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

All MSS must be accompanied by a stamped addressed envelope for reply or return. Each must bear the sender's name and address.

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

QUERIES. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine; nor can we advise on modifications to the equipment described in these articles.

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Suggested Circuits

Whenever a suggested circuit is destined to appear in the December issue of The Radio Constructor, the writer usually attempts to present a device which has something of a "novelty" value about it. Frequently, however, devices which are initially intended to possess novelty value turn out to have basic applications which make them attractive for quite utilitarian functions, and it is very possible that the proximity detector which is the subject of this month's article enters such a category.

The circuit itself is that of a sensitive proximity detector which is capable of actuating an external electrical circuit whenever any person approaches a pick-up rod or plate. By employing circuitry which is a little more comprehensive than is usual for devices of this type, the unit is capable of being set up to give a high degree of sensitivity.

Basic Design

It is possible to employ several different techniques for proximity detection but, apart from photo-electric arrangements wherein a ray of light is interrupted, the simplest method is almost always provided by alteration in capacity between a pick-up rod or plate and earth caused by the proximity of the person approaching the device. An excellent means of taking advantage of this changing capacity in order that a switching circuit may be operated consists of coupling it to an oscillator tuned circuit. Capacity variations will then cause oscillator frequency variations, which, with the subsequent use of tuned filters, may be very readily employed for operating a relay.

As originally conceivced by the writer, it was proposed that the overall proximity detector circuit arrangement would comprise an oscillator whose tuned circuit was coupled to the pick-up rod or plate, a frequency changer stage employing a second oscillator, a tuned filter, and a detector coupled to a switching valve. The two oscillators were intended to work at a relatively high frequency, say around 15 to 20 Mc/s, whilst the tuned filter would be set to 400 to 500 kc/s. The two oscillators would be adjusted to give a frequency difference equal to that to which the tuned filter was set, whereinupon small shifts in frequency in one oscillator would cause relatively large shifts in the frequency applied to the filter. Thus, assuming that the proximity of a person to the pick-up rod or plate caused the first oscillator to shift from, say, 20 to 19.8 Mc/s—a drop of 0.2 Mc/s, equivalent to a change in frequency of 1.2%, the resultant change in frequency applied to the tuned filter could be of the order of 500 to 700 kc/s—a shift of 40%. In other words, by employing a frequency changer stage and a relatively low frequency tuned filter in the circuit, small changes in pick-up capacity to earth would result in very large changes in the frequency applied to the tuned filter stage; and the device would be in consequence much more sensitive than if tuned filters adjusted to the oscillator frequency itself were employed.

It will be appreciated, of course, that this is merely employing conventional superheterodyne techniques of selectivity, but the point is worth some discussion in this particular context.

Having settled the basic arrangement, it next became necessary to translate this into a form which required no specialised components and which was suitable for amateur construction. At once two potential difficulties presented themselves. The first of these was that the two oscillators would have to be carefully isolated from each other in order to prevent pulling. The requirements of the design necessitated the oscillator circuit coupled to the pick-up rod or plate being housed in a separate unit from the main chassis, and so a partial solution to the problem of pulling would be given by employing a double triode here, the second triode acting as a cathode follower buffer amplifier. Even when such a buffer amplifier is employed some slight pulling might still be evident (due to the stray capacities in the simple circuit arrangement intended), but this should not be serious in any event, being kept to a low value by keeping the coupling between the oscillator and the cathode follower at a low level. The second difficulty arose in the matter of obtaining acceptable performance from the tuned filter and subsequent detector. An obvious choice for the tuned circuits in the filter would be provided by conventional 465 kc/s i.f. transformers, and it would be desirable to employ at least two of these. At the same time the i.f. voltage applied to the detector circuit would have to be of the order of at least several volts if reliable switching action was to be given; and such a voltage would not be forthcoming from the detector anode without maintaining a low value of coupling between the pick-up oscillator and cathode follower.

It was finally decided that the best solution to these various requirements would be given by employing two i.f. transformers in the tuned filter section, together with an amplifying valve. The use of an amplifier would enable the high voltage input to the detector to be obtained, and it would give considerably greater scope to the range of adjustments needed for coupling the pick-up oscillator to the detector anode. A small control on the amplifier would also enable a panel sensitivity control to be provided.

The remainder of the circuit difficulties anticipated were fairly easy to solve, and are covered in the circuit description which follows.

The Circuit

The finished circuit of the proximity detector accompanies this article, and it will be noted that, as was mentioned above, the pick-up oscillator is housed in a separate unit away from the main chassis.

This unit employs a double triode valve of which one half, V10, functions as an oscillator, and the other half as a cathode follower buffer amplifier. The grid of the oscillator stage is connected to L2, and causes the oscillator stage to oscillate. If any earthed body approaches the pick-up rod or plate the value of C8 changes, and, in consequence, does the frequency of oscillation of V10. V10 is a cathode follower whose grid is connected to L2, and which causes the oscillator voltage to be built up across R3. A low value is chosen for the R4 position, and this, shunted by the output impedance of V10, presents an impedance to the coaxial cable connecting the pick-up unit to the main chassis of approximately 100 ohms. There may be some slight clipping of negative half-cycles in the cathode follower stage if it is necessary to give C9 a high value during setting up, but this should not cause any difficulties in the device we are considering here.

The coaxial cable coupling the pick-up unit to the main chassis may be normal 75 ohm television feeder, and it is terminated in a resistor, R16, of 100 ohms. The mismatch at either end of the line would not cause any difficulties provided that it is not longer than some fifteen feet or so. The pick-up oscillator frequency is then applied to g1 of the frequency changer V6.

The oscillator triode V10 works at a frequency which ensures that the difference frequency given at the anode of V16 is that to which the tuned filter coils are adjusted. It is essential, also, for V10 to oscillate at a frequency higher than that at which V10 functions because the latter will always drop when the pick-up unit is not in use. If V10 oscillated at a lower frequency than V16 it would be possible for the latter to be detuned by proximity effects below V16 such that the tuned filter frequency appeared once more at the anode of V16. This state of affairs would result in unreliable operation.

The tuned filter consists of two conventional 465 kc/s i.f. transformers coupled by an amplifying valve V5. The sensitivity control R18 enables the gain of V5 to be adjusted. This valve provides a detector for the output of the tuned filter together with a relay-operating valve. This part of the circuit is intended to function such that, when the pick-up oscillator is running at normal frequency, the output from
the tuned filter section is detected and applied to the grid of the relay-operating valve as a negative d.c. voltage, thereby cutting it off. If the pick-up oscillator becomes detuned, the output of the tuned filter section drops or disappears altogether, whereupon the relay-operating valve conducts and energises the relay in its anode circuit.

In order to prevent too high an anode current in the relay-operating valve when the detected negative voltage from the tuned filter is zero, it is necessary to apply a fixed standing bias to this valve. In the circuit shown here a potential of approximately 5 volts negative is obtained by tapping into the grid leak, R1, R3, of the relay-operating valve (V4a). This voltage, decoupled by R2, C9, and R19, C19, is that to which the detector load R3 is returned, with the result that, in the absence of detected voltage, 5 volts negative to cathode is still applied to the relay-operating triode. In the diagram this triode is provided by V4(b), V4(a), with grid and anode strapped, being the detector.

Practical Points

Before carrying on to a description of setting up the device, it is necessary to discuss one or two practical points.

It was mentioned above that the tuned filter section may employ conventional 465 kc/s i.f. transformers, these being readily obtainable through normal channels. The coils L1, L2, and L3, L4, may also be similarly easily obtained, as they need consist only of conventional short-wave oscillator coils intended for covering a range of 5-18 Mc/s, or thereabout.

The relay controlled by V4(b) should have a high resistance winding, and should be capable of being energised by a current of 10 mA. Slightly less sensitive types, energising around 15 mA, could also be employed, but these necessitate a relatively high current in V4(b) when this valve is "on." The process of adjusting the fixed bias to V4(b) to accommodate such relays (or to take up differing oscillator grid currents) is discussed later. It may be noted that an earth connection to the main chassis is shown in the diagram. This is desirable but not essential. A fairly reasonable earth connection would be given by connecting a 0.01µF 750 v.w. condenser between one side of the mains input and chassis.

Setting Up

So long as the principle of operation is understood, it is a fairly easy task to set up the device once it has been completed. It is first of all necessary to temporarily connect a meter switched to read 10 mA in series with the h.f. feed to V4(b). The i.f. transformers may then be aligned by injecting a signal generator set to 465 kc/s into g1 of V2(a), attenuating output as alignment proceeds in order to prevent V4(b) being cut off. Alignment is for minimum reading in the meter.

With the pick-up oscillator connected to its rod or plate a slider should next be set up for minimum reading in the meter. For this operation the slider of R13 should be positioned approximately one-third up from the earthy end of the track. It will also be necessary to adjust C6 at this stage, the value of this condenser being such that just sufficient voltage appears at the tuned filter output to cut off V4(b) when V4(a) oscillator is at correct frequency. If it is found that it is difficult to obtain a sufficiently loose coupling by reduction of the value of C6, an additional condenser (approximately 50pF) should be shunted across R6 and the process of adjusting C6 re-commenced.

The standing bias voltage for V4(b) should finally be checked by ensuring that the anode current of this valve reaches the value needed to operate the relay (see above) when the output of the tuned filter section drops to zero. If the standing bias voltage is too great it may be reduced by reducing the value of R8, and vice versa. Incidentally, this bias voltage will not cease if the pick-up rod or plate happens to be touched, as the presence of C1 ensures that the oscillator still keeps running under such conditions.

When it is desired to use the device, all that is necessary is to switch it on and allow it to warm up for some ten minutes or so. C14 should then be adjusted (ensuring that V4(b) oscillates above V4(a)) so that the relay de-energises. Holding one hand near the pick-up rod or plate should then cause the relay to be energised. Careful adjustment of R13 (with perhaps a slight re-setting of C14 as tuned filter gain is increased) can bring the detector to optimum sensitivity, should this be desired.

Drift

A final precautionary note has to be made by drawing attention to the possibility of frequency drift in the oscillators. Since both oscillators run from the same h.f. line, variations in mains voltage should have approximately the same effect on both. Long-term thermal drift may cause difficulties, and can be best alleviated by providing adequate ventilation to both oscillators. Good quality silver-mica condensers should be employed in both oscillator tuning circuits.

Finally, it should be pointed out that the sensitivity of the pick-up rod or plate will be roughly proportional to its area or area. It should be kept well clear of eamed objects. The overall sensitivity of the arrangement may be reduced, incidentally, by increasing the value of C2, and adjusting that of C14 accordingly.
This month Smity, aided by his able assistant, Dick, examines Christmas from the point of view of the Serviceman. He also deals with one or two subjects suggested in readers' letters.

Smithy's entry into the workshop on most days was usually slightly in advance of Dick's. The Serviceman was mildly surprised one December morning, therefore, to find on his arrival that the Workshop was abased with light and, judging from the considerable amount of banging and hammering which emanated from within, that an extensive project of work appeared to be in progress. Somewhat suspiciously Smity opened the door, to find his assistant balancing precariously on a chair and putting the final touches to a large paper bell suspended from the centre of the ceiling. Around the room there was evidence of Dick's enthusiastic application to his self-appointed early morning task.

Amongst other things the signal generator was liberally festooned with tinsel; a paper chain stretched diagonally across the ceiling, drooping somewhat over the sink; a small Father Christmas beamed benignly at Smity from the tool-rack on the wall; large blobs of cotton-wool were stuck over the surface of the window; and the motto "God Rest Ye Merry, Gentlemen" blazoned out above the rack on which intermittent receivers underwent their soak tests.

Dick paused in his labours and looked modestly at Smity.

"Just thought I'd brighten the place up a bit," he remarked casually.

Smithy took the scene in slowly, his first reactions being not entirely unconnected with the thought that it was a good thing that Christmas only came round once a year. However, a glance at Dick's face made him suppress any comments of that type.

"Well, you've certainly made a good job of it, Dick," he remarked at length, "only, don't you think you're a little early? After all, there are nearly three more weeks to go before Christmas Day.

"Oh, I've only just started," replied Dick. "I shall be adding quite a lot more each day!"

Christmas Rush

Smithy had no answer to this, and he took off his overcoat and settled down to work. Dick put the final touches to the decorations he had put up, and busied himself also. There were plenty of receivers in for repair and the time passed by very quickly. So quickly, indeed, that Dick and Smithy were surprised when a glance at the clock showed that a break for tea was indicated.

"Pew," commented Dick, as he sat down and sipped at the cup he had prepared. "The time seems to have gone by like lighting this morning! Is it my imagination, Smithy, or does there seem to be more work just now than we usually have?"

"Well, it's certainly beginning to pile up," admitted Smithy. "I should say that we're just beginning to experience the trade phenomenon known as the 'Christmas Rush.'"

The rush of work which appears every Christmas affects almost everyone connected with domestic radio or TV, from the big manufacturers right down past the smaller retailers to the servicing people such as ourselves. What happens, of course, is that the public order more radio and TV sets for Christmas than at any other time of the year, and manufacturers, wholesalers and retailers are kept right on their toes getting sets into the customer's homes before the all-important Christmas Day. Some of the bigger factories work extra overtime right up to the last minute before the Christmas break. From the servicing point of view, people suddenly seem to remember that they must have their sets, or their 'reserve' sets, fixed up before December 25th, and so our work mounts up as well, I can remember several years when I've been hard at it in the workshop until nine o'clock on Christmas Eve, in order not to disappoint somebody. After Christmas Day everything goes quiet again until around the end of January, whereupon trade returns more or less to normal. In some years the 'rush' is not so marked in others, but it's always easily detectable, especially if you're connected with the manufacturing or retail side."

"I suppose the quiet time after Christmas Day is due to the fact that much of the work has been cleared up beforehand," said Dick.

Partly that," replied Smithy, "and also because it's chocked! It's true that Christmas represents a good fillip to the trade these days, but the overall scene wasn't so funny before the war when the demand for radio sets was even more seasonal than it is now for radio and TV. In fact, business was spread out over the year so badly that some factories used to give their entire labour force the day on Christmas Eve, taking them on again three or four months later.

Dick was silent for a moment.

"Well, let's hope those days don't come back again," he remarked eventually.

"Let's hope so, indeed," agreed Smithy. "Perhaps we're fortunate in having television nowadays to even things out a little."

Morning Alarm

"To change the conversation to a more cheerful note," commented Dick, "I wonder if you've got any useful radio advice to offer. I've promised one of my relatives as a sort of Christmas present that I would fix up a little time switch which would turn on my bedroom radio set in the morning. I wish I hadn't done it now, because it looks as though it's going to cost me a little more money than I had originally intended. At least it will if I'm going to make a really pubk job of it."

"Not to worry," grinned Smithy, "there's a simple little device which I've been using myself for quite a long time and which only cost me a few shillings to knock up. All you need is a relay with two sets of 'make' contacts—that is to say, sets of contacts which close when the relay coil is energised—a toggle switch and a battery. You then connect these up into a circuit like this (Fig. 1).

