which is unique in that it handles both amateur and broadcast 'veries.'

8. A section of 'Short Wave News' is devoted each month to I.S.W.L. affairs, and carries news of contests and Group activities. The purchase of 'Short Wave News' is NOT a condition of membership.

9. The address of HQ is 57 Maids Vale, Paddington, London, W.9, and the telephone number is CUNningham 6518.

IF YOU ARE A SHORT WAVE ENTHUSIAST

JOIN US NOW

AN EASILY ADDED "S" METER

Centre Tap describes a Useful Accessory for addition to any Superhet Circuit fitted with AVC.

From the time the superhet circuit first became popular, most of the better quality receivers have been fitted with some form of visual tuning indication. With the simple broadcast receiver some means of accurately determining the correct tuning point is a highly desirable feature. The superhet is inherently highly selective, and any deviation from the exact tuning point must result in a deterioration in reproduction quality. It is far simpler to tune by the ear than it is by the eye, and receivers with any pretensions of being in the 'quality' class have always been fitted with one form or another of the various visual tuning devices, of which the magic eye has been the most popular.

The 'S' meter, because of the greater ease in noting the optimum tuning point, is far more suited to laboratory work and communications receiver design, however out of place it may seem in the drawing room. Apart from this advantage, it is far more consistent with the instrument type cabinet than the 'furniture' cabinet of the commercial broadcast receiver some means of accurately determining the correct tuning point is a highly desirable feature. The superhet is inherently highly selective, and any deviation from the exact tuning point must result in a deterioration in reproduction quality. It is far simpler to tune by the ear than it is by the eye, and receivers with any pretensions of being in the 'quality' class have always been fitted with one form or another of the various visual tuning devices, of which the magic eye has been the most popular.

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Simple Application

With straight receivers, it was formerly customary for amateurs to include a milliammeter in the anode circuit of the detector valve and tune to maximum "dip" (the smallest meter reading). With a straight circuit such a device is rather by way of being a gadget, instead of a necessity as it is under the critical tuning conditions of a well-designed superhet.

It is of interest to note that in a circuit using anode bend detection the anode current, and therefore the meter reading, rises as a signal of greater strength is obtained. An inaccurate report is not only misleading, but may be actually misleading.

Simple Circuit

An "S" meter on these lines was described in the Short Wave News for December, 1948, for addition to the basic Superhet and similar receivers, the essential feature being that the set must incorporate an AVC system. It is of course, the AVC which actsuate the meter its position in the circuit being the final IF amplifying valve.

It will not give readings for CW reception, although special arrangements can be made for this purpose. The AVC is always shorted...
it possible to lay down any arbitrary rules: much depends on the receiver efficiency. The reading is not only dependent on the relative incoming signals, but will also be affected by variations in the slope of different valves. The scale will be cramped at the low reading end and a rough general approximation is given in the accompanying specimen. For the more technically minded it might be mentioned that a good working basis for the scale is a variation of 3 dB for each division.

Fitting
A convenient form of mounting where space is limited can be arranged with the assembly mounted on a paxolin or bakelite strip at the rear of the meter itself. The brackets supporting it are held by the meter terminals, and these may also serve as soldering tags. If a midget pre-set type of potentiometer is used, this arrangement will occupy the minimum amount of space. The potentiometer, by the way, which is used for making the zero adjustment, must be a good quality one. The resistors other than the two forming the potential divider for the valve screen, can also be mounted on the platform.

An alternative arrangement with the meter forming a separate external unit, as in the Eddystone and some of the Hallcrafter models, may be preferred. In this case the associated resistors, etc., are best mounted in the separate unit and the three leads taken out via a plug and socket fitted at the rear of the receiver chassis. A miniature valve base and holder will be found ideal for this purpose.

Practical Considerations
The meter movement itself will depend on the receiver into which it is to be incorporated, and for one where it follows two RF stages a meter with a 3 or even a 5 mA movement could well be used. A 0.5 or 1 mA moving coil instrument will be best for the average small receiver. The smaller the set the more sensitive the movement will need to be—it should always be necessary to need to improvise in order to get adequate readings.

