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No. 25 A SWITCHLESS INTERCOM SYSTEM

One of the greatest disadvantages of amplifying loudspeaker "intercom" systems lies in the necessity of fitting a "Talk-Listen" switch at the "master" position. Without such a switch the amplifier output and input would be linked together, either electrically or over an acoustic path, and the resultant unavoidable feedback would cause oscillation.

This month's circuit illustrates a means of dispensing with the "Talk-Listen" switch whilst, at the same time, allowing simultaneous conversation to be obtained between two points. This is achieved by using two amplifiers, these being switched in and out continually in such a manner that one is operative when the other is not. One of these amplifiers takes its input from one point and drives the loudspeaker at the other, whilst the second amplifier operates in the reverse direction. Assuming a suitable switching frequency, it then follows that speech may be carried both ways and the feedback cannot occur at all.

The circuit suffers from the disadvantage that the speech appearing at either loudspeaker is "chopped" at the frequency at which switching takes place, with the result that fidelity of reproduction is reduced. Intelligibility, however, need be affected only by a small amount.

The Circuit

The circuit given here shows one of several ways in which periodic switching of either of the amplifiers may be carried out. The voltage used for switching control has a frequency of 50 c/s and is obtained here from one half of the secondary of the amplifier power pack HT transformer, the centre tap of which is connected, in the normal manner, to chassis. Switching is then accomplished by allowing the alternative voltage from the transformer secondary to vary the grid bias of one of the early valves in the amplifier. This valve is shown in the circuit as V1.

Also included in the circuit is a diode, V2, whose purpose is to prevent positive grid bias being applied to the controlled valve when the switching voltage swings positive with respect to chassis. The resistor R1 is connected between C1 and the grid of V1 in order to prevent this capacitor (and the previous anode or input circuit) from affecting the switching point of the controlled valve. The period during which the controlled valve works with an incorrect value of bias is therefore correspondingly short. The controlled valve may consist of either a triode or a pentode (not vari-mu, of course), and its grid base may be shortened, if necessary, by operating it with reduced HT.

Due to its high value, the switching voltage will give an effect approaching that of control by a square wave. It is doubtful, however, whether it would give rise to troublesome harmonics of the switching frequency in the output of the amplifier; although a strong 100 c/s note will almost definitely be found at the anode of the controlled valve. The process of filtering out the switching frequency in the subsequent stages of the amplifier should not raise many problems. It will probably be found that a small-value capacitor (between 100 and 500 pF) connected between the anode of the controlled valve and the following grid will attenuate the unwanted lower frequencies quite adequately.

Two Amplifiers

The diagram illustrates the arrangement required for one amplifier only. The second amplifier (operating in the reverse direction) will need a similar control circuit. The control voltage of this second amplifier will, of course, need to be so connected that it is in antiphase to that used by the first. A saving may be made by using one power pack for both amplifiers, the switching control voltages being obtained from either end of the common mains transformer secondary.

ROYAL PATRONAGE

H.R.H. THE DUKE OF EDINBURGH K.G.

It is announced from Buckingham Palace that His Royal Highness, the Duke of Edinburgh, K.G., has been very pleased to extend his Patronage to the Incorporated Radio Society of Great Britain.

Although His Royal Highness has lately undertaken a great number of additional responsibilities he will do his utmost to take a personal interest in the Society.

The announcement from Buckingham Palace will give great pleasure to all Members of the Society.
This month, instead of devoting my space to a single subject, as I have done in the past few issues, I should like to deal with a number of smaller points. One or two of these are connected with topics mentioned in readers' letters, and I trust that these readers will bear with me over the slight delay which has occurred since they wrote to me.

Iron Cores

Adjustable iron-cored coils are used in both commercial and amateur-built equipment more often nowadays than they used to be. This is understandable when one considers the advantages offered by such coils as against their un-cored brethren. The iron-cored coil has the advantages of taking up less space; of parallel capacitance to be made (a particularly valuable of inductance, of holding that value over a longer period of time than does the usual copper coil); and, after it has been set up to a particular arrangement for permeability tuning. This is particularly true when the core has a threaded body and is not mounted to a separate threaded body and is not mounted to a separate.

A further application of the iron-cored coil, that of permeability tuning, does not, however, seem to have captured the interest of the amateur to any great extent. Bearing this in mind, it is interesting to note that a few commercial receiver manufacturers are using such coils, and using them in such a way as to make the inductance of the core change as the air gap in the core changes. This is done by means of a similar arrangement. In this case, a set of "ganged" cores could travel in unison in and out of inductors having one or two turns only, these inductors being connected in series with whichever short-wave coils are selected by means of the switch.

Apart from possible permeability tuning systems, iron-dust cores are encountered mainly, of course, in circuits where they are used to adjust the values of various inductors. When they are used in this fashion it is sometimes difficult to ensure that they will remain in position after having been set up. This is particularly true when the core has a threaded body and is not mounted to a separate brass adjusting screw. Fixing the core in position by means of varnish, glue or some similar hard-setting compound does more to re-adjust the core at a later date.

A preparation for holding iron cores in position which, if mixed carefully, can be made by mixing together equal weights of talc, zinc oxide and vaseline. These ingredients may, of course, be obtained from the chemist. It is important to make certain that they are well mixed together; and the best way of doing this consists of lightly heating the vaseline until it is fluid, whereupon the zinc oxide and talc can be added and thoroughly stirred in. When the vaseline has cooled, the resultant compound should be a white, sticky paste.

Suggestion

A reader who was interested in my recent comments on electric guitars, and who wishes to remain anonymous, sends in what he describes as the Craziest Suggestion of the Month. This consists of an electric jew's harp! He claims, rightly enough, that the very high harmonics up across a pick-up bobbin mounted close to the vibrating centre steel of a jew's harp would be more than sufficient to drive most dance-band amplifiers, and that the effect would certainly be novel and interesting.

I don't think that an electric jew's harp, considered as a novelty only, is too crazy an idea really; especially in the dance-band world where strange ideas often click ! I notice that no-one has, as yet, "electrified" the washboard and thimbles, (if that is the correct term), but doubtless this will come.

Another reader, E. L. Hitchcock of Ilford, Essex, has a few words to say about my recent paragraph on 1.5 volt filament oscillators. Readers may remember that I pointed out that such units could be quite suitable for a portable receiver.

Mr. Hitchcock says that he used to be fascinated by a particular transistor which MO employed a circuit arrangement of this type. This happened over five years ago, and so his recollections are not entirely clear. He rather fancy that the oscillator was the electron-coupled type you suggest in your recent paragraph on 1.5 volt filament oscillators. Readers may remember that I pointed out that such units could be quite suitable for a portable receiver.

I was also impressed by the fate of several wire-ended mica capacitors which had burst when not properly treated. These were relatively large-value components (about 0.5 μF) and were about eight years old. The heat, presumably, had caused the "innards" to expand, splitting open the outside case along the seam.

Battery Oscillators

On the other hand, however, the well-known BC221, even though it is designed for portable battery operation, uses 6.3 volt 0.3 amp valves.

Tropical Conditions

I have lately had the opportunity of examining receivers and components which have been working under tropical conditions in Malaya. Although I cannot offer a balanced or representative report, I would like to say that I was most impressed by the very quick rusting of iron and steel. Ordinary tools, for instance, became covered with a coat of rust in a matter of days. Steel chassis are very liable to rust unless properly treated.

On the other hand, however, the well-known BC221, even though it is designed for portable battery operation, uses 6.3 volt 0.3 amp valves.
A BATTERY “FOUR”  

By A. S. CARPENTER

A fairly powerful receiver with simplicity of operation was required recently for use by an inexperienced operator, who was somewhat advanced in years. Battery power was the only kind available. At first, an all-dry circuit was envisaged, but this idea was discarded in favour of a 2V type of receiver after consideration of the expense of battery replacements. Expense was a prime factor, and the following set was evolved using a WD No. 18 receiver as a basis. This was carefully stripped (the 465 kc/s IFT’s being put away and earmarked for future use) and the components re-arranged—with some added—in the form of a “straight” set—HF (VP23), grid-leak detector (VP23), LF (HL23DD) and output pentode (Pen 25), the latter being purchased separately. The HL23DD is a duo-diode triode, but in this set the diodes are not used, the valve acting as an amplifying triode.

Circuit

The complete circuit diagram is shown in Fig. 1. HF coupling follows V1, and resistance capacity coupling is employed between V2 and V3. The output valve is parafed. Volume is controlled by varying the bias on V1, a variable mu HE pentode. Although it is not possible to reach zero, a good range of control is obtainable.