The 'A' terminal points which I've marked 'To Remote Contacts' connect to a pair of contacts on a clock. To take advantage of the gadget all you have to do is to tune the receiver to the station you want before you get into bed and leave it switched on. You put the switch on the relay unit to the 'Alarm' position, whereupon its contacts open-circuit the mains supply, and the set becomes silent. At the appointed hour in the morning the contacts in the clock short-circuit, thereby energising the relay. This operates its 'B' contacts complete the mains supply to the receiver, whilst its 'A' contacts short-circuit those in the clock. The relay in consequence becomes 'held on' by its own contacts and remains energised, regardless of whether the clock contacts remain closed or not. The receiver is now switched on and commences to play. At any later time which happens to be convenient, the toggle switch on the relay unit is returned to the 'Off' position, with the result that the relay becomes de-energised. The mains supply to the receiver remains connected, however, it being completed this time through the toggle switch.

"That sounds simple enough," remarked Dick, "and I presume that the only time the energising battery has to supply any current is during the time between the closing of the remote contact and the resetting of the switch."

"That's right," agreed Smithy. "Normally, you could get quite a long life from the energising battery as it is only required for short periods. However, what is to my mind the greatest advantage of the gadget is that you only require a momentary short-circuit across the remote contact terminals for the relay to switch on and stay on; so that there is no need to worry if the remote short-circuit is a little intermittent, as might occur if homemade clock contacts were used. Incidentally, the relay contacts employed for switching the mains circuit do not have to be very heavy as they only switch the radio on. They never have to switch the radio off, which is when sparking would be at its worst."

"Well, that's where your ingenuity comes in," remarked Smithy. "It shouldn't be beyond the limits of an amateur handyman to fix a couple of contacts across a clock which closes at a certain time, even if these contacts consist
of something as simple as a piece of wire which is touched by the hour hand as it travels round. With alarm clocks there is usually a movement in a pawl when the alarm goes off, and this pawl could possibly actuate a pair of contacts."

"Fair enough," commented Dick. "It seems to be a neat gadget, and I'll get started on it this very evening."

"Before a career," added Smithy, "I should mention that there is one important point you should bear in mind. This is that one of the relay contact sets carries mains voltage, whereupon you want to make certain that its insulation to the relay yoke is reliable. You don't want mains voltages appearing at the remote contacts. If one side of the remote contact circuit is made up via the clock chassis itself, this should be connected to a reliable earth."

"I seem to remember some time ago that you said that polythene was ideal stuff for adding extra e.h.t. insulation."

"I did," admitted Smithy, "but I didn't infer that it should be used indiscriminately. Very often you have to use your judgment as to whether a component should be replaced or whether the judicious use of extra insulation can clear the fault it has developed. When I mentioned the subject last time I pointed out also that polythene is inflammable. As a matter of fact, polythene can actually be set on fire by a strong e.h.t. arc, so you should keep an eye open for risks of that sort."

"O.K.," remarked Dick. "All I wanted to use it for here was in the deflection yoke. There is an occasional spark between the line coils and the core, and it appears as though the original insulation has been damaged at

"Well, that's not entirely true, because polythene and p.v.c. are fairly recent entries into the plastic field," replied Smithy. "They were preceded by quite a few other types of plastic. What was probably the first important development was in the latter half of the nineteenth century, and this consisted of celluloid, or xylonite. This was followed, round about the First World War, by phenol-formaldehyde, which you know under the very familiar name of Bakelite. Phenol formaldehyde plastics have been in continuous production since that time, while plastic films and electronically insulating plastics are a matter of world wide from their introduction. Another type of material very common in the radio trade, and which could not be made in its present form before the war, is what is called synthetic resin bonded paper, or s.r.b.p. This followed shortly after the inception of phenol formaldehyde, and you are probably more familiar with it under the name of Paxolin. S.r.b.p. consists of layers of paper bonded together into a homogeneous whole by means of a plastic material such as the phenol formaldehyde of I have just mentioned, the result being a hard insulating sheet which can be cut to shape, stamped out, and drilled or pierced as desired. By the way, don't be put off by that word 'synthetic.' It merely means that the resin which bonds the paper together is made by a factory process instead of being found naturally, as is shellac.

"Phenol formaldehyde is a thermosetting plastic. That is to say, it is moulded into its final form by the application of heat, this causing a change—known as 'curing'—in the chemical make-up of the material, which then becomes set into the shape you want it to take up. A fully cured thermosetting plastic cannot be remoulded into a new shape by later application of heat. There are other important thermosetting plastics which are used in industry, but these don't come to the attention of the home radio or television engineer very frequently. On the other hand there are quite a number of thermoplastic materials which enter our work these days. Thermoplastic materials can be moulded into new shapes by successive applications of heat instead of being fixed in shape after their initial curing, as are the thermosetting plastics."

"Physically, I suppose that the major thermoplastic materials we meet in radio are polythene, p.v.c., poly styrene and nylon.

"We have just been discussing polythene and I don't think I need to add that it is recognizable by its slightly softness and slight waxy feeling. In its natural colour polythene has a 'milky' transparency, and this 'milknkiness' is usually apparent even in the coloured versions you see these days. For electronic applications polythene has an exceptionally high dielectric strength, this being of the order of 1 kV per thousandth of an inch."

"Isn't polythene sometimes given different names?" asked Dick.

"The most frequent alternatives you will meet are polyethylene and Alkathene," replied Smithy, "and it is becoming so plentiful now that it is being used more for non-radio than for radio purposes. Our old friend p.v.c.—or, for the record, polyvinyl chloride—is also very prolific outside of radio in such applications as plastic Mackintoshes and golf balls. Polythene and polyvinyl plasticizers to p.v.c. it can be made very hard, or very soft, as desired. Polythene, incidentally, are compounds which make the material more pliable and rubbery."

"Polythene is a hard, rather brittle, material which goes plastic at a fairly low temperature. It is very transparent and gives a characteristic 'ringing' noise if you tap it. It's an excellent material for coil formers due to its ease of moulding and low losses. The other plastic I mentioned, nylon, is becoming more and more in radio gear. In the 'solid' form as opposed to the thread, nylon is a tough and hard plastic, and has a white appearance. You will probably find nylon coil formers in some of the more modern receivers."

"Well, that's quite an interesting bit of information," commented Dick, "I'm afraid I've rather fallen into the habit of looking upon these materials just as 'plastics' only. I suppose that, if I'm going in for electronics as a hobbyist, I should start to be a keenie in the various types."

"I would certainly recommend you to do so," agreed Smithy, "as plastic materials are being used so much these days in radio and t.v. that a little basic knowledge on their characteristics and make-up is invaluable. Incidentally, you don't need anything more than the chemistry they teach you at school to get a good insight into the use of plastics."

"That's all very well," protested Dick, "but whilst I'm prepared to go up on plastics, I don't want to saddle myself with a lot of textbooks which go too deeply into the subject."

"I can sympathise with you there," admitted Smithy. "However, there is one book I would recommend to you that costs only a few shillings. This is called 'Plastics in the Service of Man' by E. V. Yarsley and E. G. Couzens, Pelican Books."

Plastics

Smithy put his emptied tea-cup back on the bench and he and Dick returned to their work. After a while Dick walked over to the cupboard and extracted a sheet of polythene, from which he cut a small section. Smithy, who had been watching him out of the corner of his eye, cleared his throat preparatory to issuing a statement.

"By the way," he remarked, "I hope you're being a little careful as to how you use that polythene."

"Why's that?" said Dick, a little startled.

"Physically, I suppose that if I said that polythene and p.v.c. represent the main plastics which have affected domestic radio and television."

DECEMBER 1957

THE RADIO CONSTRUCTOR

308
The MAYFAIR
Turret Tuned
Band 1-Band 3
Home
Constructor
TELEVISOR

PART 4
by S. WELBURN

In this, the last article in the series describing the construction of the Mayfair television, S. Welburn deals with the final steps in assembly, together with the procedure for setting up the complete receiver.

IN THE FIRST THREE CONTRIBUTIONS TO THIS series we discussed the construction of the various sub-chassis which make up the “Mayfair” television. In this final article, the assembly of the sub-chassis to form the complete receiver is described.

General Assembly

The complete Mayfair chassis is provided by fixing together the various sub-assemblies in the manner illustrated in Fig. 13. This diagram shows the positions of the units when viewed from below. It will be found that holes in the sides of each sub-chassis correspond with holes in adjacent sub-chassis, whereupon assembly may be carried out by passing 4BA nuts and screws through these holes. Fig. 13 also shows the flat strap which joins the power unit and time-base sections. This strap should be secured with 4BA nuts and screws, and it serves to strengthen the composite assembly. Finally, the rear assembly bracket is fitted, also with 4BA nuts and screws, to the rear of the vision i.f. sub-chassis, the sound i.f. sub-chassis, and the power unit. The composite assembly now becomes rigid and capable of being handled without undesirable bowing.

It next becomes necessary to fit the interconnecting wiring between the sub-chassis. First of all connect the free end of C2 (Fig. 9) to tag 2 of tag-strip A (Fig. 12). Connect pin 1 of valveholder W (Fig. 6) to pin 7 of valveholder Z (Fig. 12) and continue this lead to pin 7 of valveholder X (Fig. 2), the lead passing through the large hole between the sound i.f. and power unit sub-chassis. Using the same hole, connect tag 2 of strip D (Fig. 12) to tag 1 of strip B (Fig. 2); also connect tag 4 of strip D (Fig. 12) to pin 4 of valveholder X (Fig. 2).

The leads fitted for the following four connections pass through the large hole between the timebase sub-chassis and the power unit sub-chassis. Connect pin 7 of valveholder Z (Fig. 9) to the thick yellow lead (Fig. 2) which is bent back over the mains transformer to form an anchoring point. Connect pin 5 of valveholder Y (Fig. 9) to tag 1 of strip A (Fig. 2). Connect tag 2 of strip H (Fig. 9) to tag 4 of strip H (Fig. 2). Connect pin 4 of valveholder W (Fig. 9) to tag 3 of strip H (Fig. 2).

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The leads from tag-strip F to the on/off switch run through the ventilation hole under the smoothing choke on the power-pack sub-chassis, and across the top surface of the composite chassis.

When the sound i.f. strip was assembled, two screened leads were passed through an 8-in length of 5mm. slewing for later connection to the volume control R16. Of these two leads, identify that connected to the grid of the 6Q7 (V4 in Fig. 11) and, referring to Fig. 5, connect its inner conductor to tag 2 of the volume control. Connect the inner conductor of the other screened lead to tag 3 of the volume control. Connect the outer braiding of both screened leads to tag 1 of the volume control, and bond this tag to the metal case of the control.

Fig. 14 illustrates the scan coil assembly, to which the following connections are made. The resistors and condensers which will be referred to were shown in the timebase circuit.
assembly; and one end of the second 10kΩ 1 watt resistor, R3B, to tag 3 of the scan coil assembly. Connect the 100pF condenser C21 to the free ends of R37 and R38, ensuring adequate clearance from the other tags and components on the tag-strip.

Next come the leads connecting the scan coil assembly to the main chassis. The length of these leads depends upon the type of tube and mounting used, but their installation described at this stage in order to maintain continuity and because it should be possible to judge the length required with reasonable accuracy. It must be pointed out, however, that it is unsafe to have excessive lengths of wire between the chassis and the scan coils, and this must be borne in mind when the set and the tube are finally assembled together.

The Cathode Ray Tube

Connections to the cathode ray tube will vary slightly for different types, and it is advisable for the constructor to check the appropriate literature before finally completing the wiring to the duodecal c.r.t. base. Pins 1 and 12 of the duodecal base should be the heater connections, and these are taken to the appropriate position on the power unit chassis. For 6.3-volt tubes connect pins 1 and 12 of the duodecal base to tags 2 and 4 of the 250-5 watt resistor (Fig. 2). For 2-volt tubes connect pins 1 and 12 of the duodecal base to tags 3 and 4 of tag-strip A (Fig. 2). The heater leads should travel through grommet G2 as a fixing terminal which secures it. The position taken up by the phosphor-bronce earthing strip is shown in the tube assembly diagram, Fig. 15. The function of the strip is that of making contact to the outer conducting surface of the c.r.t.

Mounting the Tube

Tube mounting details are given in Fig. 15. As different constructors may have varying ideas for housing the completed television, the dimensions given in this diagram are for minimum clearance. When the dimensions illustrated are employed, the complete chassis may be fitted on the shelf underneath the tube. The tube mounting assembly shown in Fig. 15 is that employed in the ready-made cabinets which are available for the Mayfair television.

The following important points should be observed with regard to the tube mounting. First of all, the focus unit should be spaced away from its mounting bracket by means of a single 2BA full-nut on each bolt. Solder tags should be fitted under assembly bolts on the front tube support, rear tube support and ion trap magnet (when the latter is required). These solder tags, and that connected to the neutral point of the scan coil assembly, should then be all connected together by flexible P.V.C.-covered wire, a final chassis connection being made to tag 2 of tag-strip E of the power unit chassis (Fig. 3).

The Turret Tuner

The turret tuner is the final assembly to be wired in. This is not mounted mechanically to the chassis but is connected into circuit via fly-leads.

The current tuner receives its power supplies by connecting into the power unit sub-chassis. It is necessary, therefore, to refer to Figs. 3 and 4. First, connect a 50Ω 5 watt resistor between tag 2 of condenser C2 and pin 7 of valveholder Y on the power unit sub-chassis. This resistor is supplied with the valveholder as part of the final assembly list. It is shown in Fig. 2. The five flexible P.V.C.-covered leads from the tuner are next connected, these all passing through grommet H1 (Fig. 2). Last, connect the red lead from the tuner to pin 7 of valveholder Y (Fig. 2). Join the yellow and pink leads together and connect these to the thick yellow lead bent back over the main transformer (Fig. 2). Connect the black lead to earthing tag 12 (Fig. 2). Connect the blue lead to tag 4 of tagstrip A on the sound i.f. sub-chassis (Fig. 12).

The two coaxial leads from the turret tuner are next connected. That protruding from the rear of the tuner is the output lead, and its inner conductor connects to tag 6 of the Input Coil (Fig. 6). The outer braiding of this lead connects to chassis via tag 3 of strip B (Fig. 6). The coaxial lead from the top of the turret tuner is the aerial input lead. Connect its inner conductor to the centre tag of the aerial input socket and its outer braiding to earthing tag T3 (Fig. 6). A template is supplied with the turret tuner to enable it to be fitted to an undrilled cabinet. In order to mount the turret, the fixing and spindle holes should first of all be drilled, using the template to position hole centres accurately. The tuner is next fitted to the fixing holes with the aid of the self-tapping screws provided. Its valves should project vertically upwards. The indicating plate is next mounted by means of wood screws, care being taken to see that the correct channel indication appears at the top and to ensure that the wood screw centres correspond with the positions given on the template.

Although it is advisable to prepare the mounting holes for the turret tuner before finalising the television, it must be borne in mind that, should it become necessary to adjust the oscillator setting at any particular channel, this may only be done with the tuner unmounted.

Setting up the Television

After the television has been completed, it may be connected to the mains supply and switched on. It will prove helpful to connect an aerial to the receiver at this stage and to set the turret to a live channel. Allow one minute or more for the valves to warm up. The last valve to warm up will be the EY51.
c.h.t. rectifier mounted on the line output transformer, and it should be possible to see a hotter glow in this valve when the warming up period is complete. The brightness control should then be turned up until a raster is just visible. If the c.r.t. employed requires an ion trap magnet, this will have to be adjusted as specified in the tube manufacturer's literature before a raster will appear. Normally, the ion trap magnet is marked with an arrow, thereupon it should be positioned such that this points towards the screen and is directly above the line marked on the neck of the tube (usually in line, approximately, with pin No. 3). The ion trap magnet should be fitted on the glass of the tube neck, just slightly forward of the base. The setting of the ion trap magnet is fairly critical, and it is adjusted at this stage for maximum brilliance, reducing the brightness control as necessary.