In calibrating the scale it will be found to be far from linear—no "S" meters are! Not is
A CATHODE FOLLOWER OUTPUT STAGE

by D. W. DRAKELEY

An appreciation of the virtues of the Cathode Follower as a means of feeding a low impedance load from a high impedance signal source suggested experiments to determine the possibilities of the system when used to feed a loudspeaker load from a normal pentode or tetrode output valve.

The experiment was carried out on a five valve superheterodyne of otherwise conventional design and the output stage was first arranged as shown in Fig. 1., which shows that the output voltage is developed as usual in the primary winding of the output transformer, which for this purpose however replaces the normal bias resistor and capacitor between the cathode of the output valve and earth, the anode and screen of the valve being returned direct to the HT line, so that the valve functions effectively as a triode. The voltage developed across the output transformer is thus in series with, but in opposition to, the incoming signal voltage across the grid load impedance R; thus providing an extreme case of negative feedback in which the whole of the output voltage is fed back, instead of only a small fraction as in the usual negative feedback arrangements.

One of the less desirable effects of this high degree of degeneration is, of course, to reduce the overall sensitivity of the stage very considerably, and its gain is in fact reduced to rather less than unity. Although all forms of distortion are of course reduced in the same proportion as the gain, we are nevertheless faced with the problem of obtaining from the preceding stage a volume of signal sufficient to balance out the whole of the output voltage which is being fed back in opposition to it, and at the same time to provide the additional voltage required to load fully the output valve.

This difficulty may be overcome to a limited extent by the selection of an output valve of high sensitivity, such as the Osram KT61, but even so, in the writer's superhet, using resistance capacity coupling, it was found to be impossible to load the output valve fully, without introducing a further stage of AF application between the double-diode-triode and the output valve. This was impracticable for reasons of space and it was therefore decided to introduce transformer coupling parallel-fed between these two valves as a means of increasing the overall gain. An ex-Govt. mumetal cored transformer of 5:1 ratio was obtained quite cheaply and was found to introduce little noticeable distortion over the transmitted band of frequencies whilst providing the additional inter-stage gain required. These arrangements are shown in Fig. 2.

From an examination of the DC circuit conditions in the output stage it is clear that the grid bias of the output valve is dependent upon the DC resistance of the output transformer primary, and since in the majority of cases this will be found to be too high, a potential divider across the HT supply should be employed to introduce a positive bias sufficient to offset the excess of negative bias arising from the presence of the output transformer in the cathode circuit. The variable resistor VR should be adjusted until the combined anode and screen currents assume the correct value for the particular valve in use, when if so preferred the variable resistor may be replaced by a fixed potentiometer of comparable value. Fig. 3 shows the arrangement required.

If on the other hand, the grid should be found to be inadequately biased, as in the case of an output transformer of exceptionally low L C resistance, the position may of course be remedied by the insertion in the cathode circuit of the necessary additional resistance Rk by-passed in the usual way by a 25 μF capacitor, as in Fig. 4.

The quality of reproduction compares very favourably with that of even a first quality commercial receiver, and due to the heavy damping of speaker resonances. As a result of the large degree of feedback, the results are probably the best that can be obtained from any single valve arrangement from the viewpoint of quality and absence of distortion.

Fig. 1: The basic arrangement. This had to be modified as in Fig. 2., in order to avoid lack of sensitivity.

Fig. 2: Increased gain obtained by substituting a transformer for the resistance—capacity coupling of Fig. 1.

Fig. 3: Modification of Fig. 2, to provide for the adjustment of the grid bias to the correct figure, where the bias voltage is found to be excessive.