No reaction was used in this particular case, as it was felt that this would thereby simplify operation. To offset any difficulties over selectivity, it was decided to use high grade coils and not too large an aerial.

Coils

Wearite “P” type coils were used. As provision for “Long” and “Medium” had to be made, four coils were required. This particular make was chosen partly because of their comparatively small size, and the only difficulty (if it can be called such) is that a fair amount of wiring is required in conjunction with the wavechange switch, but this proves no handicap providing time and care are taken. The great advantage is that the “long” wave coils are completely out of circuit when receiving “medium” wave transmissions, and vice versa.

Layout

Top and underside layout arrangements are shown in Fig. 2. The chassis measures 8”x6”x2”. The four coils are mounted underneath, close to the wavechange switch. Coil PA2 is fixed to the front flange, pointing inwards, and coil PA1 to the bottom of the chassis, upside down and at right angles to PA2. PHF1 and PHF2 are fixed in the same manner as PA1, but as far apart and as far from the others as possible in order to avoid any interaction. A small 50 pF trimmer is connected across terminals 1 and 2 of each coil for trimming purposes.

The LF transformer is mounted on the rear flange of the chassis and underneath, coming between, and over, the bases of valves 3 and 4. In view of this, it is best not to mount this component until the two valves are wired up.

As will be seen from Fig. 2, the only components appearing on top of the chassis are the valves, twin-gang tuning condenser and the output transformer.
Wiring

If wires of different colouring are used for the coils and switch, ease of checking the final connections will be greatly facilitated. It is easiest to commence with the filament, coils and switch, and HT, in that order, finishing up by joining on the battery supply leads.

The “on-off” switch is incorporated in the volume control, and is arranged to switch “off” when volume is at its lowest point.

Resistors are all ½-W, and the values given were found to be the best after a period of trial and error. With different valves, some trouble from microphony was experienced, but this effect was absent in the completed receiver. A grid stopper was included in the grid circuit of V4 to avoid any parasitic oscillation.

Results

After the usual trimming adjustments were made, and with a short aerial rigged up indoors, output was found to be more than sufficient, so that there was always some power in hand.

Selectivity proved to be quite satisfactory, and the quality from the 8” PM speaker used by the writer was extremely good. In fact, results far exceeded expectations.

Cost

An overall estimate—approximately £4.

VALVES AND THEIR POWER SUPPLIES

Part 2

By F. L. BAYLISS A.M.I.E.T.

DC Receivers

Concurrently with the early AC types discussed in the previous article was produced a range of DC valves, similar in characteristics to the AC types but having comparatively high voltage heaters, all of similar current rating.

Receivers employing these valves were popular around 1930, when comparatively wide areas of the country were still served by DC mains.

Unlike the modern AC/DC receivers, however, many of these early DC sets were designed for DC—and DC only. The writer, who was resident in a DC area in 1933, has distinct memories of radio emporium windows chock full of these. Some were dual types, having the usual rectifier—often metal—and mains dropper; the remainder possessed only the resistor and smoothing pack.

There was little basic difference between the power supply circuits of these sets and those of their modern counterparts, however; occasionally the loudspeaker field winding was the smoothing component, and mains-bridge capacitors were more popular than electrolytics. The mainsdropper, usually wound with heavy gauge Eureka wire, was a much more robust and massive affair than the modern vitreous type and seldom gave trouble.

If, therefore, you happen upon a receiver such as these, check it through as you would a modern set—and don’t forget the 0.1 µF capacitor from one side of the mains to chassis. How they hum when this component becomes disconnected!

Early 6 Volt Valves

It is probably true to say that the first receivers on sale in this country possessing 6 volt AC mains valves were of American manufacture and imported.

The cabinets of some of these were indeed imposing—built on massive and palatial lines with heavy ornamentation. Ten valves, ten watts and push-pull output shook the floor of many a radio shop in the early 1930’s and, indeed, even the late 1920’s.

These receivers—and there are many of them still in use—had American valves with UX type bases. There are four common varieties of this base, UX4, UX5, UX6 and UX7; the number refers to the number of valve pins, and the two pins having the greatest diameter are heater connections.

Many of these valves are still made. If, when servicing such a set, a replacement is required, the popular and reliable Tungsram range distributed by Siemens will probably supply your need.

In any case, almost all of these valves were subsequently duplicated in the international octal range when this base was introduced. It is not too difficult a matter to remove the UX valvholders and fit an international octal in their stead.

The corresponding octal range, however, carry a new and entirely different nomenclature. For instance, the UX4 rectifier “80” became the octal 5Z4, the UX6 “78” became the popular 6K7.

If you require an octal replacement for a UX valve, consult a current valve handbook. In it, the two types are often bracketed together—or sometimes a cross-reference is given.

Power supply in these receivers was usually as shown in Fig. 3. Bias was sometimes obtained from a bias resistor in the HT-lead, as indicated, and sometimes by individual resistors in the valve cathode leads.

Some of these American companies later commenced manufacture in this country, and one or two are, indeed, in the forefront of British design and manufacture today.

The AC/DC Counterpart

These early American 6.3V AC receivers also had AC/DC counterparts in which the range of high voltage heater valves, also with UX type bases, were ordinarily used in the output stage and power pack, together with similarly rated (current) 6.3V valves in RF and IF stages.

HT was often supplied by a 25Y5 or 25Z5 rectifier, having the two anodes strapped: the output valve was frequently a “43" (octal type 2SA6) and the heater current almost invariably was supplied via one or more mains dropping resistors located in the receiver itself. (One twenty-year old set of well-known make—had no less than four such resistors in it.) Such resistors were shrouded and unshrouded, wound on porcelain formers, and air-cored on paxolin cross-pieces, in wondrous variety.

Although individual cathode bias was occasionally adopted in these receivers, another quite common method was to strap the grids to chassis—and to bias all cathodes positively via a common-to-all resistor, wound on a
25 Volt AC Types

One further and slightly older American type—now very rarely met with—is a range of AC valves having 2.5V heaters. The writer has handled only one receiver of this type, but it was probably typical. The valve line-up was 2A7 frequency changer (American “Europa”), 2AU IF amplifier (Hungarian “Tungsram”), 2B7 duo-diode-pentode (“Europa”) and 2A5 output pentode (marked U.S.A.).

Power was supplied by a small 120V secondary mains transformer in a metal rectifier voltage doubler circuit.

Other valves in this series are 2A6 duo-diode-triode, and 2B6 double-triode output. All have UX bases and are difficult to obtain as replacements, except perhaps as odd surplus lines.

They were certainly sure, and it is not proposed to deal further with them except to mention that the heater current in this case was supplied by a 2.5V winding on the transformer. (These valves are still listed, with data, in the valve section of recent editions of the ARRL Radio Amateurs Handbook, and some types were in use during the last war.—Ed.).

Although we mentioned in our last article the reason for using the capacitors C36 and C37 and the resistor R19 in the cathode circuit of V5, (Fig. 1 of last month’s issue), we did not explain then the reason for using this particular detector circuit itself.

This we intend to do now. For easy reference the relevant part of the radiogram circuit is reproduced here as Fig. 2. It will be seen that a diode instead of an infinite impedance detector has been employed, this choice having been made after due consideration of the advantages offered by both circuits.

The Detector and Cathode Follower

When a receiver which is intended to offer high quality reproduction is originally envisaged, the question of what type of detector circuit to employ assumes considerable importance. This is due to the fact that, unless due care is taken; distortion will almost inevitably be introduced at this stage. The two most useful circuits for a receiver of this type are given by the diode and the infinite impedance detector. Of the two the infinite impedance detector is, at first sight, the most attractive since it theoretically offers perfect detection and also has an extremely high input impedance, this latter attribute resulting in reduced loading of the last IF transformer. However, the rectified voltage built up across the load of an infinite impedance detector is positive with respect to chassis, thus rendering it useless for AVC purposes; whilst the use of an auxiliary diode for AVC detection once more loads the last IF transformer and straight-
away reduces the advantage given by the very high input impedance. Furthermore, the cathode of an infinite impedance detector has to feed into a load in which the AC and DC impedances are almost inevitably bound to be dissimilar (in the same way as with a diode) and this dissimilarity can introduce distortion.

This point usually appears to be overlooked when the infinite impedance detector is discussed.