![Fig. 16. The turrett, illustrating the positions of the anode coil and the hole through which the oscillator core is adjusted.](Image)

By adjustment of the contrast controls and the turrett fine tine, it should now be possible to obtain a signal, whereupon the line and frame hold controls may be adjusted to give a locked picture. The ion trap magnet is then finally set up in conjunction with the picture centering and focus controls (both on the focus assembly). A final slight resetting of the ion trap magnet might be necessary after these last two controls have been adjusted, as there may be a small amount of interdependence between them. It is permissible to use the ion trap magnet to assist in centering provided that this causes no decrease in brilliance. Similarly, the ion trap magnet should not be used to remove corner shadow if any decrease in brilliance is caused thereby. Any corner shadow which occurs may be cleared by altering the position of the scan coil assembly, which should be well up the neck of the tube.

As all the i.f. coils are pre-set, no adjustments should be necessary here. There will, of course, be slight variations from receiver to receiver due to differing wiring capacities, but these should cause negligible diminution in picture quality. If desired, a small adjustment to the sound i.f. coils may be made by primarily setting the fine tuner of the turrett for optimum volume, and then adjusting the sound i.f. coils for maximum sound output. The above adjustment should be carried out on weak signal inputs only, in order to prevent the sound a.c. circuit from masking results obtained during alignment. (The necessary weak signal may be obtained by adjustment of the vision contrast control with, if necessary, the temporary use of an inefficient aerial.) The correct fine tuning position of the turrett is that which corresponds to maximum sound. If sound-on-vision occurs at this tuning point, the Sound Rejector Coil on the vision i.f. strip should be carefully adjusted to obviate this effect. Apart from the Input Coil on the vision i.f. strip, which is dealt with below, the vision i.f. coils are best left alone, any adjustments which are made being of the order of a half to a complete turn only on any single coil.

If it is found that the channels required tend to lie outside the fine tuner range of the turrett, the oscillator of the latter may be carefully adjusted with the aid of a trimming tool made of insulating material. (A plastic knitting needle with one end filed to the shape of a screwdriver blade can be used here.) The turrett should be set to the channel which requires adjustment, the fine tuner set to the centre of its travel, and the oscillator adjusted for maximum volts through the hole depicted in Fig. 16. Adjustment of the turrett oscillator should only be needed in occasional instances.

It may also prove helpful to adjust the output coil of the turrett (see Fig. 16) in conjunction with the Input Coil of the vision i.f. strip when the receiver has been almost completely finalised. The adjustments should be made whilst receiving Test Card C, the requirement to aim for being a picture of good definition. This may not, incidentally, correspond to maximum picture brightness.

Instructions for alignment with a signal generator are given later in this article.

Insofar as the various panel controls are concerned, the function is self-explanatory. It is worth noting, however, the effects given by the two linearity controls. The line linearity control adjusts, mainly, the left-hand side of the picture; and it enables this to match the right-hand side. Adjustments of line linearity may necessitate slight compensatory re-settings in line width. The frame linearity control provides a control over both the top and bottom of the picture, and may, in its turn, necessitate a slight re-setting of the height control.

Before concluding at this stage it should be pointed out that, if it becomes apparent that an increase in height is necessary, this may be accomplished by connecting an additional 0.1F condenser across C9 (see Fig. 7) of the timebase chassis. Also, if it is found that a slight opening occurs at the top of the picture, this may be cleared by connecting an additional 150Ω resistor across R4 (Fig. 7) of the timebase section. Either of these modifications should be necessary only in isolated instances. A final point which requires emphasis is that, since the Mayfair television has a high degree of sensitivity, it may become overloaded in areas of strong signal strength. In such cases an attenuator should be inserted in the aerial lead.

**Voltage and Current Readings**

Voltage and current readings are given in the tabulated form. The number of figures are for guidance only and that individual television may give readings varying by quite an appreciable amount to those quoted. Apart from c.h.t. voltages, the readings in the table were taken with an Avo Model 7. The c.h.t. readings were taken with an electrostatic voltmeter.

**Table I: Voltage and Current Readings**

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Valve</th>
<th>Anode Volts</th>
<th>Anode Current</th>
<th>Screen Voltage</th>
<th>Screen Current</th>
<th>Cathode Volts</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound i.f. Strip...</td>
<td>V1</td>
<td>180</td>
<td>180</td>
<td>1</td>
<td>1.75</td>
<td>Power Unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V2</td>
<td>190</td>
<td>190</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V4</td>
<td>150</td>
<td>150</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V5</td>
<td>230</td>
<td>35mA</td>
<td>240</td>
<td>4mA</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Vision i.f. Strip...</td>
<td>V1</td>
<td>200</td>
<td>200</td>
<td>1.75</td>
<td>Maximum Gain</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V2</td>
<td>240</td>
<td>240</td>
<td>5</td>
<td>Minimum Gain</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V4</td>
<td>240</td>
<td>240</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V6</td>
<td>80</td>
<td>240</td>
<td>9.5</td>
<td>Average Signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V5</td>
<td>150</td>
<td>240</td>
<td>6.5</td>
<td>No Signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timebase Section</td>
<td>V1</td>
<td>240</td>
<td>240</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V2</td>
<td>240</td>
<td>60</td>
<td>12</td>
<td>Pentode Section</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V3</td>
<td>40</td>
<td>25</td>
<td>25</td>
<td>Triode Section</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V3</td>
<td>250</td>
<td>22mA</td>
<td>270</td>
<td>3mA</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V4</td>
<td>100</td>
<td>200 (Gz/G3)</td>
<td>30</td>
<td>(G1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V5</td>
<td></td>
<td></td>
<td>120</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table II: Power Unit Readings**

<table>
<thead>
<tr>
<th>Power Unit Readings</th>
<th>Unsmoothed H.T.</th>
<th>Smoothed H.T.</th>
<th>HT+1</th>
<th>HT+2</th>
<th>HT+3</th>
<th>HT+4</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 volts</td>
<td>300 volts</td>
<td>240V</td>
<td>70mA</td>
<td>5500Ω</td>
<td>180V</td>
<td>100/120mA</td>
</tr>
<tr>
<td>270V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28mA</td>
</tr>
</tbody>
</table>
the diode load resistor $R_{16}$ or across the video anode load resistor $R_{18}$ (see Fig. 4). When the meter is connected across $R_{16}$, peak indications will be given by positive readings (chassis negative), and it is desirable, although not essential, to use a high resistance meter, such as an Avo model 8, or a valve voltmeter. Also, the positive lead of the meter should be decoupled by inserting in series a resistor of some 20kΩ or so, this resistor being positioned close to $R_{16}$. If the meter is connected across $R_{18}$, the voltage reading will increase as the output from the strip increases. Again, a high resistance meter is desirable, although not essential; and it is advisable to decouple the meter lead connected to the junction of $R_{18}$ and choke B with a resistor of approximately 20kΩ. In the absence of a meter it is possible to obtain a fairly approximate indication, during alignment, of the output amplitude from the vision strip by reason of the fact that a blank raster will brighten as output increases; but the results given here are not so positive as meter readings. The signal generator should always be attenuated such that an output indication which is just comfortably identifiable is given by the strip.

The vision strip is primarily prepared for alignment by disconnecting the junction of $C_{31}$ and tag 1 of the Sound Rejector Coil. See Figs. 4 and 6. Connect the output of the signal generator between pin 7 (grid) of $V_5$ and chassis, and set it to give an unmodulated output at 17.5 Mc/s. Temporarily connect a 20pF condenser across the secondary of the Diode Coil, and align the primary (bottom core) for maximum output. Next, transfer the 20pF condenser to the primary of the Diode Coil and similarly trim the secondary (top core) for maximum output. Remove the 20pF condenser. Re-connect the signal generator (still set to 17.5 Mc/s) to pin 7 (grid) of $V_5$ and chassis. Connect the 20pF condenser across the secondary of the 2nd I.F. Coil and trim the primary (bottom core) for maximum output. Transfer the 20pF condenser to the primary and similarly align the secondary (top core) for maximum output. Remove the 20pF condenser.

TABLE III

<table>
<thead>
<tr>
<th>Mains Transformer (voltage and current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary input: 200-250 volts 50 c/s</td>
</tr>
<tr>
<td>H.T. Secondary: Voltage—300 (orange)</td>
</tr>
<tr>
<td>0 (black), 300 (orange)</td>
</tr>
<tr>
<td>Current: 300mA max.</td>
</tr>
<tr>
<td>L.T.1 Secondary: Yellow—6.3 volts</td>
</tr>
<tr>
<td>6.5 amps</td>
</tr>
<tr>
<td>L.T.2 Secondary: Red/Yellow—21.5</td>
</tr>
<tr>
<td>volts, 0.3 amps</td>
</tr>
<tr>
<td>L.T.3 Secondary: Green—5 volts</td>
</tr>
<tr>
<td>6.3 volts, 0.3 amps</td>
</tr>
<tr>
<td>L.T.4 Secondary: Black/Red (Common)</td>
</tr>
<tr>
<td>Black/Yellow—2 volts 1 amp; Yellow</td>
</tr>
<tr>
<td>6.3 volts 0.3 amp.</td>
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![The Contessa 6-Transistor Portable Superhet](image)

**The Contessa 6-Transistor Portable Superhet**

In this article, wiring details of the Contessa transistor superhet are brought to a conclusion. Also given is full information on setting up and aligning the completed receiver.

**Part 2**

by D. PETERS

In last month's issue, the Contessa portable superhet was introduced to readers of this magazine. The circuit design was discussed in full, and step-by-step wiring instructions were given, these carrying the process of construction almost to completion. In commencing this month's article we carry on with the process of wiring.

**Final Wiring Steps**

Fig. 9 shows the next process which has to be carried out in the wiring of the Contessa, and it illustrates the manner in which the two trimmers $T_C$ and $T_A$ are fitted to the chassis.

The moving vane terminals of these two trimmers (i.e. the central lead-outs) are soldered to a piece of short heavy-gauge wire, which then passes through the chassis, connecting to earth tag (Fig. 2). The fixed vane tags of the trimmers are connected to the adjacent fixed vane tags on the two sections of the tuning condenser. The soldered connections between the trimmers and the tuning condenser tags are just visible, behind the trimmers, in Fig. 9. Also fitted at this stage is $C_5$, this condenser being located under the chassis and connecting between tag 1 of $L_{A(b)}$ and $L_{A(b)}$, and the fixed vane of $V_{C(b)}$.

The next component to connect up is the volume control $R_3$, and the wiring required here is illustrated in Fig. 10. Reference should also be made to Fig. 8, wherein three chassis holes were designated with the letters "X," "Y," and "Z." These three holes allow the passage of leads employed in the volume control circuit, and they are referred to in Fig. 10. It will be noted that one of the wires soldered to the volume control connects to the resistor $R_5$. In the wiring stage illustrated in Fig. 7, one lead of $R_5$ was left unconnected.

To complete the wiring now required, a length of tinned copper wire should be soldered to the free lead of $R_5$, this being passed through the chassis to the appropriate volume control tag. This lead, including the joint at $R_5$, should be covered with sleeveing.

Fig. 11 illustrates the connections to the wave-change—on/off switch, and shows also the manner in which trimmers $T_C$ and $T_A$ are soldered to earth bus-bar "B." When
making connections to TC2 and TC3 it is important to ensure that all the leads which make up the tags are reliably soldered. Two leads pass through the chassis in Fig. 11, one being the positive (red) battery lead and the other the lead travelling to tag 1 of L3(ab). Both these leads pass through the large hole which is located at the front of the chassis between the wave-change switch and the tuning condenser. After passing through this hole the lead to tag 1 of L3(ab) should run parallel to the front edge of the chassis, turning at right angles close to tag 8 a twisted pair terminating in the battery plug. Care should be taken to ensure that the red lead connects to the thick pin. The three leads designated “P”, “Q” and “R” in Fig. 11 are connected up in the next stage in the wiring.

This next stage involves primarily the fitting of the long wave loading coil, L2. The tags of this coil are soldered directly to the two switch tags marked “P” and “Q” in Fig. 11. The coil then becomes self-supporting and projects directly backwards from the switch, bearing slightly against the can of IF2. Its position is readily apparent in the photograph.

Chassis. It should be fitted such that the slot in its tag-ring is towards the rear of the chassis. Fig. 12 gives a view of the ferrite frame tag-ring and indicates the circuit points to which the wires from its tags connect. The exact layout of the ferrite frame should be such that, of course, be shortened as necessary before being finally connected. The two blue leads from the tag-ring pass through the small chassis hole adjacent to that through which earth bus-bar B passes, whereupon they then travel directly to the circuit points depicted in Fig. 10. The leads are fitted in small steps only that the two blue leads are connected as shown in Fig. 12, since reversal may result in inferior performance. Care should be taken whilst handling the ferrite frame, as it is quite brittle and may break if carelessly handled. It is for this reason that this component is the last to be fitted.

The chassis proper is now complete, all that is finally necessary being to connect the speaker leads (fitted in Fig. 8) to the speaker itself. It is worth while mounting the speaker in its cabinet before testing the receiver, whereupon it becomes possible to earth its frame at the same time as it is connected to the chassis. The earth connection to the speaker frame is provided by fitting a solder tag under one of the mounting screws at the tag-panel end, and connecting this to the same speaker lead as is employed by the earth output lead.

The Contessa receiver is now ready for testing.

Testing the Receiver

It is desirable to have a quick check for correctness of wiring may next be carried out, after which the transistors are fitted to the appropriate sockets. Special attention must be paid to ensure that the transistors are fitted correctly; i.e. emitter wire into emitter contact, base wire into base contact, and collector wire into collector contact.

The transistor lead-out wires will be firmly gripped by the contacts, with no risk of accidental disconnection later. After being fitted, the transistors should hang downwards from the underside of the chassis, adequate clearance being obtained from adjacent components. When the transistors have been inserted into their sockets the chassis needs to be handled carefully, and it is a good plan to provide props at either end whilst adjustments are being made. The battery plug may now be inserted into the 7.5-volt battery and the receiver switched on. If there is evidence of a.f. oscillation, resulting in the occurrence of a howl, the battery should be disconnected and the leads from the secondary of the output transformer reversed at the 2-way tag-strip. If there is no evidence of oscillation, a milliammeter should be inserted between the black lead from output transformer T2 and the h.t. negative line, and the receiver switched on again.

The combined collector current of TR3 and TR6 will now be indicated by the meter, and a reading of 4mA under no-signal conditions should be obtained. If the combined collector current is low, it is necessary to reduce the value of R16 until the required current is obtained. The simple method of doing this consists of temporarily parallel-ling high value resistors (say 100kΩ) to commence with) across R16. The value of R16 must be increased accordingly.

After R16 has been satisfactorily adjusted, the receiver can be checked and aligned. In the absence of a signal generator it is possible to carry out this process on received signals without any great difficulty.

The receiver should be switched to the medium waveband, the volume control set to the maximum position, and the tuning condenser carefully swung to see if any additional stations may be received. If, as is possible at this stage of alignment, no station is heard, stronger signals may be obtained by temporarily connecting a reasonably efficient aerial to the fixed vanes of VC1(a) via a condenser of 50 to 200pF. When a signal is picked up the tuning condenser should be adjusted for maximum volume, after which the i.f. coils should be carefully aligned. As alignment proceeds signal strength must be reduced as necessary, either by rotating the receiver or by plugging directly via the ferrite frame, or by disconnecting or loosening the coupling from the temporary aerial if the latter is used. When the i.f. transformers are finally aligned, tuning should be sharp, exhibiting good selectivity.