Fig. 4: Modification of Fig. 2, to provide for the adjustment of the grid bias to the correct figure, where the bias voltage is found to be inadequate.
A SIMPLE RADIограм

by W. E. CREES

The sight of a number of pleasant looking table model gram cabinets in one of London's well known radio shops resulted in the construction of the radiogram to be described. Although this was built for use with the above mentioned cabinet, the reader will quite easily be able to adapt the circuit for use with his own ideas on the housing of the finished model.

The circuit consists of a TRF for MW only, using EF39 for RF and 6H6 as detector, feeding into an EF37 AF stage with 6V6 output. The output incorporates tone control and negative feed back. All components are easily obtainable, and the results very satisfactory. The EF37 is capable of giving all the gain from the PU that is necessary to drive the output stage.

A TRF was chosen, because of one, its simplicity, and two, its high quality, to which the AF stages can do justice. A pair of Wearite PA2 coils are used to cover the MW band only. The RF is transformer coupled to the diode detector. In the detector circuit the value of R3, the diode load resistor to VR1, is important and should not be altered. Moving to the AF stages, these are conventional except for the tone control and feed back network, between V3 and V4. Here voltage feedback takes place through a CR network from the anode of V4 to the anode of V3. The voltage feedback is proportional to the voltage across the primary of the output transformer.

Variable treble control is given by VR2, while C17 gives a fixed bass boost. This circuit is very useful as a means of minimising the scratch on old records. The power supply is built on a small separate chassis partly because of space limitations, but chiefly to help remove as far as possible the mains transformer from the vicinity of the high gain AF stage and away from the gram, pick-up. If a shallow cabinet is used, as in the author's case, a problem immediately presents itself. The depth between the motor board and the bottom of the cabinet is insufficient for a large speaker. This was solved by using two 5 inch speakers in parallel. Readers will be aware of the advantages of using a large speaker with a good baffle area, but in spite of not being able to do this, there is no noticeable deterioration in quality. Also overloading of the speaker does not take place. If a large cabinet is to be used, then twin speakers will not be necessary. The use of two speakers in this way means they must be connected in parallel.
A NEW ATTENUATOR

by W. G. MORLEY

The writer is indebted to W. E. Thompson (St. Leonards-on-Sea) for pointing out several discrepancies in the attenuator circuit shown on Page 185 of the February issue of the Radio Constructor; and has therefore designed a new attenuator which may be used instead of the one originally published and which showed incorrect values of resistance in one of the arms.

This new attenuator circuit is shown in the accompanying diagram. It may be seen that the coarse attenuator switch offers outputs of "Full", 1/10, 1/100 and 1/1000 of the voltage obtained from the oscillator. These voltages are again split up by the fine attenuator, which gives ratios of "Full", 0.8, 0.6, 0.4, 0.2 and 0.1 of the output given by the coarse attenuator.

The impedance presented at the input to the attenuator is approximately 100Ω, whilst that at the output varies between 0.1Ω and 100Ω. On the "Full" position of the coarse attenuator, the left-hand potentiometer network is switched out of circuit, the fine attenuator itself then providing the input impedance.

If the ratios given by this circuit are calculated it will be found that those offered by the coarse potentiometer are actually 1/10, 0.1Ω, 1/100 and 1/1001, and not the exact figures mentioned above. The slight discrepancies are due to the fact that, except in the "Full" position of the coarse potentiometer, the 100Ω of the fine potentiometer network is in parallel with whatever part of the coarse potentiometer falls between the coarse tap and the common chassis connection. The values of the coarse potentiometer have been chosen to allow for this; and also to enable sufficiently useful ratios to be obtained without incurring the use of awkwardly valued resistors.

In addition, the slight alterations caused by connecting the fine potentiometer across the various sections of the coarse network cause some slight changes in input impedance. This varies between 99.9Ω and 101Ω. This variation is, of course, too small to cause any noticeable changes in oscillator characteristics.

There is also a small error in the frequency given for the PA 6 coil on page 153 of the January issue. For 50 pF capacitance, this coil should resonate at 3,680 kcs and not 3,280 kcs. The error was caused by an error in typing from the original manuscript.