When we come to consider the diode, we find that this also suffers from its own peculiar disadvantages. To begin with, to obtain the greatest efficiency of detection from the diode to work over that portion of its characteristic in which its plate resistance is reasonably safely that the only signals which are not handled at full detector efficiency are those which are so weak that they cannot be received clearly off background noise. With this circuit it was found that it was impossible to notice any deterioration in fidelity at all, even on the weakest signals received by the radiogram.

Of far greater importance with the diode detector is the necessity for ensuring that the AC and DC impedances offered by its load are as nearly as possible. Fig. 3 shows a simple diode circuit to illustrate what is meant by this statement. In this diagram the capacitor C1 is used to isolate the DC voltages built up across R1 and so enable R2 to function as a grid leak for the following AF amplifier.

Unfortunately, C2 also serves to pass both AF and IF voltages, with the result that the DC diode load is represented by R1, whereas the AC load is represented by R1 and R2 in parallel.

It can be shown that, to obtain the minimum distortion from a diode detector, the following relationship must be satisfied:

\[ \text{Diode load impedance} \rightarrow \text{Degree of modulation frequency currents} \rightarrow \text{Direct currents applied signal} \]

Therefore, even when the usual 3:4 (or lower) resistive AC/DC load ratio found in the average superhet is employed, we still cannot be certain of accurate reproduction of transient or sudden fortissimo passages by the diode detector; particularly when receiving certain Continental stations which may employ a higher percentage of modulation than that used normally by the B.B.C.

A further point of considerable importance lies in the provision of tone control circuits. If these are to be comprehensive they must obviously be outside the negative feedback loop used by the subsequent AF amplifier.

At the same time they cannot be connected directly into the diode detector AF circuits. If, for instance, a tone control circuit were connected across R1 or R2 of Fig. 3, the changing capacitance values given by the circuit would upset the characteristics of the diode load. In addition, they would alter the RF by-pass values and probably cause de-tuning of the IF transformer secondary as well.

If, for instance, a tone control circuit were connected across R1 or R2 of Fig. 3, the charging capacitance values given by the circuit would upset the characteristics of the diode load. In addition, they would alter the RF by-pass values and probably cause de-tuning of the IF transformer secondary as well. Further to this is the fact that it is extremely inconvenient to make R1 or R2 a volume control, and it would prove unworkable (to say the least), to fit, say, a treble accentuator immediately after such a component.

If we are to use a diode detector we are therefore faced with the necessity of having a low AC/DC impedance ratio, a useful volume control and provision for tone control circuits, all within the immediate vicinity of the diode circuit itself. All these requirements have been met at once in this particular receiver by the somewhat unusual method of using a cathode follower immediately after the diode detector.

With this circuit, the resistor R2 of Fig. 3 is replaced by the grid-chassis input impedance of the cathode follower, the whole circuit being shown in Fig. 2 where V6 is the cathode follower.

Since the input impedance of V6 approaches infinity, the DC and AC diode loads have an impedance ratio of very nearly unity, thus almost entirely eliminating the biggest disadvantage given by the diode detector. The resistor R1 of Fig. 3 now becomes a volume control (R23 of Fig. 2). It may be noticed that the lead from the volume control to the grid of V6 (including C43) is not shown as being screened. Sufficient screening is provided in practice by taking advantage of the layout, but in such a manner that the capacitance to chassis is negligible.

The tone control circuits are taken from the cathode load of the cathode follower, the impedance of this load being sufficiently low to provide a signal capable of being controlled for bass and treble reproduction without altering the conditions under which the valve itself works. It is also possible, with this circuit, to transfer the AF voltages from the cathode load to the tone control components by means of ordinary screened wiring, without bothering about many losses due to capacitances to chassis.

The Pick-up Filter

It will be noted also that normal screened wiring is employed to transfer the output of the pick-up to the volume control R23, the use of this wire being admissible since the added capacitance given by the wiring is in parallel with that given by the IF bypass capacitor, C40. Referring back to Fig. 1 of last month's article it may be seen that an input filter, C42, R24 and R25, is connected between the pick-up and the radiogram proper. This filter is intended for a crystal pick-up. The pick-up used by the writer was that fitted to the Collaro RC500 auto-changer.

When a magnetic pick-up is used the filter may be removed and a direct connection employed in its place. However, if the magnetic pick-up should be a high-grade instrument the manufacturers will very probably advise the use of an alternative type of filter, and their literature should be studied on this question. The input impedance for "Gram" is 500 kΩ paralleled by slightly less than 200 pF; but the resistance value may be lowered by connecting...
a shunt resistor between the "Gram" contact of S8 and chassis. When S8 is set to "Long," "Medium," or "Short" this additional resistor will be out of circuit and cannot therefore affect radio reproduction.

The Tone Control Circuits

The tone control circuits used in the radio are reproduced in Fig. 4. The controls themselves consist of two switches S13 and S14.

S13 is a four-way switch used to select four different values of capacitance in series with the AF feed to the treble control. The values of the capacitors have been chosen to allow a gradual bass cut as the switch is rotated. It should be pointed out that the "lift" is fairly small and its effect is only fully noticeable when a properly baffled speaker is used. The bass control is intended mainly for gramophone reproduction, where it will be found that it effectively reduces "rumble" and the some-what annoying bass distortion given by worn records. On "radio," it is usually quite sufficient to set the control to "Full Bass."

The treble control is a little more complex and employs the six-position switch, S14. This switch makes use of the resistors R30 and R31 to provide both treble cut and accentuation. In the two "top" positions (at the "Treble Accentuate" end) accentuation is provided by the capacitors C49 and C50 respectively. The third position is blank, allowing unaltered reproduction to be obtained. The three "bottom" positions apply the progressively increasing values of capacitance offered by C53, C52 and C51 across R31. The effect, as the switch is turned from "Treble Accentuate" to "Treble Cut," is smooth and gradual, allowing a nicely balanced tonal response to be finally obtained.

Interconnecting Leads

It would be bad practice to apply the AF output from the radio unit via normal screened wire to the input terminals of the AF amplifier, since the high capacitance inherent in such a lead would upset the results obtained from the tone control circuits. It is therefore necessary to use a screened lead which has a very low capacitance. The writer found that the simplest way of doing this was to use a length of coaxial cable, the outer conductor being, of course, connected to chassis at both ends. A three-foot length of such cable would have a capacitance between inner and outer conductors of less than 50 pF or so and would be almost ideal for the job. Other types of low-capacitance screened wire could be used instead of the coaxial cable should it be so desired.

In the writer's model, the screened wire to the AF amplifier is fitted with a pair of tags at its end, these being coupled to two separate terminals on the amplifier chassis. The other interconnecting leads between the radio chassis and the amplifier are taken to an octal valve adaptor, an appropriate valve-holder being mounted on the amplifier chassis. It should be noted that mains wiring is also taken through this plug and socket, thus enabling the switch on the volume control not only to switch on the two chassis but also to switch the mains to the gramophone motor as well.

(The IF's were wrongly given as 456 kc/s last month. They should be 465 kc/s.)—Ed.)

Mainly for the Beginner

SUPERHET DETECTORS

By H. E. SMITH G6UH

Superhet Detectors

The double-diode-triode type of valve is almost universally used as the second detector in domestic receivers, and is more often than not used in Short Wave receivers by home constructors.

For ordinary broadcast reception, the DDT valve is ideal, providing detection, AVC, and one stage of audio amplification. It is a linear device, and will handle large signal inputs. All this is very necessary in order to avoid distortion. But what do we require in SW reception? One thing we need is a sensitive detector, in order to sort out some intelligibility from that weak carrier. It is not entirely necessary that our detector should be linear, nor is it necessary that it shall be capable of handling high signal voltages. Diode detection is the most insensitive method of all, except perhaps for the crystal detector. The crystal is inefficient because it will allow current to flow through it in the reverse direction. The diode is better than the crystal in this respect, but it still falls short of the ideal detector in that it is relatively insensitive and must be fed with power for optimum operation. It consumes power and thus reduces the Q of the tuned circuit, causing a loss of selectivity.
The anti-interference aerial is, as its name implies, a type of aerial designed for minimum pickup of local interference, such as car ignition and other forms of electrical interference. It is already known that the best cure for electrical interference to radio reception is to get at the source of the trouble and fit suppressors to the offending apparatus. In many cases this is not possible, and until legislation is passed making it illegal to operate electrical apparatus or use cars unless fitted with suppression devices, the interference pulses must be minimised by using special aerials, and by the fitting of noise suppressors to our radio and television receivers. It has already been established that peak car ignition interference exists between 60 and 20 Mc/s. These frequencies include the Television bands and some of the SW Broadcast bands. It is on these portions of the SW spectrum that car ignition interference is at its worst, but it does, of course, extend from well into the 420 Mc/s. Amateur band to below 1 Mc/s.