It next becomes necessary to set up the core of the oscillating coil, L3(ab) to L3(ab), and the trimmer TC4. The oscillator circuit is set up by tuning in a known station at the high frequency end of the medium waveband (tuning vanes unmeshed) and adjusting TR4 until the tuning condenser takes up what is judged to be its correct setting for this wavelength. A known station at the lower frequency end of the medium waveband (tuning vanes meshed) should then be selected and the core of L3(ab) to L3(ab) adjusted to give a similarly correct tuning condenser setting. The process should be repeated once more at the high and low frequency ends of the band with the same two stations (the settings of TC4 and the oscillator coil core are slightly interdependent), after which the medium...
Any temporary aerial which may have been employed should be removed together with the ferrite frame circuit is adjusted, although it may help, primarily only, to hold an aerial lead close to the ferrite frame coil in order to give a very small degree of capacitive coupling. Adjustments to the ferrite frame circuit should always be carried out with as small a signal input as possible, rotating the receiver if necessary to reduce sensitivity. The tuning condenser is first of all adjusted to pick up a station at the high frequency end of the band, whereupon trimmer TC1 is adjusted for maximum volume. A station at the low frequency end should then be selected, this being brought up to maximum volume by adjusting the position of the coil on the ferrite frame. As, due to hand-capacity effects, it may be a little difficult to judge the optimum position of the coil on the core, a good method of checking its resonant frequency can be carried out by means of experimental adjustments to TC1. For example, if after picking up the station at the low frequency end of the band, TC1 is adjusted experimentally and it is found that signal strength increases for an increase of

When medium wave alignment is complete, the receiver should be switched to the long waveband. Using, if necessary, a temporary aerial coupled very loosely to the ferrite frame coil, TC1 should be adjusted until a known station (preferably the B.B.C. Light programme) on 1,500 metres is received for a correct setting of the tuning condenser. The core of L2 and trimmer TC2 should then be adjusted for optimum volume. The best combination of the settings of L2 and trimmer TC2 is normally that which results in a relatively low capacity in TC2.

Alignment with a signal generator follows much the same procedure as that just detailed. The signal generator output may be initially injected into the circuit via a condenser of 50 to 200pF connected to the base of TR1. The signal generator should be set to give a modulated output at 31.5 kc/s. The i.f. transformers are then adjusted for maximum volume, reducing signal generator output as alignment proceeds.

To adjust the oscillator circuits, the signal generator should be applied, via a 50 to 200pF series condenser, to the fixed vanes of VC1(a). The oscillator circuits are then adjusted in the same manner as was described above, the signal generator providing the requisite signals at the high and low frequency ends of the band. Due to inevitable loading effects the signal generator should not be used for aligning the ferrite frame circuit, adjustment here being carried out on received signals as described previously.

Long wave alignment is also carried out in the manner previously described, although it may prove helpful to employ the signal generator for initially adjusting TC2.

Final Adjustments

It may be remembered that, in the first article, it was stated that R3 may have to be adjusted to suit particular transistors fitted in the TR4 position. Normally no adjustment will be needed here at all, but if there is any tendency to squeal the value of R3 should be increased until the effect clears. Squealing will make itself evident as a loud hiss, usually at the high frequency end of the medium waveband. Assuming that the set is initially very badly out of alignment after construction has been completed, it is just possible that slight squealing may be evident at one or two settings of the tuning condenser. If this occurs, the necessary temporary increase R3 during alignment, reverting to its nominal value afterwards.

It was stated earlier that, if a bowler or other form of signal generation brings evident with the receiver is first switched on, the connections from the output transformer secondary at the 2-way tag-strip should be reversed. However, incorrect phasing of the negative feedback loop may not always result in an audible oscillation, and it is desirable, after alignment has been completed, to check for correct phasing whilst a station is being received. This check may be carried out by primarily disconnecting TR4 from the 2-way tag-strip (Fig. 8). Temporarily connecting R19 to the tag-strip whilst receiving a signal should cause a decrease in volume, and particularly in background hiss, when phasing is correct.

In order to begin in any further checks which may be required, prototype voltage readings were given at the appropriate points of the circuit illustrated in Fig. 1. These readings are relative to chassis, and were taken with an Avo Model 8 switched to the 10-volt range. The receiver was tuned to approximately the middle of the medium waveband, with no signal input, and the volume control set to minimum. It must be pointed out that readings taken on receivers built to the Contessa design may not exactly agree with those given in Fig. 1, this being due to component tolerances and slight discrepancies between transistors.

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The Cabinet

If the cabinet specified in the parts list is obtained, housing the receiver is quite a simple operation. All that is then required is to fit the chassis to the side supports already provided. A minor point which requires attention is to ensure that transistor TR4 is well clear of the speaker after the chassis has been assembled. The front escutcheon may be glued to the cabinet or merely held behind the knobs. The latter method of fixing is quite satisfactory, especially if felt spacing washers are fitted under the knobs.

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December 1957
Radio Miscellany

Inimations of space last month prevented me from mentioning some of the interesting points from an "Old Stager" as they were received from Mr. B. G. Ashman of Stevenage. He truly qualifies for the Old Stager title on the grounds of remembering being referred to in "Wireless World" in 1914. This model used well-cut discs driven by clockwork. With its aid, figure and letter groups could be practised single-handed, and it proved of considerable value for teaching correct spacing, but it was inclined to "splash" when used above 8 words per minute.

Like many old timers he still has some of the treasures of bygone days, included among them being the former and pins for making wavemeter coils in the manner I described. This was marketed by Igranc (a name to conjure with in the early days of broadcasting), and as far as he can recollect the name of the manufacturer was the part of the model of this pattern marketed by (?) Burne Jones & Co. Also preserved are a couple of early Polar condensers built in heavily constructed brass boxes 3½x3½x1½ in., in which sprung metal plates are compressed to increase capacitance. This idea remains with us today in our trimming and padding capacitors, and has in its time been used to make variable grid leaks. In the latter carbon granules were used, the resistance decreasing under compression. Unfortunately they didn't spring back on their own, so to get a critical setting in an unstable circuit with a highly cherished "soft" valve, keen types, anxious to wring the utmost performance, detached their variable grid leaks and gently tapped the granules loose. This was a ritual when replacing soft valves—a frequent occurrence as they had very brief lives. But it was a period when we were "forefathers," one simply had to grin and bear it. I cannot recall the British manufacturers marketing soft valves, although they gave remarkable results as detectors. An early device, tuning by the use of metal plates in the field of inductances, still survives in the modern slug-tuned coil and transformer. Sometimes it seems there is nothing new in radio. Electrolytics were used in the early part of the century, to disappear and re-emerge triumphantly years later. F.M. 100 was used in the early days, only to be dropped in favour of a.m., and scanning systems were devised long before sound radio started, let alone before t.v. was thought of. B.G.A. was lucky enough to be chosen for one of the first radio courses given to cadets at Marconi House, which jumped his knowledge forward from perikon crystals to the "real thing"—magnetic detection and two-electrode valves. He mentions that carborundum detectors were at that time doing regular service, and his introduction to the three-electrode valve was by way of an advertisement announcing the De Forest Ultra Audion valve.

Both these latter points bring back memories for me. In 1920 as a small lad I built my first receiver, which kept me weeks before rewarding me with a signal—this was "powered" by carborundum. My first valve set, built a few months later, used a triode, and wasn't for two or three weeks much more rewarding. In the period when I was getting "no joy" I consulted a local "expert," an ex-First World War R.A.F. type (then the Flying Corps). To my horror he held a lithe match against my precious valve. As this treasured possession had cost me many weeks hard-earned pocket money I protested vehemently. He said: "You'll never get a signal out of these things unless you warm 'em up thoroughly. We always did it at Farnborough. I writhed in agony, feeling experiments with a box of matches on somebody else's valves may be all right, but it's not so clever watching other people do it with your property. Maybe he was confusing it with the engines. Any clot knew they had to be warmed up first. Funny enough, years later mains valves came along and you really have to wait for them to warm up, but I have yet to hear of anybody trying to shorten the warming-up period with the aid of a box of matches!

Still Further Back

Another reader whose store of souvenirs dates from the really early days is Mr. J. W. Tilley of Redditch. He is only a little over half the age of some of our old time correspondents, so his detailed knowledge of the history of our hobby has been acquired by reading and collection. In quoting from a full-page advertisement in a copy of the Modern Electrician for December 1923, he gives details of the Polar Bloc system and also mentions the Blackadda system of unit construction introduced in 1926. For the encouragement of this fascinating subject he gives the following references.

1913. A series of articles in Work (a weekly periodical published by Cassell's) from October onwards describing the construction of a crystal receiver. This was reprinted in Part 22 of the Amateur Mechanic in August 1914. He also lists a number of subsequent articles, including the sets of cigarette cards which we discussed in this column some three or four years ago. He dates How to make your own Wireless (Crystal Set and How to make a Valve Amplifier for the BDV Crystal Set as 1923. Twenty-five cards in each set.

He commends those interested to that excellent publication Radio Communication, History and Development (Science Museum Handbook). This is a H.M. Stationery Office book containing 58 fine plates, and costs 3½d.

centre tap ... talks about items of general interest

Finally, as there has been such a lively interest among "Wireless" and the possibility of a nation-wide club opening up, he suggests that the little metal plates the manufacturers used to put on the back of the early sets might well be collected, as a possible asset to a future enthusiast. J.W.T. sends along his specimen. Set No. 805 made by B.S.A. Radio Ltd., Birmingham. Anybody got a lower number in that series.

Value for Sxvxpencex

In view of the large amount of lively correspondence from readers on topics recently raised in this column, I am rather disposed to give the American request for an ideal combined good-listening-extended-play-test-record brought in only three responses. Is it impossible to find so many virtues contained in a single record? Incidentally, none of the three claimed that their recommendation met up with the exacting requirements of their friendly. They feel, however, that their choices can be depended upon to show up many common defects in reproduction systems and, when the amplifier is pure, play an important role in a worth-while music record programme.

Firstly, W.H.J. of Enfield Road, Derby, chooses the Royal Philharmonic playing Elgar's "Pomp and Circumstance" Marches 1, 2, 4 and 5 (Philips NBE11002). It has an overlapping of the attack, and some dynamics are rather flat. A more accurate version of this was recorded by the London Symphony Orchestra for the same company.

The second is from J.V., Salisbury Street, Bedford, who recommends Chabrier's "Escales". He writes: "This should sound clear and crisp—not like a roughly handled dustbin. It meets most of the qualities required and is backed in addition by a pleasing recording of Walteufel's "Skaters Waltz" (Columbia SEL1528). (Openen: A very good choice. Perhaps not so exciting as No. 1 in some respects, but together they could provide some useful comparison.)

Finally, E.D. of Earlsfield Road, S.W.18, writes: "I can hardly imagine any 78 record possessing all the points our Aberdeen friend demands, but for sheer tonal beauty with passages taken up by separate sections of the orchestra, sometimes simultaneously, and for rugged grandeur of swelling volumes Mendelssohn's "Hebrides" Overture (Philips ABE10006) is hard to beat. For 'listening's sake' it should be in a dark room or with the lighting turned dim." (Openen: An impressive record, especially when heard in the right mood. Backed by 'Ray Blas Overture'. Test qualities perhaps a little more limited, but would quickly reveal reproduction shortcomings to a critical ear.)

No doubt many amplifier enthusiasts refrain from turntable recordings because they thought too much was asked from a single record. Is anyone familiar with an E.P. recording they consider a still better test record than those mentioned?

The Show's the Thing

Those who, in view of the complication of the modern t.v. and f.m. receivers, have doubted the continuing popular appeal of the "wireless set" need have been surprised at the big and enthusiastic attendance at the Radio Hobbies Exhibition. In the exhibition, there were surprisingly improved at its success, and several of those not represented this year have expressed their intention of being there next time. At the moment it is not certain whether Phil Thorpe would sign his A.G.A.E. continued on page 356
The PETITE Battery Portable Superhet

Described by

JAMES S. KENT

A NEW RECEIVER DESIGN HAS ALWAYS proved of interest to the home-constructor, whether it be t.r.f. or superhet, portable or “static,” battery or mains operated, valve or transistor fitted. The design about to be described is of the valve portable type and has been expressly designed for ease of construction by the hobbyist fraternity.

A portable receiver is an admirable acquisition to the home radio equipment and, at this time of the year, when one is pre-occupied with the selection and purchase of Christmas presents, such a receiver may possibly fit the bill with respect to solving one such gift problem. For those requiring a portable design for outdoor use in the coming summer season, would be the time to commence construction—so that it is completed well in time for the fine weather outings and forays.

From the front cover photograph it will be noted that the whole assembly is housed in an extremely attractive and professional-looking carrying-case. The front panel is of hammered bronze finish metal complete with a gold mesh speaker grille, the black knob and dials being well matched against such a background. The completed receiver weighs only some 5lb, and the two-tone case colours of red and grey, or fawn and red, make this portable both pleasing to the eye and easy to carry.

Circuit

The frame aerial assembly, fitted inside the cabinet lid, is tuned by C3A on the Medium wave position and by the combination C1A, C1 and C3 on the Long wave position of the wavechange switch. The frequency changer is the Mullard DK96, a pentode type that performs extremely well in such an application. The numbers around the valve refer, of course, to the actual base connections. R1, R5 decoupled by C1H apply the a.v.c. voltage to both the frequency changer and the first i.f. stage. This effectively prevents over-loading when tuned to the local transmitter. The oscillator section is tuned by C3B with C7 in parallel on the Medium wave and the additional C6 on the Long wave position. C5 is the oscillator padding condenser, and is in series with C6; the latter, together with R2, forms the oscillator grid components; the oscillator “amode” grid 3, is fed directly from the oscillator coil winding.

The output from this stage is applied across the first i.f. transformer, type 965P (965 kc/s) and from thence into the I.F. stage. This is a perfectly standard circuit designed around the Mullard DF96 r.f./i.f. pentode. The resultant output from this stage is rectified by the diode section of V5, and the audio is fed via the slider of R5, and C5, into the pentode section of the DAP96. The potentiometer R3 acts as the volume control. R19 is the V3 anode load component, while R9 is the screen series resistor decoupled by C14.

The amplified a.f. is fed into the output stage via C16, the condenser C15 filtering any residual r.f. to chassis. The grid leak and bias components respectively are R17 and R11. The on/off switch is incorporated in the h.t. and I.F. lines, the switch itself being id operated. The output from the DL96 a.f. pentode is fed into the speaker via the output transformer, C17 applying a measure of tone correction. The speaker is a 5in 3Ω type.

Reverse of Petite panel, showing arrangement of chassis, speaker and on/off switch

Assembly

Figs. 2 and 3 show the above- and below-chassis assembly with respect to the main components. To commence the assembly, mount the components in the following order, for correct location of these see Fig. 3. Fix into position the output transformer so that the lead-out wires are away from the chassis. The solder tags S1 and S4 are fitted one under each fixing screw. Next place and secure
into position the wavechanger switch and the volume control R7. Mount the ganged condenser C1A, C1B using three fixing screws, and bend one tag clear of the first if necessary.