W. E. Thompson, who has used a p" coils in his instrument, passed on some interesting information about the signal generator; stating, amongst other things, that the cathode follower circuit of page 182 of the February issue has cleared up a lot of trouble in his particular model. He also states that he has extended the range of the PA1 coil to just below 110 kcs by switching in an extra 500 pF capacitor across the tuned circuit, thus enabling old-fashioned receivers which employ that IF to be serviced.
YOUR WORKSHOP

In which J. R. D. Discusses Problems and Points of Interest connected with The Workshop side of our Hobby, based on Letters from Readers and his own Experiences.

Junk!

It is certainly worth while keeping all the useful stuff, but the rest should really be thrown away. With regard to components, these should be kept only if they are serviceable and are not of obsolete patterns. Broken down capacitors and burnt out resistors should of course be thrown away at once, in case one should accidentally try to use them again. Components which may be stripped can have their useful parts removed before being discarded. For instance, burnt out transformers can yield some useful nuts and bolts (and the laminations, if required) before they are finally thrown away. Or again, old volume controls possess bushes and mounting nuts, etc., which are worth while keeping.

Nuts and bolts, particularly small ones, are items that seem to suffer most in the average workshop. This is difficult to understand because new nuts and bolts are quite expensive and they are always necessary for constructional work. One often finds them thrown away altogether, or piled together in a large box which necessitates a great deal of searching before the requisite nut or bolt may be found.

The best system, and the one which saves a fair amount of room if the layout of the work-bench is given careful consideration when it is originally planned. Many amateurs also like to give their workshops something of the atmosphere of a " den ", as this not only helps to give the room a confortable air, but also enables them to invite their friends in to relax in congenial surroundings.

The Workshop as a Whole

Perhaps the most important attributes are comfort, plenty of equipment and plenty of space to move about in.

Comfort is very important, as one may spend many hours in the workshop, and it is easy to become overtired if little points which make things easier are not attended to. Such things as good lighting, fresh air, warmth and so on, all help in this direction.

The work bench itself is also important, owing to the large amount of time spent at it. The best bench is one at which it is possible to work comfortably either standing or sitting. This can be ensured by having the bench about three feet from the floor and using a fairly high chair or stool for those jobs which allow one to sit down. The underneath of the bench should be kept free from boxes, etc., so that there is plenty of space for the knees.

Accessibility of equipment consists mainly of the careful planning of bench and shelf dimensions and of their positions. Plenty of workshop space is not always easily obtainable, but cramped quarters can be made to give a fair amount of room if the layout of the workshop is given careful consideration when it is originally planned.

Valve Tester

Dear Sir,—Referring to the current article "Building Your Own Valve Tester", may I make a suggestion which would appear to have some practical value.

If the 6X5 rectifier in Fig. 3 is replaced by a metal rectifier of suitable rating, one can at once omit R6 and the 6.3V heater winding. Moreover, since this metal rectifier will deliver grid bias potential almost immediately the tester is switched on, it automatically ensures that the valve under test has full grid bias before HT is applied. One can therefore use any type of rectifier for HT; the 5Z4 specified to guard against HT being applied before GB can therefore be a similarly directly heated type, or even a full-wave metal rectifier.

Incidentally, and as a matter of interest, the following observations might give others some food for thought. In the circuits of Figs. 2 and 3 we have a full-wave rectifier for HT (Fig. 2) and a half-wave for GB (Fig. 3). The HT rectifier conducts twice each cycle whereas the GB rectifier conducts but once. Whether we have this feature have upon the grid bias and anode current of the valve under test, and the consequent mutual conductance reading obtained?