Leaving Television, we shall deal only with the Broadcast and Amateur bands. It should be stressed that where severe local interference is being experienced, both from cars and electrical machinery, several important points must be observed.

1. The aerial must be erected as high as possible.
2. The "lead-in" or "feeder" should be screened or "twisted" in order to ensure that as little as possible of the interfering pulses shall be picked up on the "lead-in."
3. The aerial should run at right angles to the source of interference and not parallel to it.
4. Wherever possible, in areas of severe interference, the aerial should be designed to "resonate" on the frequency band most used by the listener. (This may entail erecting two or even three separate aerials).

Taking these points one by one, the first consideration is height. Car ignition and most other forms of interference are usually greatly attenuated at heights of 30 feet or more above the source, and at 75 feet or more horizontally (see Fig. 1). We shall deal first of all with a listener on the 10-metre Amateur band, who desires maximum results with a minimum of interference. We will suppose that a main road runs along at the front of the house, and some 100 feet of garden is available at the rear. A 10-metre half-wave dipole is the best aerial to use, with 50 Ω coaxial feeder forming the "down lead." This is shown in Fig. 2.
together with the lobes of maximum reception. It will be apparent that "minimum" reception is in a line with the wire, and it must, therefore, be installed "against" the noise source, rather than for maximum signal from any given area. All four important points, previously given, have now been dealt with. Coaxial feeder has an "inner" and an outer and, referring to the sketch Fig. 3, the "outer" should be connected to the half nearest the house. The feeder should be taken straight down from the aerial and may even be buried in conduit for the rest of its journey to the house. If the receiver in use is of the "domestic" type, it will probably be designed for use with "high impedance input." In this case, the 50 Ω feeder cannot be connected directly to it. (Note:— Nearly all types of Communication Receivers are designed for "low impedance" aerial connection, and will thus not require any modification). A simple aerial tuning unit must be constructed in order to couple the 50 Ω feeder to the high impedance input of the receiver. A coil of 8 turns, 1" in diameter, wound with No. 16 Copper Wire, spaced 1/3" between each turn, and tuned with a 50 to 100 pF variable capacitor is all that is required. This is sketched in Fig. 4, and the unit will only require tuning. Listen to a signal on the receiver, and adjust C1 for maximum. The unit will now need no further adjustment. It will be appreciated that this unit is more in the nature of an "impedance transformer" than a tuning circuit.

Another requirement is a good earth connection. This should be as short as possible and of low resistance (i.e. thick wire). Provided that a height of some 30 feet has been obtained for the aerial, and it has been erected at least 75 feet from the main road, the car interference level should now be lessened by well over 50 per cent. This arrangement will also minimise the interference from nearby vacuum cleaners and other electrical apparatus. It must be realised that this aerial resonates on the 10-metre Amature band, and it is on that band that absolute maximum results will be obtained. It will operate satisfactorily up to 15 or even 20 metres, but will be less efficient. An aerial for the 20 metre band should be exactly twice the length for optimum results, and in this case, the number of turns on the aerial tuning unit should be doubled.

Various types of anti-interference aerials are obtainable commercially, and these are designed to operate over the whole short and medium wave ranges. Some are fitted with a switched transformer at the connection to the receiver to provide a better impedance match over certain ranges of frequencies.

Main borne interference

It is not generally realised that much of the interference from electrical equipment is introduced into the receiver via the mains lead. Before erecting any special aerial, therefore, it is a good plan to try some simple limiting devices on the mains input. Fitting two 0.01 μF capacitors across the mains, with the centre connection to earth, often effects a surprising improvement.

Indoor aerials of all types are particularly prone to pick up interference from the house wiring, and where an indoor aerial is absolutely necessary it is always better to instal this as near to the ridge of the roof as possible, and use a screened down lead, with the screening well earthed.

The "Doublet"

A cheaper, though somewhat less efficient type of noise reducing aerial for the SW broad-
MODERN PRACTICAL RADIO AND TELEVISION

This work covers every phase of Radio and Television: from many viewpoints and meets a great demand. The author, C. A. Garrington, M.Brit.I.R.E., has been responsible for training Radio and Television Service Engineers and is also well known as a lecturer on Radio and Cathode-Ray subjects.

SOME OF THE CONTENTS

RADIO CIRCUITS AND DATA

A wide selection of typical and basic circuits with formulae and data, are also included, together with a number of Manufacturers' and complete basic circuits showing the latest trends and practices, apart form a comprehensive range of unit circuits.

THE ILLUSTRATIONS

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THE EDITOR INVITES

articles from readers, of a nature suitable for inclusion in this magazine. Articles submitted for publication should preferably be typewritten, but ordinary writing is acceptable if clearly legible. In any case, double spacing should be used, to allow room for any necessary corrections. Drawings need not be elaborately finished, as they will usually be redrawn by our draughtsmen, but details should be clear. Photographs should preferably be large (half-plate) but in any case the focus must be good. Much useful advice to prospective writers is given in our "Hints for Article Writers," which will be sent free on request.

The interference problem is one which cannot be generalised, and so much depends upon the particular type of interference and upon the location. Special aerials alone will not completely solve the problem. For more complete rejection of noise, the receiver should have a suppressor incorporated, either of the diode or crystal type. Most communications receivers have this incorporated, but with the domestic SW Receiver a modification is recommended, using one of the systems as detailed in various Amateur handbooks. Car ignition (or "pulse type") interference is comparatively simpler to eliminate than brush discharge, or "hash" from electric motors and similar apparatus. This latter is best dealt with at the source.

Mainly for the Beginner...

(Continued from page 236)

and leaky grid detectors, as this is a problem which appears to be worrying a great number of beginners. One simple method which you can try is reducing the HT on the screen which appears to be worrying a great number of receivers. If the valve may be cut off on strong signals if not adjusted correctly.

The Editor Invites

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THE MAGNA-VIEW

The Radio Constructor's 16 inch Televisor

PART 11

Revised Sound Noise Limiter

Some effective improvement in the sound section has been made to the noise limiter, the new arrangement of which is shown in the diagram. Reference to the August issue will show that the required modifications are very slight. New components are given their actual values in the circuit, whilst the remainder are numbered as before. The most noticeable improvement is the complete absence of background when no signal is being received.

The peak interference clipping remains as efficient, and the volume level is maintained. As very little trouble is incurred, it is undoubtedly a worthwhile modification.

Queries

Quite a few queries have arrived at these offices, and a selection is printed here for the interest of readers.

THE MAGNA-VIEW

The Radio Constructor's 16 inch Televisor

PART 11

French without BBC

Probably the most interesting was the vision and sound strip which failed to receive the BBC, but reproduced a French station. Oddly enough, this particular set when in circuit with a signal generator accurately tuned to 45 Mc/s gave out a terrific signal. The answer to this one was, of course, that the coils L2A and L2B were accidentally separated by so great a distance that no coupling was effected and, in consequence, the oscillator section failed to inject into the mixer half of the 12AT7. An average separation between these coils is 1'. No analysis of the French station was carried out, but presumably it was a harmonic sympathetic to the intermediate frequency of the TV strip. The signal generator produced enough signal to bridge the gap, thus distracting the constructor from the real fault.
Another query, relating to the coils, referred to the correct connections. The lower end of the coils should be taken to the "earth" points. L1, which has a PVC winding intended for display on the English Electric stand at the International Telecommunications Exhibition at Earls Court, and is a complete working model, visitors were able to appreciate that this set fully supports all our claims.

The English Electric Co. wish us to state that a complete design of the "Magna-View" television in an attractive external cabinet form is available from them, free of charge.

Applications should be sent to The English Electric Co. Ltd., Television Dept., Queens House, Kingsway, London, W.C.2.
D. COHEN

COMMUNICATIONS

Mains Transformers

These transformers are all famous radio manufacturers' surplus and are fully interlocked and guaranteed.

Primary 200-250 V. P. and P. in each, 1/4 extra.

350-350 100 mA., 4 V. 4 amp., 2 V. 2 amp., output drop 1%, 14/6.

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2 V. 2 amp., 1/2 extra.