Place the oscillator coil L1, by pressing it into the grommet G6, the coil entering the grommet to a depth of approximately 1/4 in.

This completes the assembly instructions. Note that the following wiring instructions may be carried out before fitting the front panel.

Wiring

Reference to Fig. 3 will show that all of the small components are depicted in their respective positions, and these should be placed as near as possible to the location indicated. It is important to keep all the condensers and resistors with their leads as short as possible and as close as permissible to the chassis. With regard to the actual soldering, it is advisable to use a good quality flux-core solder and an iron of the instrument type. Liquid fluxes should not be used as these cause corrosion at a later date and may result in the breakdown of components. The tags shown in black (Fig. 3) are the fixing tags and will, therefore, be connected to the chassis as earth connections.

Connect together Z8, Z9, Y7, X2 and W2 (these, of course, refer to the valveholder and individual tags of the respective valveholder). Wire and solder together Z6, N6, T6, T7 and M6, following this by connecting together Z6 to the centre contact of Z and S1. Having completed the above, solder and wire together the centre contact of Y to Y1 and the solder tag S5. Connect together the centre contact of X, X1, X3 and T3/1 (earthed tag of the T1 tag-strap). Join together the centre contact of W, W3 and T3/1.

Next, connect X3 to W5; W4 to T1/4; L1 to T1/1; M3 to T1/2; N3 to T1/5; and lastly N4 to X5.

This completes the wiring with respect to the connection together of various points in the circuit. We now continue by including into the receiver all the resistors contained within the design.

Wiring the Resistors

The following enumerated resistors should be soldered, at each end, to the circuit points listed. Connect one end of R5 to W6, the other to T3/2; R7, W7 and T1/4; R8, M6 and L6; R4, M6 and W5; R2, T1/2 and T3/1; R1, T1/5 and T3/4; R6, Y6 and T4/2; R1, Y5 and T3/5; R11, T4/4 and T4/5 and R13, Z6 and T4/4.

Dealing next with R1—the volume control potentiometer (see Fig. 2), connect tag 1 to the adjacent S1, tag 2 through the grommet G4 to T4/3 (see Fig. 3) and tag 3 of R7 again through grommet G1 to T1/5.

This completes the resistor wiring instructions.

Wiring the Condensers

In the same manner as above, the condensers should be soldered into the circuit, at each end, to the following points:

Connect one end of C1 to T2/1, the other end to T2/2; C2 to T1/1 and T2/1; C4 to T2/3 and T2/4; C8 to T1/1 and T1/2; C10 to T1/2 and T3/2; C12 to T1/5 and T1/3; C14 to T3/2; C15 to T3/4; C17 to T3/5 and T4/1; C19 to T4/2; C17 to T4/3; C17 to T4/4; C17 to T4/5; C17 to Y4 and T4/1; C17 to Y5 and Z5; C17 to Y6 and Z6 and C17 to Y7 and Z7.

Connect the free end of C5 to T1/1. Follow this by soldering the positive end (+) of C11 to T4/2 and the negative end (−) to T1/3. Connect the variable condenser C1A through the grommet G1 to T1/1 and C1B through the grommet G2 to T1/1.

Continuing with the wavechanger switch, connect together tag 2, tag 5 and the earthed tag S4 (see Fig. 2); follow this by connecting tag 4 of the switch through the grommet G2 to T1/2. Join tag 3 to T1/5 via G3. Tag 6 is connected at a later stage and tag 1 is left blank.

The next component to wire into circuit is the output transformer. This is done by taking both the red leads through the grommet G5, soldering one to Z6 and the other to Z7. These leads are interchangeable and, therefore, it does not matter which way round they are connected into the circuit. Feed the yellow leads through the grommet G5, these two connections being soldered to the loudspeaker at a later stage.

Having proceeded this far it would be as well for the constructor to check over the parts already completed receiver against the drawing given in the going instructions, in order to ensure that no errors have been made with respect to the inclusion of components and the wiring.

Assembly of Front Panel to Chassis

This is the next step in the construction of the “Petite” receiver, and the first item to be dealt with is the lid operated on/off switch. Fit this switch using the small self-tapping screws supplied; the contacts should be facing inwards from the edge of the panel (see illustrations). T23, C15, 4BA screws, the nuts being fitted on the inside of the chassis.

Secure the speaker to the front panel, using four screws, the speaker mesh being inserted between the speaker itself and the panel. This mesh will be held rigidly in position when the speaker screws are
securely tightened into place. The speaker should be so positioned that the connecting tags are towards the chassis. Next, solder to these two speaker tags the two yellow wires from the current transformer that were previously fed through the grommet G2. These wires are interchangeable and may be connected either way round.

Take the calibrated scale and fit this to the tuning condenser (C1A and C3b) spindle. The condenser should be at maximum capacity, i.e., all the plates in mesh, and the scale adjusted until the line between 550 and 1,200 locates on the M.W. index line on the panel. The grub screw in the knob is then tightened.

The volume knob is next fitted to the spindle of R7 (volume control) and secured by means of the grub screw, the position of the knob not being important. Next, fit and secure the knob to the wavechanger switch.

We must now wire into circuit the lid operated on/off switch. Connect switch tag 4 to T4/5, taking this lead along the chassis below the speaker. Join tag 3 of the switch to T1/2.

Dealing with the battery connections next, we require for this four lengths of wire, each 8in in length, both ends being bared in preparation for the soldering process. Taking the H.T. connections first, solder the end of one wire to tag 2 of the lid operated switch and the other end to the thin pin on the two-pin plug (H.T. negative). Solder to the thick pin of the two-pin plug one end of a further length of wire and twist this around the length of wire soldered to the thin pin, and follow this by soldering the remaining free end of this wire to W7 (i.e. positive). For the H.T. connections connect the end of one wire to T4/5 (H.T. negative). Taking the last remaining length of wire, solder one end to T4/5 (H.T. positive). Next, take the three-pin plug and, with the pins held away from you, the left-hand pin is connected to that wire coming from T4/5. Twist the remaining free-end lead around this former wire and solder the free end to the right-hand pin of the battery plug. The top centre pin of this plug is left blank.

Frame Aerial

This is the next item to be included in the circuit, and wiring should be carried out as follows: to the yellow tag of the aerial solder one end of a 6in length of wire, the other end being connected to T3/4. Join the black tag of the aerial and T3/4 together by means of an 8in length of wire. From the green tag of the aerial solder a 9in lead through G1, between C3b and the chassis, to tag 6 of the wavechanger switch.

Having completed the above, fit the frame aerial into the cabinet lid and under the detachable panel, with the frame windings towards the outside of the lid. The connecting leads should be taken under the edge of the frame back plate and thence through the slot provided in the lid and the panel.

The whole wiring and assembly processes are now complete, with the receiver ready for the calibration and lining-up of the various tuned circuits.

**Calibration Using a Signal Generator**

The receiver should be lined-up completely before fitting the whole assembly into the cabinet.

To commence, inject a 465 kc/s signal into the grid of W (pin 6) by connecting the generator lead to T2/1, having first removed the yellow frame aerial lead from this latter point. Adjust the I.F. cores for maximum output. Having achieved this, replace the lead on point T2/1. Next, switch to the Medium waveband and inject a 200-ke/s signal into the frame aerial by placing the output lead from the generator close to the frame. Turn the pointer knob to 220 metres and adjust the trimmer C5 for maximum output. Following this, tune the generator to 500 metres and set the pointer knob to the same wavelength.

Adjust the iron core of L for maximum output. Return to 220 metres and re-tune, checking again at 500 metres. Switch to the Long waveband and tune the generator to 1,200 metres, setting the receiver pointer to correspond. Adjust the trimmer C1 for maximum output.

**Calibration using Stations**

It should be remembered here that the I.F. transformers are pre-aligned before despatch and, therefore, the cores should not be touched until a signal is received—when they may be carefully adjusted for the maximum output.

Turn the wavechanger switch to the Medium waveband position and tune in a station towards the lower end of the pointer scale, say, between 200 and 260 metres. Set the pointer to the station wavelength and adjust the trimmer C4 until the transmission is heard at the maximum strength.

Having done this, turn the pointer to the wavelength of a station received locally at good strength between 430 and 550 metres, adjusting the iron core of L until maximum strength is obtained. Next, return to the first station and adjust the trimmer C5, checking again at the higher wavelength station and readjusting the iron core of L if necessary. Repeat this procedure several times until no further signal strength improvement is possible. Turn the wavechanger switch to the Long waveband position and tune in the B.B.C. transmission on 1,500 metres. Adjust the trimmer C3 until the maximum audio output is achieved.
It should be remembered that the “Petite” is fitted with a frame aerial and, this being so, the maximum signal strength receivable from any station will only be achieved when the edge of the cabinet lid points directly at the locality of the transmitter. It follows, therefore, that the receiver should be rotated in order to obtain the maximum output from any given station.

Having completed the lining-up process, the receiver assembly may be enclosed within the cabinet, but first the batteries must be securely contained before finally placing into position the whole assembly.

Inclusion of Batteries
The correct positions of the batteries, looking into the base of the cabinet, is that the l.t. battery should be on the right with the h.t. battery on the left, the plug of the latter being placed towards the back of the cabinet.

The batteries are now secured into the cabinet with the metal clamp provided, this being fitted over the bolt in the base of the cabinet and held in position by the special nut provided for this purpose.

The receiver itself is firmly secured into the cabinet by inserting the two screws provided into the brackets fitted within the cabinet.

Conclusion
The “Petite” portable receiver is not only comparatively easy to construct, as may be gathered from the foregoing, but is also an ideal workshop project for the few remaining months of winter. Those commencing construction now will have on hand, at the ideal time, a portable receiver for the summer occasions when such a receiver will make all the difference to those family outings to the coast or countryside. To those thinking of the proverbial seasonal stocking—what better “filler” than this?

Component List—continued

Resistors
R1 470kΩ ½ watt
R2 27kΩ ½ watt
R3 33kΩ ½ watt
R4 33kΩ ½ watt
R5 2.2MΩ ½ watt
R6 10Ω ½ watt

Component List—continued

Condensers
C1 4–60pF Trimmers
C2 130pF, 2½ mica
C3 Ganged variable
C4 100pF
C5 4–60pF Trimmers
C6 100pF
C7 532pF, 2½ mica
C8 470pF, 2½ mica
C9 0.01μF, ceramic
C10 0.01μF, ceramic
C11 0.01μF, ceramic
C12 100pF
C13 0.002μF, ceramic
C14 0.001μF, ceramic
C15 100pF
C16 0.001μF, ceramic
C17 0.002μF, ceramic
C18 2μF, 150V wkg., Electrolytic

Valves
V1 DK96 (W)
V2 DF96 (X)
V3 DAF96 (Y)
V4 DL96 (Z)

Batteries
H.T.—Ever-Ready type B126 or equivalent
L.T.—Ever-Ready type AD35 or equivalent

O/P Transformer (Premier Radio Co.)
Knobs, Dials and Wavechange Switch
(Premier Radio Co.)

Lid Switch (Premier Radio Co.)

Valve Holders
Tag-strips and Battery Clamp (Premier Radio Co.)
1 IF Transformer, type 965P (M) (Premier Radio Co.)
1 IF Transformer, type 966P (N) (Premier Radio Co.)

Oscillator Coil (L) (Premier Radio Co.)
Frame Aerial Assembly (Premier Radio Co.)
Grommets, screws, etc.

Speaker, 3Ω
Cabinet, Chassis and Panel (Premier Radio Co.)

ERRATA

THE ‘MAYFAIR’ TELEVISOR
In part two of the October issue, two errors occurred, and should be noted.
R5 was given as 22kΩ in the circuit diagram and 10Ω in the Components List. 22kΩ is correct.
C2 (across R5) was not included in the Components List. The value is 10pF, as given in the circuit diagram.

NEW RADIO CLUB
A new club, to be known as the “Roch Valley Radio Club,” has been formed in Rochdale. Meetings will take place each Tuesday at 8 p.m. in the Windmill Hotel, Sudden, Rochdale. All people interested will be made welcome. For the present all enquiries to be made to D. J. Power, Esq., 2 Clement Street, Rochdale.

DECEMBER 1957
A CONSTRUCTOR VISITS THE...

UNLIKE previous such exhibitions where the accent had been on the purely amateur radio communications aspect of the hobby, this one presented a much wider scope, which was reflected in the number of exhibitors. The ultimate success of the venture is shown by the fact that the total attendance was nearly three times that of the previous Amateur Radio Exhibition.

From the outset it was apparent that the whole venture would not only strike a new note, but also bring in the current popular trend of "Do It Yourself". This was very evident from the number of stands that featured items of radio equipment in kit form; these included receivers, test gear of all kinds, transmitters, and even aerials.

Two stands were "on the air" directly from the hall, one operating on the 2-metre band and the other on various frequencies on the lower communication bands. Many contacts were made despite the fierce competition for QSO's by outside stations, all contacts being recorded on a special QSL card.

For a review of the various stands we call first at:

London HIFI Group

Many items of equipment, specifically designed for the high frequencies involved, were on show—all being built and tested by members of the group. Noted at random were a 2.500 Mc/s receiver by N. Caws, G3BVG, a 1,500 Mc/s transmitter, and a 70 cm exciter, both by A. L. M byett, G3BRW. This stand housed the 2-metre station previously referred to, the equipment for this being supplied by H. F. Smith, G2OBD, G. M. Stone, GOFJP, and A. J. Worrall, G3WPA respectively. Staffed entirely by members of the group, the station call sign varied according to the operator concerned, each using his own call sign suffixed by the necessary /A.

Royal Air Force

Of interest here, apart from the apprentices actually constructing a bands-width amateur transmitter on the stand front, was the 2-metre station complete inside a tent—the whole presentation being GIFFGA as operated during the R.S.G.B. 2-metre Field Day on 18th August this year by Mr. Seymour, GG5NS/P.

Short Wave Magazine Ltd.

On show and sale here were the latest American radio books and magazines. The Short Wave Magazine was of special interest to the S.W. enthusiast as it does all the activities of the transmitting enthusiast, including constructional and operating articles, DX Commentaries, v.f.f. news, and other items of interest.

The Minimitter Company Ltd.

This stand proved of great interest to the amateur transmitter and listener by virtue of the fact that the special equipment most suited to their needs was on display. Of these the Minimitter Amateur Band Converter was especially noted. This converter allows any receiver, capable of receiving on either 1.5 or 6 Mc/s, to operate on any of the five main amateur communication bands without alteration. A large full vision slide-rule type dial, accurately calibrated in Mc/s, is fitted. The frequency ranges are: 3.5 to 3.8 Mc/s; 7.0 to 7.3 Mc/s; 10.4 to 14.4 Mc/s; 21.0 to 27.45 Mc/s and 28.0 to 30.0 Mc/s. Valve types are a 6L5X and a 6AS8, with a contact-coupled metal rectifier supplying the required power. The "Mercury" transmitter also attracted considerable attention with its obvious eye appeal of two-tone silver/grey hammer finish, chrome handles and black panel fittings. The transmitter itself is assembled in four individual units—each being easily removable for any necessary maintenance—the method of assembly ensuring complete screening of the separate sections. The "Mercury" operates over five amateur bands, namely 3.5, 7, 14, 21 and 28 Mc/s, and can be driven from d.c. inputs of up to 150 watts which can either be 100% amplitude or narrow band f.m. modulated, for telephony working.