W. E. Thompson (St. Leonards-on-Sea).

(Mr. Thompson is quite correct in stating that a metal rectifier can be used to replace the 6X5 of Fig. 3; and as this will supply grid bias as soon as the tester is switched on, there will then be no necessity to have an indirectly-heated valve as HT rectifier. The point of omitting the 6.3 volt winding will not apply in most cases, as the type of transformer used would almost inevitably be fitted with such a winding. In addition, the use of a metal rectifier might perhaps prove an advantage, insofar as it would reduce the initial cost of the tester.

The fact that a full-wave rectifier for HT and a half-wave rectifier for GB are employed will not affect the mutual conductance readings at all, as the tests are all carried out with stabilised DC. The outputs of the rectifiers, whether full or half-wave, are all smoothed before being applied to the valve under test.

It must, of course, be pointed out here that the constructor does not necessarily have to use the power supply circuits given in Figs. 2 and 3, although these should provide the best means of obtaining the various voltages required for the tests. If he has other components available which are capable of supplying the requisite currents and voltages to the stabilisers, then these can be used. However, care must be taken to see that such a supply is adequate and well-smoothed, and that all other requirements mentioned in the articles are satisfied.—W. G. MORLEY.

Inexpensive Television

Dear Sir,—I have made the set more or less per the book, and find my three main faults are (1) Background noise from RF26 Unit causing grain on the picture (I am 67 miles from SC) (2) IF break-through and (3) Slight non-linearity at top end of frame. Only to-day, though, I have reduced fault No. 3 by the addition to frame amplifier shown in the diagram. I hope this may be of interest to you.—T. Walker (Kuncom, Ches.).

short wave news

We regret that, owing to the present dispute in the printing trade in the London area, it is impossible for us to give precise information as to the date of appearance of our companion journal "Short Wave News". Readers may rest assured that it will be produced as soon as circumstances permit.

component values

C1, 0.001 μF
C2, 0.01 μF
C3, 0.001 μF

These values may need adjusting in some cases, and C1 and C2 connection (HT+ or E) may need to be changed.
Mains/Battery Receiver

Dear Sir,—I was agreeably surprised to read the replies concerning the trouble I was having with my receiver, and which you so kindly sent. I am now beginning to realise that the added AC which caused the heaters to glow more brightly, while it didn't affect the DC meters. At any rate, I haven't burnt out any more valves!

Before concluding I should like to state that I have been a reader of the "Constructor" for several years now and it has helped considerably in increasing my knowledge of the hobby. Particularly instructive and interesting were the articles on "The Design of the Superhet" and the "Logical Fault-Finding" series; the latter having helped me a great deal in repairing my own and friends' receivers.—

W. Savage (Kilburn).

Meter Shunts

Dear Sir,—In the July, 1950, "Radio Constructor" appears an article "A Multirange Meter For Less Than £1" by Mr. L. E. R. Hall, starting on P. 345. The method suggested for obtaining the value of resistance for the mA shunts is open to considerable error. The meter can be of any value resistance, so let us assume that it is 100 Ω. When connected up as suggested for calibrating the 10 mA scale, we have the circuit shown in Fig. 1(A). The variable resistor is adjusted for full-scale deflection (1 mA). Now we shunt the meter with a resistance which we vary until the meter shows a deflection of one-tenth full scale. This gives the circuit shown in Fig. 1(B).

The shunt resistance will be somewhere about 11 Ω and so the total resistance of the meter and parallel shunt will now be approximately 10 Ω. Now we have NOT moved the variable resistor, but due to the total resistance in the circuit being lower than before, the current in the circuit has increased, i.e.,

\[ I = \frac{E}{R + R_s} = \frac{0.00106A}{1100} = 0.00106A \] or 1.06 mA.

This error is on the 10 mA scale. On the higher ranges the error will be greater, as the shunt will be of lower value and so the total resistance will be smaller and the current greater, in addition to which there is the error on the previous range.

These errors must be allowed for by calculation, or eliminated altogether by using a meter of known accuracy in series with the variable resistor and meter under calibration, to show that the current flowing is indeed 1 mA, 10 mA, etc., etc.—

R. Jones (Bromley, Kent).

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