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An Easily Built

LOW OHMS METER

by G. BLUNDELL

The usual resistance ranges on universal meters will not read resistances of the order of one ohm, and the current consumption from the battery is always quite high on the lower ranges (some 200 mA is a normal figure).

Due to this high consumption, unless the battery is new the voltage takes some time to stabilise, and the zero reading is continually varying. The circuit shown here overcomes this defect, as the consumption is only 2.5 mA, but it will comfortably read a resistance of a quarter of an ohm. The accuracy of the reading is independent of the state of the battery so long as it is lively enough to allow the zero reading to be reset.

All that is required to calibrate the instrument is one standard resistor of a value equal to the mid-scale reading, in this case 5Ω.

The movement is an ex-WD RF ammeter, which was purchased at very low cost as the thermo-couple was faulty. The latter was removed and the meter connections were wired directly to the terminals on the case. This particular movement had a resistance of 2Ω and a full scale deflection of 2.5 mA.

Ordinary types of movement, such as the 0-1 mA type, can be used, but their internal resistance is usually too high, and it would not be possible to use the printed scale which accompanies this article.

Fig. 1 shows the circuit. It can be seen that the meter is energised by the battery, with the fixed dropping resistor to limit the current in the circuit to the value which will give full scale deflection of the movement. The variable resistor is employed to compensate for ageing of the battery. The resistance to be measured is placed across the meter movement and calibration resistor m, instead of in series as is more usual. This means that the scale is the normal way round, instead of giving the usual backwards reading, i.e., 0 ohms is at the left of the dial.

Reference to Fig. 2 shows that when a resistance is being measured there are two possible paths for the current, one through the movement and one through the unknown resistance X. If X is equal in value to the sum of the movement resistance M and the calibrating resistance m, then the current I will divide equally between the two paths and the meter reading will be halved. This is the most simple case to appreciate, and will be followed when calibrating as described later.

Take another case: if X had been 1 Ω resistance, and M+m is 5 Ω, then five times as much current will flow through the Ω resistance as will flow through the other path. Another way of putting it is that the movement current is only one sixth that of the total current. This leads us to the formula:

\[ \text{Meter I} = \frac{X}{X+M+m} \times \text{FSD} \]

From this the table given was worked out. Thus, given the centre point of the scale being accurate, the rest can be worked out. If the correct movement is used it is not necessary to calculate this or use the table, as the scale given can be used.

Internal view of the meter, showing layout and wiring of components

Although the unknown resistance changes the resistance of the energising circuit, the change in the current is so small that the effect can be ignored. If the same circuit were set to measure 10 Ω mid-scale, there would be some inaccuracy.
Also, the battery and dropping resistors are across the movement, and therefore affect the higher resistance readings. Fortunately, the resistance of the droppers is high compared with the meter reading, and this effect is also negligible. Because of this, slight changes in the dropping resistance to compensate for the battery voltage do not affect the scale reading.

Touching the pointer or giving it a slight bend will do no harm, but do not accidentally give it a "bash" on the tip when replacing the scale. This often proves fatal.

Removeme in the works, but don't try to pick them out. Whilst removing the two fixing screws, but don't drop them in the works. If you do, beware of damaging the hairspring; shake them out, but don't try to pick them out. When putting on the cover, don't force it.

The instrument is now ready for use. When putting on the cover, don't force it. Sometimes the zero screw on the cover does locate properly the first time! Put the screws in the cover and then check that the zero setting screw is working properly in both directions.

Connect up the instrument and adjust the dropping resistor until full scale deflection is obtained. Connect the standard resistor and adjust the movement series resistor until the correct scale reading is indicated. This series resistor will have a value of some 3Ω only, and can be made from Eureka or even fine copper wire. Some four feet of 38 swg enamelled copper would do, or some three inches of the same gauge Eureka.

The instrument is now ready for use.

Please mention this Magazine when writing to Advertisers
noise pentode which is operating as a resistance-capacitance coupled amplifier. The output of this stage is fed into the input of one half of a double triode which is arranged as a cathode follower. The low gain input channel is fed into the other half of this valve which functions as a straightforward amplifier. The output of this section is also fed to the cathode follower. Screened cable should be used for the input and output signal connections, the input leads being kept as short as possible, whilst within reason the output lead may be as long as required.

Secondary Resistance

I have a mains transformer which has a 250-0-250V secondary winding. Upon measuring the resistance of the two halves of the secondary I was surprised to find quite an appreciable difference in reading. Does this indicate that one half of the winding has some shorted turns?

B. Marsden, Lincoln.

It is quite usual to find a difference in resistance between the two halves of a centre-tapped secondary winding. This difference is due to the fact that one half of the winding is placed nearer the transformer core than the other half, and is therefore wound on a slightly smaller diameter. This means that less wire will be used for a given number of turns, and hence the resistance of the inner section will be lower than that of the outer section. Both sections will, however, have the same number of turns and will provide the same output voltage.

THESE MINIATURES CAN BE OF GREAT ASSISTANCE TO THE AMATEUR

Brimar 1AC6 — Heptode Frequency Changer

The need for economy in current has, up to now, prevented battery frequency changers from giving a performance approaching that of a mains valve. Research into new types of filament coating has culminated in the 1AC6 which not only gives a higher performance, but a considerable decrease in current consumption as well.

The oscillator section of this valve requires only 50 volts of H.T. at 1.6 mA and operates up to 30 Mc/s without difficulty. The grid and anode connections of this section are separate from the other, and a normal tuned anode or tuned grid oscillator circuit with feed-back coil may be used.

With an anode current of 0.6 mA and a screen current of 0.15 mA the conversion conductance is 0.325 mA/V, and the filament is rated at 1.4 volts, 50 mA.

If you intend to build a battery shortwave or portable receiver, the inclusion of the 1AC6 is well worth considering.

Brimar 6AK6 — Output Pentode

Constructors of car-radio and mobile equipment may take note that this valve is now made in this country. With its heater rated at only 0.15 Amp at 6.3 volts, and the anode at 30 volts, the 6AK6 is quite capable of this, however, and consuming 15 mA from the H.T. supply, brings to a close the day when the power output stage has always to be associated with heavy consumption.

The 6AK6 is a standard 6.3 volts, 0.3 Amp noval-based miniature pentode with a phenomenally high mutual conductance. Produced primarily for R.F. and I.F. amplifier service in T.V. Receivers, great care has been taken to maintain a high input impedance to prevent excessive damping of the tuned circuits. The cathode is connected to two of the base pins, so that two connections can be made to earth. This lowers the impedance in the cathode circuit at high frequencies and so helps to raise the output power.

To test for shorted turns on a mains transformer, it should be connected to the mains supply and allowed to run entirely off load for an hour or so. After this time there should be no detectable change in its temperature. A number of shorted turns will result in a substantial rise in temperature even when the transformer is operated off load.

AC/DC Receiver

Is it important when installing an AC/DC radio or television receiver to ensure that the mains plug is inserted in such a way that the chassis of the set is at earth potential?

K. Barr, Glasgow.

It is always considered to be good practice to connect the mains to an AC/DC set in such a way that the chassis is at earth potential. No matter how good is the insulation provided by the cabinet of the set, there is always the possibility that the user may accidentally come in contact with the chassis, possibly via one of the knob fixing screws or a chassis retaining bolt. There are small neon test prods on the market which are invaluable to the service man for detecting faults. The filament of the valve lights when the probe contacts a live part. For a receiver which is often moved from room to room a small indicating neon can be permanently installed on the back of the set. The neon is connected from the chassis to the external earth socket, and will give immediate indication should the chassis be connected to the live side of the mains.

Brimar 6BW7 — Television R.F. Pentode

The 6BW7 is a standard 6.3 volts, 0.3 Amp noval-based miniature pentode with a phenomenally high mutual conductance. With a 180 volt H.T. supply, the slope is 9.0 mA/V, so that a high stage gain can be obtained. Produced primarily for R.F. and I.F. amplifier service in T.V. Receivers, great care has been taken to maintain a high input impedance to prevent excessive damping of the tuned circuits. The cathode is connected to the cathode follower output stage. The drain being 5 mA. 250-0-250F secondary winding. Upon measuring the resistance of the two halves of the secondary I was surprised to find quite an appreciable difference in reading. Does this indicate that one half of the winding has some shorted turns?

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It is quite usual to find a difference in resistance between the two halves of a centre-tapped secondary winding. This difference is due to the fact that one half of the winding is placed nearer the transformer core than the other half, and is therefore wound on a slightly smaller diameter. This means that less wire will be used for a given number of turns, and hence the resistance of the inner section will be lower than that of the outer section. Both sections will, however, have the same number of turns and will provide the same output voltage.