E. J. Philpott's (Metalworks)

L. Philpott, QH8, has for many years specialised in making cabinets, chassis, racks and panel assemblies, and sheet metalwork of all types and descriptions, both to individual requirements, and as standard stock lines. The company will, as a service to constructors, drill all metalwork to specification and return complete with hammering finish in the required colour. Alternatively, a chassis drilled by the constructor himself may be forwarded for treatment in the desired finish. Those requiring further details and the illustrated brochure should write to Chapman Street, Longborough.

Standard Telephones & Cables Ltd. (Brimar)

Several items of interest here caught the writer's eye. Among these was the new Brimar 2DP High Quality Amplifier having 25 watts maximum output at 0.1% distortion using an ultra-linear push-pull output stage. Another item of great interest to the hi-fi fan was the Brimar Quality amplifier designed and constructed by W. J. Thompson, A.R.I.E.E., full details of which will be commenced in The Radio Constructor for February. Also on show were the new 90W t.v. tubes CT78M and C215M, together with a range of 70W types, all with electrostatic focus. A range of car radio valves, operating from a 12-volt h.t. line directly from the car battery, were also displayed, these being the types 12A6C, 12AD6, 12A5E and the 12K5. The well-known Brimar semi-conductor devices such as transistors, Brimindors and germanium diodes were also to be seen.

E.M.I. Industries Ltd.

This Institute, famous for its popular complete practical home training courses in radio, television and electronics, provided an interesting display of equipment, which the student builds and studies at home. Of special interest was the tape recorder type CPR/1 which incorporates a hi-fi amplifier, and a 34 m.w.t.f. receiver. A signal and pattern generator, a miniature oscilloscope and a four-valve t.f.f. receiver were also to be seen. All these items of equipment are retained by the student as his own property once these have been constructed side by side with the theoretical instruction.

Amateur T.V.

This provided much general interest—particularly as live interviews, etc., were going on almost the whole of the time. A mass of L.V. transmitting equipment was on display, including an image orthicon camera control unit by G3KOK/T, and a photionics camera control unit by G2WJT, both of the cameras also being constructed by the same amateurs respectively. Other items of equipment to be seen were two camera scanners, a test card "C" monoscope camera and test pattern generators.

K.W. Electronics Ltd.

This firm, now famous for its GSKW Multiband Trap Amplifier, has a varied selection of equipment both for the amateur radio enthusiast and for the home constructor generally. Also on show was the portable record player kit, this being battery operated and complete with a 45 r.p.m. turntable, pickup arm, and all parts for constructing the amplifier. The price, continued on page 347
The Cooper-Smith TYPE BPI HIGH FIDELITY AMPLIFIER

Part 1 by J. COOPER

TECHNICAL DETAILS

Main Amplifier
Output 10 watts rated, 12 watts peak.
Total Distortion better than 0.15% at 10 watts.
Frequency Response within 1 db 20-25,000 c/s.
Noise and Hum 10 db below rated output.
Output Stage “Class A” ultra-linear.
Negative Feedback 18 db.
Output Impedances 2-3 and 12-15 ohms.
Circuitry: new all push-pull circuit ensuring perfect balance over audible frequency range and beyond.

THE OBJECT OF AN AMPLIFIER IS TO magnify certain electrical impulses. Any alteration to the form of the impulses during this process is known as distortion, and a “high fidelity” amplifier can only be so described when the output is the same “shape” as the input, but much greater. This is achieved in “hi-fi” amplifiers in various ways and with varying success. In the Cooper-Smith it is achieved with the greatest success by a process known as “balanced phase inversion,” and by the employment of the special components that this involves. It may fairly be described, in fact, as a precision instrument. This is how it works.

The impulses are fed via a pre-amplifier (to be described later) into V1 (see Fig. 1). This valve, a 12AU7 triode, is actually two valves and is shown thus in the diagram. Now for push-pull operation it is necessary that the signal applied to each half of the output stage (V3 and V4) be equal but opposite, i.e. 180 degrees out of phase, so that when one grid is driven positive the other is “going negative.” In this way the work is shared, resulting in approximately double the amount of power output and less distortion. To do this some means must be found of converting the incoming signal to two “out-of-phase” impulses. This function is known as “phase inversion” and is performed by V1 in conjunction with V2, which is also two valves in one (12AX7, high impedance twin triode). It will be obvious that the impulses must be perfectly balanced, and this condition has never been achieved hitherto except by the use of a very costly transformer, although many circuits using valves have been tried which resulted in unbalance at some point in the audio spectrum, usually in the higher frequencies.

The phase inversion circuit used in this amplifier, which is much too complicated to explain here, was developed in the U.S.A. for use in medical apparatus where perfect balance was essential at all frequencies from the extremely low up to around 1 Mc/s. This accounts for the low percentage of distortion (0.15% at 10 watts) of this amplifier.

To ensure perfect balance, VR1 is incorporated. When the two grids of V1 are connected together by S1 the valves are in phase and should cancel out, and adjustment of VR1 to lowest volume achieves this condition. When S1 is returned to normal position the valves are balanced and functioning correctly.

High stability resistors are used throughout to prevent drift off balance (though much more expensive than ordinary ones), and the reason for the use of matched pairs will be obvious. Another factor in eliminating distortion is the use of direct coupling between V1 and V2, which reduces phase drift to a minimum. The stage gain here is approximately 25.

The amplified signal, which is adequate to provide the necessary 10 volts grid swing, is now fed by resistance-capacity coupling to the output valves V3 and V4 (EL84 pentodes) which are, of course, also in push-pull. The feature of this stage is that it is “ultra-linear.” Pentode valves have a very high efficiency but are liable to “peaking,” an annoying form of distortion which is eliminated in this circuit by feeding the screen grids from taps in the primary of the output transformer instead of directly from the h.t. line. This gives the valves the low distortion qualities of triodes, while retaining the efficiency of pentodes.

The output transformer, which is the most important single component in the amplifier, is specially made, as are the power transformer and choke, by Electro-Voice Ltd., a firm well known in the scientific world, and is of the highest standard. It has a high primary inductance, giving full bass response, and the low leakage inductance necessary to prevent the loss of high frequency signals and to ensure that the large amount of feedback used in this amplifier does not cause instability.

Negative feedback is obtained by feeding the signal back from the secondary through R4 to the cathode of V1. This has the effect of leveling the frequency response and reducing hum and noise. Introduction of negative feedback into an amplifier necessitates a higher overall gain than would otherwise be the case, to compensate for the reduction in gain that it entails. The resulting flat response, however, makes this well worth while.

Three-quarter front view of main amplifier unit

This completes our description of the main amplifier, which, although complete in itself, still needs some form of control; this is provided by the pre-amplifier, which is to be described later. The pre-amplifier could have been incorporated in the main amplifier, but is housed in a separate screened unit to enable it to be placed in the most convenient position in the cabinet, only two plug-in cables being required to connect the two units. (The main amplifier is designed to give...
easy access to all connections, controls, etc., from one side only.)

Now a few words of warning. Don't expect 100% "exactness." An amplifier, no matter how good it is, is only a link in a chain:

Performer — Studio — Microphone —
Transmitter — Atmospheric conditions —
Receiver — AMPLIFIER — Loudspeaker —
Listening room — Your ear.

or

Performer — Studio — Recording Apparatus —
Original Recording — Record Factory —
AMPLIFIER — Loudspeaker — Listening Room — Your ear.

And in the same way as the strength of a chain is that of its weakest link, so the exactness of the reproduction is only as good as that of the worst factor above — and none of these is perfect. For example, although f.m. can provide distortionless and interference-free reception with a wide frequency range, if the broadcast consists (and it very often does) of a poor recording of a good performance the results you hear won't be any better than if you had a poor amplifier (it will probably sound worse, as you may be able to hear the faults better). Similarly, it's no use feeding this amplifier from a poor pickup or into a poor loudspeaker. However, your amplifier will be above reproach... other things can be improved later — at least, those you are able to control.
Whilst on the subject of records, we'd better mention "surface noises." When you hear your favourite records on hi-fi apparatus for the first time you will probably hear things on them that you've never heard before, such as the "ting" of the triangle or even the soloist's breathing; this is because you are hearing the higher frequencies for the first time. Now as far as the recorded noises, the needle will register the noise of its own passage over the surface, which also contains high frequencies, and you are going to hear it as well; you can't have one without the other, and you've got to decide how much needle hiss you are going to put up with. You will find that some makes of records has more than others, that dust can be heard as well as seen, and that records which have been played with a steel needle are ruined.

If your radio unit is for the reception of a.m. (amplitude modulation) it will be of the r.f. (straight) type or the superhet variety. If the former, many whispers and other extraneous noises will be reproduced by this amplifier that would not be heard on an ordinary one, and while the latter cuts out most of these, it does so at the expense of the higher and lower frequencies. If you are fortunate enough to be within the range of the B.B.C. f.m. (frequency modulation) broadcasts, however, you can obtain superb reproduction and the drawbacks are few.

To be continued

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**Autumn Audio Fair 1957**

It was your correspondent's first visit to Harrogate, the venue of the First Northern Audio Fair from the 25th to 27th October, and it seems likely that the same might apply to many of the visitors to the Grand Hotel. Reliable reports indicate that contacts were made with enthusiasts from as far afield as Coventry and Birmingham in the south, Carlisle and Newcastle in the north. Enthusiastic also were the organisers, who were able to report a total of 18,000 visitors by the end of the show.

In spite of the attendance, the wide corridors allowed easy access to the various demonstration rooms, even if it was impossible to get into them! As "one of the crowd," it was noted that quite apart from the ready assistance available from the thirty-two exhibitors, the organising committee were to be congratulated on the excellent staffing and other arrangements together with the attractive and comprehensive catalogue.

There can be no doubt that the cult of "Hi-Fi" has caught the public imagination, and in consequence it is pleasing to see a new range of equipment being established. Such equipment (should one call it "Mid-Fi") while not of the very highest quality in terms of performance, will, nevertheless, give good results and for a modest outlay. It must be stressed that examination showed no deterioration in the quality of the workmanship and materials used. This, surely, will be the future trend. While there will always be a demand for the best, the layman is becoming audio-minded, and he will require reasonably priced apparatus which need not be superfluous in performance.

A leaflet from the Dulci stand modestly describes the H4PP as a radiogram chassis, but it is actually a useful combination of a.m./f.m. radio with a 6 watt push-pull amplifier operating under distributed load conditions. Independent bass and treble controls are provided, and there is provision for tape record and replay and disc reproduction. The frequency response is claimed to be 40 to 18,000 c/s ±1 db. Under £30.

The Pye "Mozart" amplifier has full controls and measures only 10jin x 3jin x 5in, yet is said to have an undistorted output of 10 watts from a single E134. A 12 watt speaker, designed to fit on a bookcase, would seem to be a worthy companion. 41 gns. for the pair.

E.A.R. offer the "Triple-Four" ultra linear amplifier at 11 gns. This unit gives 6 watts output, with bass and treble controls, and has a frequency response within 1 db from 50 c/s to 15 kcs. Again of small size, the "Triple-Four" does, however, require external power supplies.

The writer was then prompted to look for a suitable record player, and saw the Garrard TA/Mark II. This is a four-speed single record player which, though not claimed to be a transcription unit, gives the impression that it would serve its owner well. £9 15s. 8d. including tax.

While it is impossible to mention more than a few of the interesting products displayed, space must be found for a note on the Trix "Everman" system which is comprised of two units. The one contains a 6 watt amplifier and Garrard turntable, the other is a three-speaker reproduction of convenient size. Trix are renowned for the attractive styling of their products and the "Everman" is no exception. A visit to the demonstration room showed that the performance is equally pleasing.

It was hoped to pass comment on the Connoisseur system of stereophonic sound on disc, but on the three separate occasions that their demonstration room was visited, too many other visitors had the same idea!

There can be no denying that Audio Fairs are here to stay, providing as they do a unique opportunity both to hear the best in audio equipment under favourable conditions and to meet the technical brains of the various manufacturers.
Can Anyone Help?

B. Blackburn, 30 Greenlea Avenue, Westfield, Yeading, Leds., urgently requires the manual of the T1154/R1155 combination. Please state price required.

H. V. McEvoy, 90 Bueril Avenue, Rochdale, Lancs., asks if anyone can supply details of the power pack and/or any other data of the Admiralty receiver type 354G, Admy. Pat. No. 561. Any responses kindly met.

R. Pollock, 32 Worley Drive, Bradford Moor, Yorkshire, is in need of the service sheet for the 38 Walkie-Talkie, and would like lists of other service sheets available.

J. M. Aspinkall, 97 Mayfield Road, Dagenham, Essex, would be grateful for the loan of the manual and/or circuit of the R.C.A. Aircraft Receiver AVR-20.

K. B. Levitt, 55 Old Winton Road, Andover, Hants, wishes to know if any reader can advise on any improvements to the output stage of the R.109 Set, or any other modifications.

Peter Shore, c/o P.O. Box 6226, Johannes- burg, South Africa, asks if anyone can help him get a comprehensive book or reprint from a magazine covering modifications and improvements to the R.1155 and RF24, RF26 Units.

W. Marcham, 12 Harcourt Close, Linsdale, Leighton Buzzard, Beds., would like to beg, borrow or buy the circuit diagram of a tape recorder made by Audigraph Ltd. (Tamms Products); valve line-up: Recorder, A.F. Amp. into 6SC7/Playback, A.F. Pen into 6J5. All letters answered.

P. Wright, 111 Yew Tree Road, Birchen- cliffe, Huddersfield, W. Yorks, will gladly for the service manual, circuit and/or any other information on the Edystone 358X receiver. He would also appreciate advice on where to get a faulty coil repaired, and is also searching for information on the R.109.

H. Groves, 28 Elmwood Road, Chiswick, London, W.4, telephone CHI 6040, is in need of information on an Infra Red Telescope. Expenses paid.

J. Long, 254 Princes Avenue, Kingsbury, London, N.W.9, would like to purchase the service manual for the Eckovision TV model TSC.113.

Can Anyone Help?

N. A. B. Plumb, 43 Gashworthy Square, Whipton, Exeter, teleph. Exeter 67969, wishes to purchase or borrow an instruction manual, also a circuit, of the AVO Valve Tester with Separate Base Unit.

W. Winter, 10 Siding Street, Stacksteads, Bacup, Lancs, is seeking, and is willing to pay for, information, circuit, manual, etc., on the Admiralty receiver G.C23 Marconi 1945.

G. H. K. Mitchell, 22 Landale Road, Peterhead, Aberdeenshire, wishes to purchase a copy of "Building and Operating the Sound Master Tape Recorder."

P. Bedwell, 61 Banbury Road, Stratford-on- Avon, Warwick, wishes to purchase information on the Receiver Unit type 6A (10P/13014).

N. Hales, G2DTO, 165 Longley Road, Tooting, London, S.W.17, seeks information on the ex-R.N. receiver R185, 28-85 Mc/s, believed i.f. 5.25 Mc/s. Can anyone help?

DB9 Radio Control for Model Ships, Boats and Aircraft

By F. C. Judd, G2BCX

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Cloth bound edition 11/6 postage 8d.

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By Raymond P. Stock

The only book dealing solely with this important part of radio control

Price 4/6 postage 4d.