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QUALITY FEEDER UNIT

for the

VHF FM PROGRAMME

by G. BLUNDELL

PART 3

Coil Details

These are all fairly straightforward, with the exception of the discriminator coil over which particular care must be taken. In every case, the spacing between the windings on any one former must be rigidly adhered to, as this affects the coupling between the circuits. All the tuning condensers must be small enough to mount inside the screening cans, and must be mounted level with the winding that they tune. Wiring the tuning condensers underneath the chassis instead of in the cans will result in uncontrollable instability.

The condensers with a TC part number were not included in the original parts list, and these must also be obtained. Note carefully that all condensers with TC numbers must be silvered mica types, and not stacked mica or ceramic. This is necessary to ensure stability of the capacitance.

Instability which would be caused by coupling along the heater line is prevented by a combination of chokes and condensers. This is cheaper and more effective than the use of condensers only. The hardest coil to wind is the spaced bifilar winding L7B. This form of winding is necessary in order to keep the winding exactly balanced. Lack of balance results in distortion. If there is no spacing between the windings, the stray capacitance becomes too high.

The coil (L7B) consists of two 8-turn windings, interwound with, but spaced from, each other. This spacing is achieved by introducing 32 swg enamelled wire between the other wires. Four wires must therefore be wound at one time. The coil is covered with distrene varnish and then the spacing wires are removed. With care and patience a neat job can be made of this coil. The finished length of it should be approximately $\frac{3}{4}$`. TC8 is the coupling condenser, with a value of 47 pF.

Table of Coil Details

<table>
<thead>
<tr>
<th>COIL</th>
<th>No.</th>
<th>TURNS</th>
<th>GAUGE</th>
<th>TC No.</th>
<th>CAPce</th>
<th>SPACING</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial</td>
<td>L1</td>
<td>4</td>
<td>28 DSC</td>
<td>TC1</td>
<td>33 pF</td>
<td>$\frac{3}{4}$`</td>
<td></td>
</tr>
<tr>
<td>Mixer Grid</td>
<td>L2</td>
<td>5</td>
<td>18 swg Tinned Copper wound on $\frac{3}{4}$<code> mandrel. Coil length $\frac{3}{4}$</code>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oscillator</td>
<td>L3</td>
<td>4</td>
<td>18 swg Tinned Copper wound in opposite direction to L2, same mandrel, coil length $\frac{3}{4}$`.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heater Chokes</td>
<td>L8</td>
<td>20</td>
<td>22 swg PVC wound on $\frac{3}{4}$` mandrel.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Formers and Cans

1. Short former $\frac{3}{4}$ sq. base $\times$ 1.4' high (Aladdin) with short screening can.
2. Long formers $\frac{3}{4}$ sq. base $\times$ 2.4' high (Aladdin) with 3 long screening cans.
3. Large screening can $\frac{3}{4}$ sq. $\times$ 2.4' high.
Coil Construction and Wiring

VHF Feeder Unit — Main Chassis Dimensions
Can Anyone Help?

Dear Sir,

I am trying, unsuccessfully so far, to obtain some technical data on the Marconi CR100. Can you help me at all?

W. M. ROBINSON, 2 Kimberley Road, Cambridge.

Home-made Tags

Dear Sir,

The enclosed solder tags are made from a cocoa tin, cut with a pair of scissors. Soldering is made a pleasure when using them, and dry joints are out of the question.

R. A. POOLE (Newark, Notts).

(The samples were quite neatly made, and from personal experience there is no doubt that such tags are quite efficient, and do solder readily.—Ed.).

“Ma” Raymond

Dear Sir,

Centre Tap refers to Lisle Street, and “Ma” Raymond in particular, in his Radio Miscellany, December issue. This famous thoroughfare holds a reputation which is almost world-wide, and it is to the credit of the many radio dealers there that it has acquired renown as a hunting ground for the radio fraternity. Let me hasten to add that I refer only to radio apparatus, not to certain other forms of relaxation which is told can be obtained for money almost anywhere along the road. As a focal point for radio bargains, Lisle Street must surely be one of London’s Famous Places, if not all this time.

The battle which raged between “Ma” Raymond and the equally well-known Will Day will go down in history—in a purely business sense they seemed always to be at each other’s throats, determined to put each other out of business by their ruthless slashing of prices. As for “Ma” herself, she was as I believe an American—her accent certainly gave one that impression. I fancy she might have served some time at sea, judging by the flowery language she could use! I could not agree more with Centre Tap when he says that she could treat a customer to a stream of eloquence that took his breath away, yet despite this attribute she had a heart of gold and displayed it on many occasions. She was a shrewd woman, able to weigh up a person with a single glance. She knew whom she could harangue, and if the recipient of her invective dared clash with her, she was not incapable of inflicting physical violence upon him.

I was a schoolboy in those days, but I well remember two incidents. The first was when she was kind enough to give ear to my plea for a valve, the cheapest she could sell me. She took one look at me, and presumably decided I was a deserving case. Two Dutch bright emitters were thrust into my hand—“Take ‘em home, lad, and Gawd help you if you don’t make ‘em work!” she told me. The price? Not a penny would she accept. Some months later when buying a sheet of ebonite there, I dared to point out that a corner was chipped. My reward on that occasion was enough blasphemy to fill a book, a clump on the ear, and an attempt to assist my hurried exit by a kick in the pants. The venom in her eyes, and the sting of her hand, are as clear now as the day it happened. No doubt about it, she was quite a character.

Yours sincerely,

W. E. THOMPSON (St. Leonards-on-Sea).
Much has been written about the useful life of valves, and the rule of the thumb dictum—1,000 hours before the performance is markedly impaired—is still generally accepted. Tests usually prove that the emission falls away gradually at first, followed by a faster decline which eventually slows down. Like old soldiers, they simply fade away. All the same, it is uncommon to find valves still in regular use after having given several thousand hours of useful service. In fact, this is what may normally be expected if one is not too fussy about good performance.

Less has been said of toughness to rough handling. Most of us have, at some time or the other, dropped one, or more commonly still let one roll off the table or work-bench. Unless the glass actually fractures they do not, like the early valves, appear to suffer. Modern electrode assembly is far more accurate and rigid than in the earlier types.

In the early days many valves had pressed metal around the caps, and I remember once restoring to perfect condition a valve which had the cap wrenched right off. I felt wonderfully proud of myself until some time later when I visited a valve factory and saw how easily they were assembled by hand—once you got the knack of it. At that time the production of seven pin valves had actually started. My repair had been a mere triode, but I was handicapped by shorter lengths of wire, although by way of compensation I had cut away about 1/4" from the top of the base. It took me about thirty minutes to get the wires through. The girls there were managing seven wires per base and doing them three or, four a minute!

By Letter Post

Although I should be the last to advocate the careless handling of them in transit, valves are far more robust than is generally believed. Most modern types are well able to withstand shock treatment without suffering electrode displacement. I remember some twenty years ago seeing a G.E.C. film on valve manufacturing processes. It concluded with scenes of packing cases, filled with the normal cartons used for marketing, being heaved overboard from a low flying aircraft. After this they were checked. It seemed an odd procedure, but was intended to emphasise that even the distribution of the valves received the same careful planning as was given them in all stages of manufacture.

I suppose I should have forgotten all about this film except for a recent incident. I sent for a couple of attractively-priced ex-W.D. valves. They came by return of post—wrapped in a sheet of newsprint covered with thin card. Being of the B7 type they entered my OTH by way of the letter box, so the least of the buffeting they suffered was to be bounced on the doormat. I straightaway put them to test and found them to be perfect. Incidentally, I later sent for a couple more and they, too, arrived safely, but this time the retailer concerned must have been a little too cautious and mood. He put in a second sheet of newsprint!

Such recklessness (with valves, not newsprint) would, a few years ago, have been regarded as sheer craziness.

Simplicity

Some years back I described a chassis which I called the "free-deck." Although it has not been widely marketed, many constructors have used similar designs of their own fashioning. Years ago, when receiver design was simpler and the constructor built up a "fresh" circuit every other week, it was recognised that the LF and power stages of every set were inevitably unchanged whatever variations one chose to make in the other stages. Why, then, pull them down only to re-assemble the same thing all over again? Consequently the thoughtful constructor built the audio and power stages as a separate unit.