DECEMBER 1957
AN INEXPENSIVE IMPEDANCE COMPARATOR

by S. LOUGHLIN

The determination of values of resistance, capacitance and inductance is generally thought to be an expensive business, involving direct-reading instruments well beyond the average enthusiast's junk box or pocket. Here's one way round the problem—an extremely simple and inexpensive little instrument which will measure the impedance of any component at a known frequency directly in ohms. Using this figure, conversion (when required) to values of capacitance or inductance is an easy matter by means of a cheap set of ABAC tables. This instrument requires very little calibration, is compact and economical of components, and you will soon find it indispensable in your shack or workshop. (Particularly if, like the writer, you take an insane pride in the use of "unknown" ex-W.D. components!)

Uses
The instrument performs the following functions:
1. The direct measurement of unknown resistors.
2. The direct measurement of the impedance of any component at any audio frequency.
3. The indirect measurement (via ABAC tables) of unknown capacitors and inductors.
4. The indirect measurement of unknown frequencies in the audio range.

In addition, the instrument has proved particularly useful for the creation of resonant conditions in the audio range.

Principle of Operation
The circuit of the instrument (less power supplies) is shown in Fig. 1. In all essentials it is balanced about the earth-line and closely resembles a pair of valve voltmeters working in opposition. Unbalance between the two halves of the circuit is shown on the centre-reading meter, M1, connected between the anodes of V2a and V2b.

In operation the instrument is first balanced with toggle-switch S2 at "normal" (shorting points A and B). Adjustment of R8 then corrects any discrepancies in components or valve parameters between the two networks.

A component of unknown value is connected between the X terminals, and a known input frequency (50 cycles) injected into the comparator networks by means of the low-impedance transformer T1. R1 is then adjusted until a centre-reading on M1 is obtained with toggle switch S2 depressed. The comparator circuits will then be balanced, and the voltages developed across R1 and the unknown will be equal. This means that the impedance of the unknown at 50 cycles must be equal to R1, and can, therefore, be read off from the instrument. If the unknown is a resistor this will be its value in ohms; if it is a capacitor or an inductor, the reading from the comparator will require conversion on ABAC tables.

Circuit in Detail
A d.p.d.t. switch allows the selection of a 50 cycles frequency at 6.3V from the heater line, or of any unknown frequency where this has to be measured. Input to the comparator is by way of T1, a 1:1 ratio low-impedance transformer, for application to the calibrated resistance R1 and any unknown component connected between the X terminals. R1 is a current limiter which prevents damage when the component to be tested is of very low impedance.

The alternating voltages appearing at points A and B are rectified by the two diodes V4a and V4b, and the negative-going d.c. voltages developed across the load resistors R3 and R4 are applied to the grids of V2a and V2b. C1 and C3 short to earth any ripple frequencies reaching the grids through the stoppers R2 and R5, and also maintain a small negative charge on the grids. C1 and C3 complete the diode networks by isolating the d.c. voltages from the comparator input.

In the anode circuits of V2a and V2b, R5 and R6 are the triode loads, and R8 the balancing potentiometer. R11 protects M1 from overload before approximate balance is achieved, and S4 cuts R11 out of circuit for final balancing.

Component Values and Tolerances
Owing to the pre-balancing procedure allowed by R8, no great accuracy of components is required beyond adhering to the general values specified. The use of resistors of the normal ±10% range will be found adequate.

M1 is ideally a centre zero 0.5-0.5mA meter, but in the prototype a straight 1mA meter was used. The needle was adjusted to rest at the centre of the scale, and the magnetic shunt (a small piece of iron across the polepieces) removed to increase sensitivity. Whatever meter is used, a smooth but "lively" action is essential.

For power supplies, any pack which will deliver 240-280V d.c. at 20mA and 6.3V at 0.9A is suitable; a lower value of h.t. could probably be tolerated if necessary.

Construction
Almost any handy chassis can be used, as layout is not very critical, but it is a good plan to screen the upper from the lower half of the circuit. In the original model a slight tendency to instability was cured by mounting M1 in a separate wooden case and running a...
length of twin screened cable to an output jack on the chassis. All the switches and terminals are brought out to a front panel on the box housing the comparator chassis.

**Calibration**

The accuracy of the instrument depends on the calibration of R₁. This resistor can either be a known resistor of 50 kΩ total resistance or a standard non-reactive potentiometer of the same value with a dial and pointer fitted. The potentiometer should be calibrated with a resistance decade borrowed for the purpose.

A link has been included in the circuit in series with R₁ to allow for the inclusion of a known "ballast" resistor to maintain the terminals of impedances higher than 50 kΩ, if necessary.

**Voltage to the comparator—6 V must be**

**The reading (in ohms) obtained from R₁**

As a current of 6 V must be therefore, a small a.c. voltmeter was added to the unit (Fig. 2). With a 5 kΩ resistor as shown, 6.3 V caused a 1 mA meter in the comparator, the meter to move 1 [3/4] of its scale. Any similar arrangement could be made up quite quickly and checked against the meter line of the comparator.

**Table 1**

<table>
<thead>
<tr>
<th>L (Henrys)</th>
<th>ohms</th>
<th>C (μF)</th>
<th>ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001</td>
<td>3.142</td>
<td>0.001</td>
<td>3.144</td>
</tr>
<tr>
<td>0.01</td>
<td>3.142</td>
<td>0.1</td>
<td>318,400</td>
</tr>
<tr>
<td>0.1</td>
<td>3.142</td>
<td>1.0</td>
<td>318.4</td>
</tr>
<tr>
<td>1.0</td>
<td>3.142</td>
<td>10.0</td>
<td>318.4</td>
</tr>
<tr>
<td>10.0</td>
<td>314.2</td>
<td>100.0</td>
<td>318.4</td>
</tr>
<tr>
<td>1,000</td>
<td>3142</td>
<td>1,000</td>
<td>318.4</td>
</tr>
</tbody>
</table>

**Operation**

1. **To measure the value of an unknown resistance**

When warming up, the instrument is first roughly balanced with S₁ open and toggle switch S₂ in its normal position shorting points A and B. When adjustment of R₁ is made, a nearly central reading on M₁, close S₄ and trim again for exact balance.

Open S₄ and connect the resistance to be measured between the X terminals. Inject 50 cycles via S₁ and T₁, and ascertain, by depressing S₂ for short periods, when successive adjustments of R₁ have brought the whole circuit into balance. S₄ can now be opened and R₁ used to trim for final balance. M₁ is kept in position 1, which remains steady whether S₂ is depressed or not.

The setting of R₁ will now correspond exactly with the value of the unknown resistance, and this value can be read off directly from R₁.

2. **To measure the value of an unknown capacitance**

Balance valve network exactly as in (1). Open S₄ and connect capacitor to the X terminals. Inject 50 cycles and balance as in (1).

The reading (in ohms) obtained from R₁ will be equal to the impedance of the capacitor at 50 cycles. Now read off value of capacitor (in microfarads) from a set of ABAC tables.

3. **To measure the value of an unknown inductance**

Follow standard procedure as above, and read off value of R₁ (in ohms). The measurement of an inductance is complicated by its d-c resistance, and this must now be determined by a quick test with a battery and meter. A 1.5 V cell and a millimeter reading up to about 200 mV would do all that is required here.

When both the impedance and the d-c resistance are known, the inductance in henrys is found by the following formula:

\[ L = \frac{Z^2}{2\pi f} \]

where \( Z \) is the impedance in ohms, and \( R \) is the d-c resistance in ohms. The term \( 2\pi f = 314.2 \) at 50 cycles, the frequency used in this comparator.

4. **To measure an unknown audio frequency**

This is accomplished by reference to a capacitor connected between the X terminals. In order to obtain a close-tolerance component, the impedance at 50 cycles of any capacitor of convenient value, say 0.1 μF, is measured in the normal way on the comparator. S₄ is then selected to select the unknown frequency, and a second reading on R₁ obtained. Use of a simple formula will now give the required frequency value:

\[ f = \frac{Z_2}{Z_1} \times 50 \text{ c/s} \]

Care must be taken when measuring external frequencies not to apply too high a

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**1957 RADIO HOBBIEST EXHIBITION**

From page 335

Eddystone Communication receivers, formed an attractive stand here. The B.B.C. children's 1-valve receiver was well laid out on a cocktail cabinet and this, together with the range of Eddystone components, formed an interesting counter show.

**Mullard**

Apart from a large range of valves and t.v. tubes, several items of equipment, capable of being easily constructed by the home hobbyist, and sponsored by the Mullard design laboratories, were on view. The new 3-valve 5 watt and the 5-valve 5 watt amplifiers, together with a 7 watt a.c.-d.c. unit, were to be shown. A direct coupled 25 watt amplifier, a 4-channel audio mixer unit, an f.m. tuner unit, and a 2-valve pre-amp for the 5-valve 20 watt amplifier.

Taylor Electrical Instruments Ltd.

Of more interest were the Radio and T.V. Signal Generator Model 6A1-100 khz to 220 Mhz on fundamentals; a Sweep Generator Model 92A; an f.m. Oscillator Model 191A, for transformer, and tester and speaker response tests; and a Portable Multi-Range Tester 77A.

**Radio Society of Great Britain**

The centre of attraction here was the "live" amateur radio station GB3K/SA, which, at the time the writer was present, was busy making contacts with various amateurs. The Hallamites SX26A receiver performing extremely well. A large selection of home constructed and designed equipment of all kinds and types were to be seen displayed on the various stands. An Electronic Log, "Keyerry", G3JK; the winning N.F.O. transmitter "The Marlow", G3XDF, and the winning "Occam", G3CRM, were on show.

**Edizone Radios Ltd.**

Many kits offered by this company to the home constructor were well displayed and working for demonstration purposes. The 3-watt amplifier, a most compact unit, appeared to be well made, and not being constructed by the kit beginner, was of singular interest. The "Rambler", portable receiver, a pleasantly quiet performer capable of receiving records of several types—both "straight" and superhet, a "Memory" and a "Mimeograph", the latter a "memory" and a "Wave" Converter—in fact, it was the prototype that was on view—the being the only one in existence at the present time.
BUILDING A...

FREQUENCY
METER

Test Gear for the Tape Recording and
Hi-Fi Constructor—Introduction and Uses

by H. GARLICK

TO THE A.F. ENTHUSIAST, PARTICULARLY
the reader designing his own tape
recording equipment, a frequency meter
is an invaluable piece of test gear. Simple to
construct and foolproof in use, it provides a
very reliable direct reading of any single
frequency that it is monitoring.

Meters are available on the market which
read frequency without any associated
electronic circuitry, but their usual range is
very restricted, and in fact instrument manu-
facturers generally confine the scale reading
to power frequencies. The instrument about
to be described, however, is capable of read-
ing frequencies in the band 0 to 10 kc/s in
three ranges. By an extension of the same
principles given below, a frequency meter can
be designed to cover any required band of
frequencies.

Using such a meter when checking tape
recorder amplifier characteristics makes the
performance analysis an extremely simple
task.

A test recording would be made, using
either a gliding tone frequency test record, or
the output from an audio oscillator; and on
playback, the tape amplifier output would be
connected both to an output meter and the
frequency meter as well as the usual loud-
speaker. Changes in output level would then
be identified immediately with the
frequency at which they occur, providing a
direct and straightforward assessment of the
gear's performance.

The frequency meter may also be used with
the home constructed audio signal generator
as an absolutely reliable calibrating device.
So often the biggest difficulty encountered in
this type of oscillator is an accurate means of
calibrating the output frequencies of the instru-
ment—a difficulty solved with the aid of the
frequency meter.

Using the technique outlined for tape
recorder amplifier analysis, the frequency
meter becomes a "must" as an item of test
equipment for the hi-fi amplifier constructor.

Principle of Operation

Fig. 1 shows a pulse train that might be
generated typically by a conventional multi-
vibrator. In such a circuit the pulse duration
t in the figure could be, for example, 100 μsec
and the interval between pulses T might be
1,000 μsec. The ratio of these times t/T is
known as the mark-space ratio, and such a
pulse ratio would indicate that current was
being drawn by one part of the circuit for
1/10th of the time that the circuit was
quiescent. In other words, the average
current drawn would be 1/11th of the peak
pulse current. The dotted line in Fig. 1
indicates approximately to scale the average
current for the current pulse shown.

This effect may be easily produced with the
simple meter and battery circuit shown in
Fig. 2. When the switch S is closed con-
tinuously the meter will indicate current,
determined by the battery volts E and the
resistance R. If, for example, the battery
c.m.f. were 10V and the resistance 100 ohms,
the meter would indicate a current of 100 mA.
If now the switch is opened and closed at a
rate too fast for the meter to follow, the
reading will fall from 100 mA to some value
determined by the on/off, or mark/space,
ratio of the circuit. If, for example, the
switch is rapidly made and broken, so that
on the average over a period it is closed for
only half the time, then the current reading
will fall to 50 mA. This is because the inertia
of the meter movement prevents the needle
from following the rapid fluctuations of
current and hence it indicates only the
average current flowing.

It is this same simple principle which
enables us to use the conventional moving
coil meter to monitor frequencies in the
circuit described in this article.

Referring again to Fig. 1, it should be
obvious that if twice the number of pulses of
the same duration t, as already shown, were
to occur in the same period of time, then the
average value of current would be doubled.
The Multivibrator

Most readers will be familiar with the basic multivibrator circuit shown in Fig. 5, the outline of whose operation is given below.

Here again the two valves, V1 and V2, share a common cathode load and the biases of their respective grids arrange that only one valve at a time can conduct. Because the grid leak R at V2 grid is returned to the h.t. rail, then V2 will be the valve which conducts (the value of R is generally sufficient to prevent excessive grid current flowing), while the circuit remains untriggered. The application of a positive-going trigger pulse at V1 grid or a negative-going trigger pulse at V1 anode will result in an instantaneous drop in potential at V2 grid due to the grid coupling and V2 grid. This will result in a fall in cathode potential and V1 will now be able to conduct due to the reduction in its grid bias. This in turn causes a drop in voltage at V1 anode and hence a still further drop at V2 grid. In fact, when V1 conducts due to this transitional trigger voltage, as in the Schmitt Trigger Circuit, the regenerative action thus initiated results in V2 being cut off, allowing V1 to conduct. The period of the latter's conduction, however, is restricted by the time taken for charge to be dissipated from the anode load. The waveform of the voltage appearing at V2 grid, as shown in Fig. 6, shows that the grid is forced instantaneously from a potential V2 by an amount equal to the converged drop at V1 anode (say V1 volts) to a potential V2 - V1 volts, which is considerably negative with respect to the new cathode potential, V1.

The potential at V2 grid starts to rise towards the h.t. potential, as condenser C discharges through resistor R and V2 grid, therefore, rises at a rate determined by the time constant CR. When this grid potential has risen to within a few volts of V2, V2 is once again able to conduct, momentarily increasing the total cathode current. The consequent increase in cathode potential and hence increase in bias on V1 reduces the anode current of the latter, and V1 anode voltage instantaneously rises, lifting V2 grid voltage at the same time. Once again, therefore, the action is regenerative and V2 is returned to its original conducting condition.

Nothing further will happen until another trigger pulse occurs.

The lower waveform in Fig. 6 shows the pulse appearing at V2 anode and its time relation is indicated with respect to the grid waveform. The duration of this pulse clearly is fixed by the time constant CR and the voltages appearing in the circuit, and will, therefore, be independent of the rate at which the circuit is triggered, provided that the latter is never more frequent than the width of the pulse will allow. The voltage pulse at
V₃ anode appears only while V₁ draws current, and hence the current waveform in V₁ is of exactly the same duration as the voltage pulse illustrated at V₂ anode. If, therefore, a meter connected with the anode lead of V₁, this meter will read the average current drawn by V₁, which in turn is determined only by the rate at which the anode of V₂ is charged by the 100 μsec period of the pulse duration is constant. In other words, the meter reading will be proportional to the frequency of the triggering source.