Selection of components (I can think of no better name) has remained with us in some form or the other ever since, and I have seen several instances where it has been adopted by V.I.P. of the receiver manufacturers. In fact, all, the mixer and oscillator section remains unaltered whatever arrangement or number of valves you choose to precede it. At least one popular home-built TV receiver is also designed on these lines.

It seems we shall have to elaborate on the idea and evolve a side-by-side-twin-free-deck chassis; unless Mr. Turner (of whom I have not recently had any news) has devised any further improvements to chassis construction, beyond the detachable holes, which might be incorporated in it.

After Sales Service

We used to hear a lot about alleged profiteering by radio repairers and there is no doubt that it was fairly prevalent during the War and the early post-War years. Not that even then the less scrupulous dealer was to blame for it all. Spare parts had a mysterious way of disappearing into the black market, where a high price was demanded from repairers who had been held up for them for months and ten more days too late! It was perfectly natural for a man with a come-back at the R.S.G.B. Exhibition. Maybe he, too, possesses occult powers. By my reckoning it appeared about a fortnight before the Show opened. Perhaps he was expecting his last event—just about for ten more months and ten more days too late! Of course, he might blame the poor printer. Our own printer dropped the job for me in this column last month. I wrote about "markers" for locating the two-meter band—instead of which it read as if I was commending readers to go to warp a...
In a recent article entitled "Why go Hi-fi," I decried the constant search after wide frequency response as an essential of quality amplifiers, and it is intended that this shall be the first of a series of articles describing equipment which will, if given a chance, prove my point that quality is more a matter of balanced response than of wide frequency range response.

The amplifier to be described first is a simple enough job, comprising only two valves, an EF37 voltage amplifier and a 6V6 output stage. It gives an output at 4 watts of quite decent quality, certainly better than is achieved in most radiograms nowadays.

The circuit Fig. 1 calls for a few comments, although it is fairly conventional. Working through the amplifier, the first thing which will be queried is the input system, particularly the feed condenser C1. This has a value of only 0.001 μF; this is to obtain a certain amount of apparent top lift, although actually it cuts the bass. Aurally the effects are similar. Next the RC network from anode to grid on V1; this is a simple but very effective method of applying NFB which also introduces a certain amount of tone correction; its fitment is entirely optional and can be left out completely, but better results can be expected with it fitted. The condenser must be a very good MICA type as the slightest DC leakage will produce the most shocking results.

The adjustment of this network is fairly simple. With R1 set for max. gain and the tone control R3 backed right off to have minimum effect, the 0.5 MΩ pot. R2 is adjusted until the reproduction is most natural and then left. Volume will go down as the correct point is approached, but as there is no actual "dip" and then a rise again it is possible to pass the optimum point, when volume will continue to drop and reproduction will become woody.

The volume control R1 should be of a value to match the pick-up in use; as most pick-ups seem to be unmarked, a value of 10kΩ is suggested as a starting point for most moving iron types, remembering that a transformer is still needed for the low impedance type. For crystal pick-ups a good figure would be 5 MΩ, but as pots with such a high value are hard to come by, a 2 MΩ may be used with a resistor in series with the pick-up for matching purposes.

As no isolated HT winding is used on the transformer, the chassis is alive to earth and must be treated as cautiously as a universal set. The rectifier can be any HT type capable of handling 60 mA or more.

Universal Working

The set can be used on DC with very little modification. The output valve must be changed and two alternatives are available. If an EF36 or EF37 is used in the first stage, a CL33 is used as the output valve; these have 0.2A heaters.

If a 6J7 is used in the first stage, a 25L6 should be used as the output valve; as these have 0.3A heaters. I have used all of these line-ups and no circuit changes are needed except, of course, for the heater line.

The transformer is done away with and the heaters connected in series, and a suitable resistor added as in Fig. 2 for 0.3A working. The value of R = 766Ω for 230V working, and R = 760Ω for 0.2A valves = 1150Ω. It is also worth while adding a Brimistor at the point X; your dealer will supply the appropriate type. This carbon 1% types do this job nicely and, although the value may be altered slightly, a 1% type should still be used here. I would recommend keeping within 5% of the stated value, but 10% can still give excellent results. Using 25L6 in the output stage, adjust bias to 300V.

Enquiries have been received at these offices from constructors who have attempted Large Screen conversion, the circuitry of which was published elsewhere.

It should be fully understood that constructors must not attempt a hybrid circuit incorporating, perhaps, a mixture of several designs, unless they are fully qualified to do so. The line output transformer generally specified can, under certain conditions such as high rail voltage (see June issue), give rise to a highly dangerous EHT potential.

This magazine can accept no responsibility for designs published elsewhere, or for our own designs which have in any way been modified by the constructor.
CONTROL BOXES FOR SURPLUS GEAR

By P. TURNER

Quite a lot of the surplus radar gear which has been disposed of was housed in 'slide on' cases of generally similar pattern. Typical examples are the Type 62 and 62a Indicator Units and the Type 64 Modulator Unit. The construction of these pieces of equipment takes the form of a panel about 10" wide by 12" high, fixed to a chassis of the same width and about 18" or 20" in length. The complete chassis and panel slides into a sheet metal casing, leaving only the front panel exposed.

Such equipment, while providing many good components, is nevertheless a little restricted in the use of the carcase and case for housing the construction of these pieces of equipment, is nevertheless little restricted exposed.

The method of assembly is quite simple. (1) Put the chassis into the case. (2) Put the plug (old valve base) through the prepared hole and into the slip on socket. (3) Slide the control box into its slides. The result is neat and professional in appearance. It allows casings to be kept on apparatus which otherwise might be used without a case. This makes for a greater measure of SAFETY in the operation of equipment. Remember that if you get hold of it properly, 230 volts can kill as swiftly and as surely as 2000 volts. And being dead is so permanent, too.

These control boxes are fairly easy to make and the use of them gives that rapid ease of assembly and removal which makes good equipment a joy to service. If the box is made from sheet metal about one sixteenth of an inch thick there is no need to rivet or bolt at the corners. The small dimensions ensure that the box is stiff enough if it is just bent to the form of a chassis. If it is the controls work just as well when the case is off, if they are plugged in, so that servicing and adjustment can be carried out with all parts accessible and working if necessary.

Aluminium is probably the easiest material to use, but tin plate is very good and has the merit of being capable of having soldered seams. This is a very great advantage when screening is necessary between controls. It also has the merit of being available free in the form of the humble fruit or tomato can.

A large tin when shorn of the rims and seam and opened out provides a sheet of high quality tin plate (it has to be high quality for internal construction), give a detailed description of which the connections are made in such cases. Some of which are internally connected, and the electrode assembly is thereby accommodated on a Noval (Byant) type described as an Enneode. It has seven gusses necessary to particular circuits is described. There is also an accompanying X-ray photograh of internal construction, give a detailed description of the connections, in the series, and the clear type-font employed.

The method of dealing with each type of valve is to show the characteristics, and in many cases, there is also an accompanying X-ray photograph showing internal construction, give a detailed description of the connections, in the series, and the clear type-font employed. One would be difficult to imagine how else, or where, one could obtain such extensive information as is given for each valve described.

Although there seems to be stress on the fact that the valves are produced in the Netherlands, it is as well perhaps to point out that valves with similar titles are available from British manufacturers, and the characteristics are, of course, alike. Thus, the Rimlock type to which a large part of the book is devoted is the same as the British 15A, that is, an eighteen foot base with a location for a metal shield. The Naval-based valves also have British counterparts in the B9A series.

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Each series of valves is dealt with in separate sections of the book, and a series of receiver circuits designed around the valves in the section concerned is given. These range from a simple four-valve battery receiver to a fifteen-valve quality receiver for A.C. mains. Amplifiers and F.M. receivers are also included. Each of these designs is given full technical description, and useful tables of measured values. In some cases, the design and construction of F.M. transformers applicable to particular circuits is described.

A valve of unusual interest is the type EQ04, a new type described as an Enneode. It has seven grids, some of which are internally connected, and the electrode assembly is thereby accommodated on a Noval (B9A) base. This valve, for which there does not yet appear to be a British equivalent, has been specially developed for use as detector and amplitude limiter in F.M. receiver circuits, and some simplification of circuitry is achieved by its use.

There appears to be no error in the numbering of the curves for the EZ41 rectifier, page 120. Curves 1 and 2 seem to be reversed, for one would expect a higher output voltage when using a higher value of reservoir capacitance, even though the anode series resistor needs to be higher for a larger capacity of the valve.

It is confidently stated that having regard for the weight of information it contains, this book is offered at a reasonable price. No less pleasing is the binding of blue linen and gold lettering to match other volumes in the series, and the clear type-face employed.
Arax Multicore Solders. A 10 oz. tin of Ersin Liquid Flux retails at 6/-.

Ersin Multicore Solder which has for many years been supplied to manufacturers in gauges to 22 S.W.G. is now supplied to special order on 1 lb. reels in even gauges between 24 and 34 S.W.G. Comparative lengths per pound for 60/40 alloy are approximately 95 ft. of 16 S.W.G., 240 ft. of 22 S.W.G. All gauges, even to 34 S.W.G. contain 3 cores of flux.

For electronic heating methods and other soldering operations, Ersin or Arax Multicore Solder is now made in the form of plugs and pellets. They are available in a wide range of sizes in all standard tin/lead alloys.

Bult-jointed solder rings made from Ersin or Arax Multicore Solder or solid wire can also be supplied and are claimed to be more economical to purchase than stamped washers. Among the specifications of Ersin Multicore Solder Rings which are already being manufactured are 1", 2", 3", and 4" diameter rings. Other sizes are made to special order.

With the co-operation of Johnson Matthey of Hatton Garden, Ersin Multicore Solder is now available in Comsol alloy. This tin/lead/silver solder has a melting point of nearly 300°C which is 13°C above the melting point of usual tin/lead alloys.

Ersin Multicore Comsol solder is normally supplied in 16 S.W.G. and is intended for soldering processes where components are likely to be subjected to excessive working temperatures. Projector lamps, some types of electric motors, etc., are examples. It is believed that Comsol may also be suitable for use on radio and electrical equipment being subjected to sub-zero temperatures, although research into this is at present still proceeding.

Generally, this new product will be supplied direct to manufacturers, the price being slightly less than that charged for Er in Multicore 60/40 alloy.

Manufacturers are invited to write for samples of any of the new lines or to consult the Technical Service Department of Multicore Solders Limited on any problem in connection with soldering.

**New Multicore products for specific uses.**

In addition to the standard range of 6 tin/lead alloys in 9 gauges and variety of packings already available to manufacturers and the trade, MULTICORE SOLDERS LIMITED announce the introduction of many new products, each designed for specific uses.

Prominent among these are the following, extra details of which are readily available from the manufacturers.

At the special request of trade friends Multicore Solders are now producing, in large quantities, an economy pack for Television Engineers. Packed in the yellow and black Multicore carton is a 1 lb. reel of 50/50 alloy. These rings are already being manufactured are i", 1.5", 2", and 3" diameter rings. Other sizes are made to special order.

The amount of scan obtained from this equipment would suggest that if a 20° tube should become available to the constructor, it is unlikely that there would be any difficulty in achieving a full picture.

We congratulate Allen Components on their progressive efforts to obtain still further efficiency from their products.

Messes. J. Bull and Sons, 246 High Street, Harlesden, London, N.W.10. An instrument of real use to the radio-man and kindred workers is the Neon Tester. One of these, the type 400, was recently sent to us for test by the above firm, and has been used by us on many pieces of equipment.

Some of the possible applications are:

1. AC or DC ? — Finding the live conductor — Leakage — Continuity — Condensers — Fuse tests with live mains — Potential tests on running motors and dynamos.

Constructors of the “Magna-View” will find this instrument particularly useful, especially so where the mains rectifier circuits are employed. A result for the installation of neon polarity to establish relationship of the chassis to mains negative was under consideration, but the possession of the Neon 400 has rendered this plan unnecessary and wasteful.

Two seconds of testing and any doubts are removed: indeed, an entire house could be covered very quickly, with the advantage that in every socket likely to be used for any AC/DC equipment the pin polarities would be known.

Made in the style of a fountain pen, the instrument may be permanently carried around without any inconvenience. The price is Us. 3d., and a small pamphlet is included which gives instructions for carrying out tests. In our opinion, a very useful implement.

Messes. A. Shepherd and Sons, Ltd., Child's Place, London, S.W.5 have sent us for review samples of their “Decal” transfers. The set consists of 6 sheets of panel markings and names suitable for any electronic apparatus, contained in a stiff folder. The transfers are well protected against handling before use, and full instructions are included for their application. The list of words and symbols is exceptionally complete, and a goodly number of letters are included so that, should a particular word not be available, it may easily be made up.

There are also a number of numbers (1) and Greek letters, as well as mathematical signs and such useful items as μF, μsec, μA, mA, Mc/s and so on. Altogether, we think well worth the sum of 4s. 9d. plus 3d. postage...
THE WATT-HOUR METER

By T.H.R.

Notes on its use as a Test Instrument

Few amateurs possess a watt-hour meter (though most have them in their houses—the property of the Electricity Undertaking), but the possession of such an instrument can be a great asset in the planned economy of electricity consumption. At the present time, owing to changeover of types, many second-hand meters have found their way into the surplus market, the cost varying between ten and thirty shillings. This article sets out to describe some of the ways in which the watt-hour meter may be used to ascertain the running costs of various electrical appliances, and includes two graphs to minimise arithmetic.

Application

On a D.C. mains circuit where Ohm's Law applies, Volts and Amps can be measured, and Power and Work readily calculated. In A.C. circuits, however, to find the Power (which multiplied by time equals Work) the product Volts x Amps has to be multiplied by the Power Factor of the particular load, a factor which is often unknown. The Watt-Hour meter, however, measures the actual Work Done, from which can be directly determined the running cost; the kilowatt-hour being the "Unit" of Work charged for by the Electricity Undertaking.

Procedure

Two different operations are possible with the watt-hour meter:

1. **DETERMINATION OF RATE OF POWER**

   \[(VA \times \text{Power Factor} = \text{Watts})\]

   Through a window in the front of the meter can be seen a horizontal disc, which revolves at the rate of 1 Rev./min. for every 5 watts of power consumed. From this relationship the two graphs have been prepared. Graph No. 1 shows Watts against Revs./min. and may be used for loads greater than 100 watts. For smaller loads, Graph No. 2 is more convenient, and gives Watts against the time in seconds taken by one revolution of the disc.

   Rate of Power consumption of any piece of equipment, wireless sets, motors, etc. can speedily be determined by this method, and the running costs calculated.

2. **DETERMINATION OF WORK DONE**

   This figure is read directly from the dials, subtracting the initial reading from the final one, and is simply an integration of Power with respect to Time. The advantage of the integrating dials is the ability to assess the average consumption of appliances controlled thermostatically. For example, the meter may be left in circuit for a week with, say, an immersion heater, and the relative costs of continuous thermostatic control and intermittent switching ascertained.

Mounting

It is essential that the meter should be vertical, and this is best done by fixing it on a ¼ plywood bracket, as shown in the photograph. A mains input lead of power cable should be provided, and the load connection sockets can be screwed directly to the metal plate which covers the meter terminal block. In the instrument shown, 3 amp. and 15 amp sockets are provided, other fittings being available by means of adaptors. The mains earth wire should be taken to a screw on the cover plate, and connected to the earth terminals of the sockets. Four rubber feet complete the construction.

Meters of different amp. ratings are available, and these rates should not be exceeded.

Graphs

In most surplus meters, the discs revolve 1,200 times per kW/hour, and the graphs have been prepared on this basis. If the figure is different (as shown on the front panel), the graphs will have to be re-drawn, as follows:

Graph No. 1 should be plotted from the formula

\[1 \text{ Rev./min.} = 60,000 \text{R watts} \]

where R = No. of Revs. per kW/hour.

Graph No. 2 is based on

\[\text{Watts} \times 3,000 = \text{Secs./Rev.} \]

where A = 3,600,000/Revs. per kW/hour.

When completed, the graphs may be stuck on the back of the bracket, and covered with transparent selftape.
Is Your Slip Showing?

Let's be honest—we all make a slip sometimes, but when it comes to radio construction don't take a chance on unknown and unproven circuits! With our series of unique LIFE-SIZE, 'EASY-AS-A-B-C' circuits, matched components, punched chassis and ALIGNED UNITS radio assembly is really simple for the Home Constructor! If you have average ability you can tackle any or all of our LARGE RANGE OF GUARANTEED OUT-FITS knowing that failure is impossible! Send 2/6 NOW for your copy of our world-famous "HOME CONSTRUCTION'S HANDBOOK." The NEW 1933 ISSUE is:

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(Continued from p. 269)

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