From this simplified circuit description, therefore, we can see how the principles outlined in the opening paragraphs can be applied to the design of quite a simple frequency meter. Certain refinements are incorporated in the final circuit to provide more reliable operation as the circuit of Fig. 7 shows. These are discussed later.

**Meter Range Restrictions**

A reasonably sized meter will have a scale which can be read with reasonable accuracy down to 1/100th of full scale deflection. To be of any practical use, the frequency meter—to cover the audio range at least—must read from 0 to 10 kc/s, a range of 2,000 to 1, and hence it is impossible to use the meter directly to count the triggers; the range must be covered in a series of readable steps. This is achieved in much the same way as a multi-range ammeter is constructed, using shunt resistors to scale the range as required. This procedure will result if the anticipated range is covered in three steps, viz. 0-100 c/s, 0-1,000 c/s and 0-10 kc/s. This poses the problem of selecting a suitable scale current for each range, one which, in fact, is quite simply accomplished and is described below. In addition, a basic calibration against some standard and readily available frequency must be effected from which all ranges can be calibrated. The mains supply is the obvious source of a reliable frequency standard, and a simple means of calibrating the meter on one range against the mains frequency is incorporated in this design. The calibration, once set, then covered permanently.

To avoid circuit complications, the duration of the pulse produced by the multivibrator is maintained constant over the entire frequency range. This has been done by changing its value with each range that the circuit reads. Now at 10 kc/s the interval between pulses is 100 μsec, and, therefore, the longest pulse that can be obtained is somewhat less than this duration—say 90 μsec. In this instance, this will result in a mark/space ratio of 9:1 or 10% duty cycle. This is the left-hand multivibrator valve (V₁ in Fig. 7) for 90 of the 100 μsec period of the pulses. Because the meter connected in this anode circuit responds to the average current drawn, it will read only 9/10 of the anode current flowing in V₁ when the latter conducts. This, then, is the condition for the maximum frequency reading that the meter must indicate, and the deflection produced will be adjusted to give a full scale reading corresponding to 10 kc/s.

Covering the minimum frequency range, the meter must produce a full scale deflection for an input of 100 c/s at full scale deflection (10 c/s). This period of the pulses is very long—namely 10,000 μsec, and yet the pulse duration will still be only 90 μsec or so. In this instance, the average current flow of the meter would be 90,000/100,000 of the current drawn by V₁ when it conducts. Some idea of the sensitivity required for the meter movement can be gained by this method. It was realized that this average current must produce a full scale deflection corresponding to 100 c/s. If V₁ draws a total current of 11μA when it conducts, then for the meter to read full scale at 100 c/s, it will be drawing an average current of 90/110,000 of 11μA, which is approximately 1 μA. This determines the type of instrument to be used.

Reverting to the highest frequency scale, it was seen that the meter would indicate 9/10 of the anode current drawn which, from the above, will be about 10μA. Obviously, both to protect the meter and to enable such frequencies to be interpreted, the meter will have to be shunted out. The same procedure is also necessary on the middle range covering 0-1,000 c/s when, at full scale, the average current in the meter circuit would be approximately 1μA.

**Setting up the Meter**

The appropriate shunts are adjusted prior to assembling the meter in the unit, and Fig. 8 shows the details of the circuitry ready for setting up. The 1kΩ resistor in series with the meter is the same resistor which is wired in the anode circuit. The two variable resistors which allow the case to be carefully adjusted so as to give a correct calibration are also wired in the final arrangement after adjustment described below. If the controls are removed from surplus equipment and are available with locking devices, then the controls, once set, should be securely locked to prevent any subsequent movement which would result in scale errors.

Connect the shunts to the meter via the rotary-range-shifting switch S₁ as shown in Fig. 8 and connect to the 15kΩ variable resistor VR₁: this switch S₁ and VR₁, which should, of course, be open. VR₁ is only required for setting-up purposes, and can be greater than 15kΩ should the latter value not be available in the constructor's kit. If a larger value is used the control is more coarse in operation and a little more care is required of the operator.

Controls VR₂ and VR₃ need not necessarily be those specified either; suitable values may lie in the ranges 150 to 500 ohms and 15 to 30 ohms for the respective controls, should it be more convenient to choose other values.

Having set up the circuit of Fig. 8, make sure that all the resistance of VR₁ is in circuit, and with switch S₂ at position 1, close switch S₁. The meter will then read nearly 100μA (full scale). With S₁ open and with S₁ closed, the meter will be fully deflected to read 100μA. Open switch S₁, and switch S₂ to position 2. Now finally adjust VR₁ until the meter reads exactly 10μA. The accuracy of the meter readings will subsequently depend on the care with which this is done; if any great pains are taken, it can be realized that this average current must produce a full scale deflection corresponding to 100 c/s.

If VR₁ draws a total current of 1μA when it conducts, then for the meter to read full scale at 100 c/s, it will be drawing an average current of 90/110,000 of 11μA, which is approximately 1 μA. This determines the type of instrument to be used.

Oscilloscope Monitoring Points

Two optional sockets are shown on the diagram of Fig. 7—namely SK₁ and SK₂. These have been included for the benefit of those readers possessing an oscilloscope. The output from SK₂ is a differentiated pulse suitable for triggering or synchronizing the average scope timebase, while the second SK₁ provides an output pulse representative of the current pulse which operates the meter, and thereby provides a means of checking the operation of the frequency meter. A pair of phones connected across this point and earth will give an audible indication of satisfactory circuit operation.

Neither of these outputs is really essential, and can, therefore, easily be omitted. If this is done, then C₂ and C₃ can be removed, with Ri₄, which for a direct connection to the ht. rail of 300V must be substituted.

**Wiring the Circuit**

The circuit should be laid out so that the output is kept clear of the input. Although this is the case, and may be taken with the arrangement of the components about the appropriate valve bases, and a layout that involves leads from valve base to a component on a tag board should definitely be avoided. The comp-
ponents are for the most part of such a size to permit direct connection to the pins on the valve bases, a practice it is best to follow. All the controls and sockets should be mounted in an accessible place on the front panel, except the power controls VR3 and VR4, which once having been adjusted in the initial setting-up phase should require no further attention.

No power supply has been shown in the circuit diagram, but the instrument will obviously be far more versatile if the h.t. and l.t. is available as a built-in feature. Quite a straightforward circuit, providing 300V at about 30mA h.t., and 6.3V at 1.2A l.t. will be adequate, while smoothing on the h.t. line need not be elaborate. A typical circuit is shown in Fig. 9.

Initial Checking

When the wiring is complete, plug in the valves, and connect a pair of high resistance phones via an isolating condenser (C5 if this has not been omitted) across the load R15. Switch on and leave the circuit for 10 minutes to warm up. During this time, and subsequently, nothing should be heard in the phones except the faint hum provided that nothing is connected to the input socket SK1. Furthermore, the meter should read zero on all three ranges. Now with VR1 at minimum voltage, and rotary switch S2 in position 1, which is the 0–100 c/s range, press the push-button. In the "normally-closed" position, the contacts on this push-button connect the input socket to C1, thereby passing any incoming signal to V1. However, when the button is pushed, the 6.3V heater supply is connected in circuit, thereby injecting 50 c/s to the grid of V1. This signal should trigger the multivibrator and consequently cause the meter to indicate some value. Set this deflection to the "50 c/s" reading by adjusting VR4, which controls the current drawn by the meter.

This extremely simple operation is all that is required to calibrate the meter on all ranges, once the preliminary setting-up of the meter counts has been completed. It is advisable to check the calibration from time to time as the instrument warms up, since local heating can cause the timing of the multivibrator to contract. For this reason the "calib" and "set 50 c/s" controls should be mounted on the front panel. In this respect it is advisable to take care in the positioning of the timing components C5 and R15, ensuring that they are kept clear of any "hot spots" on the chassis.

To test the frequency coverage of the circuit, either an audio oscillator or frequency test record and associated amplifier will be required. In the latter instance an amplifier is necessary to give an input signal of the correct minimum amplitude for satisfactory operation of the Schmitt trigger stage. In any event a single frequency source must be used.

With this source connected to the input socket, then a steady increase in frequency should result in a smoothly rising deflection of the meter needle.

When working on range three it may be found that the meter reading, and the tone heard in the phones, suddenly falls off before a frequency of 10 kc/s has been reached. This will almost certainly be due to the timing combination C5 and R13, and the cure consists of reducing the value of R13. At present its value stands at 1.5MΩ. In the first attempt, reduce this to 1.2MΩ. Having made this change, it will calibrate the meter on range 1 to set 50 c/s. Thereafter the meter should read up to 10 kc/s.

The oscilloscope owners have a distinct advantage here in that they can actually "see" what is happening by monitoring the output from SK3. For satisfactory operation the width of the pulse at the output should be approximately 50 c/s. The result of reducing the value of R13 is to decrease the width of the pulse, thereby increasing the limit to which the frequency may be set without eliminating the space in the mark-space ratio. Unfortunately, reducing the pulse width also reduces the mean current drawn by the meter, and in consequence this must be increased by re-adjustment of VR1.

If the trouble is still not cured by reducing R13 to 1.2MΩ, then 1MΩ should be tried and so on down to 680kΩ. At too low a value of VR1 it will be found that the meter can no longer be calibrated on range 1, and it is highly probable that some other fault exists in the wiring. The importance of a clean and tidy layout cannot be stressed too greatly here, as the adverse effects of unduly large stray capacitances will almost certainly restrict the range of this simple receiver.

In actual fact no difficulty should be experienced by the reader if a fairly intelligent layout is used, as the one outstanding advantage of this electronic frequency meter is its simplicity of setting up and operation.

Modifications

The approximate price for the 100A meter used in this design is about £2. To some constructors this may present too big an investment, and they may, therefore, be cheered by the prospect of being able to use a less sensitive type of moving coil movement. It is possible to use a 0–500mA meter in a slightly modified circuit, but electronically the price to pay is that of a greatly increased h.t. drain and the need to use power output resistors R1 and R2. If a 25kΩ potentiometer is connected between R1 and R2, and the slider connected to both the grid of V1 and the coupling capacitor C5, it will be found that the amplitude of a test signal at the input can be gradually reduced as this variable control is adjusted, to give a condition of maximum sensitivity. Once this working point has been found, the control should be locked.

Another modification which can be incorporated to give better operation concerns the calibration push-button. If a double-pole version of this switch is available, then the second pair of "normally made" contacts should be connected in series with range switch S2, breaking the present circuit at the point marked X in Fig. 7. When the push-button is now operated, the meter will automatically be switched to range 1, as required for calibration purposes.

The use of the frequency meter have already been covered in the opening paragraphs, but in conclusion the discriminating reader will have seen that the circuit has wider applications than just the coverage of the audio frequency band.

In fact, with no other modifications to the present circuit than changes in values of C5 and R13, it is possible to design this frequency meter to cover an entirely different band of frequencies up to some hundreds of kilocycles. By arranging both for range switching and tuning controls, it is therefore possible to design an instrument only slightly more involved than the version described which will cover an extensive frequency band.

FIG. 9
Power Supply Suitable for Frequency Meter

M468

Itemizes those component numbers that will require replacing, and their approximate values are indicated. The reader will probably also find that the timing components, C5 and R13 will need changing, but substitution here will have to be done on an experimental basis, rather along the lines already indicated.

R10, 220 ohms VR2, 50 ohms w.w. pot.
R12, 3.3kΩ, 10 watt VR3, 5 ohms w.w. pot.
R14, 1.2kΩ, 5 watt VR4, 4kΩ, 4 watt w.w. pot.
R15, 220 ohms VR1, 6.8kΩ, 1 watt

Of course, if the reader is content to build a frequency meter with only two ranges, namely the 0–1,000 c/s, and 0–10 kc/s ranges, then it is possible to use a 0–500mA meter, merely omitting all the existing circuitry for range 1. If this is done, then R13 should be reduced 150 ohms, and VR1 in Fig. 8 should be about 5kΩ.

The frequency meter may be made more sensitive to inputs of low amplitude by the incorporation of a variable control between

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Radio Miscellany—continued from page 325

will be able to undertake the management of it for 1958. It is to be earnestly hoped he will find himself able to take care of the organisation. He certainly struck the right note—plenty to interest the beginner, while at the same time fully covering the needs of the advanced and transmitting amateurs.

I spent several short periods at the Radio Constructor Stand, where many of our readers forgathered, hoping to spot one or two of the old timers. Not a grey beard was to be seen. Maybe the hobby keeps young in appearance as well as in spirit. Should this, indeed, be so, if that Veteran Club is formed the secretary is encouraged to insist on inspecting birth certificates before accepting ages!

The thing that impressed me most. The big manufacturers' growing interest in the amateur market—especially Mullards.

The liveliest display. The British Amateur T.V. Society Stand. Congratulations to 3CVO, 2DUX, 2J and 2OK. Twice when I went near the stand the latter turned the camera on me. Maybe it was to show me off—I'm not all that photogenic! Earlier I had a shock at finding myself occupying the centre of the screen at the Pye Stand, where the most impressive thing was my shirt. I wonder I wasn't snapped up for an ITV Tide advertisement! Perhaps 2OK was only trying to prove his camera was 100% OK on white.

Items I played with longest. The aluminium solder on the Enthoven Capacitors. The soldered numerous bits of wire on all the aluminium within reach. The chap in charge of the stand didn't actually say so, but I could tell by the way he looked at his foot that he wanted to carry on if I had better go and fetch my own aluminium. The man I bought a sixpenny sample which I felt entitled me to play with the Vibration compare apparatus, and doodled happily on a strip of virgin foil I managed to cajole.

Most likely future purchases. The G8KW multi-band double with traps. I bear a ground plane is also in the offering and a vibroscope.

Popularity Poll. On the Thursday evening I asked six likely looking up-and-coming youngsters to look at the amateur-built items displayed on the R.S.G.B. stand to see what ideas they would be most likely to copy when they got home. Three of them said the chassis bending jig (by G8TL). One of them didn't return—perhaps he thought there was a catch in it—or possibly, as one invariably finds in the Gallup Polls, he was one of the "don't knows."

Verdict. The best post-War Amateur Show yet. Next time there will be even more exhibitors and still bigger crowds.

1957 RADIO HOBBIES EXHIBITION continued from page 347

Jason Motor and Electronic Company

This company, busily engaged in two exhibitions at one and the same time, the other one being the Audio Fair at Harrogate, exhibited the new switched f.m. tuner (The "Mercury," the "Peter-"—another switched f.m. tuner unit; the "Argonaut," a very fine a.m./f.m. receiver complete with audio and power sections, and the well-known Jason f.m. tuner unit in two versions that for local and that for fringe area reception.

Data Publications Ltd.

The complete range of current publications was on show here, and great interest was shown in the items of equipment displayed which were changing rapidly. These were featured in the most numerous of The Radio Constructor, or were to be described in forthcoming issues. The photograph of the stand does not give a true impression as it was taken before the stand was completed.

Wireless World

On this stand were to be seen copies of the well-known range of Radio Club magazine Wireless World, Electronic and Radio Engineer, and books such as Foundation of Electronics by G. Scruggs, B.Sc., M.I.E.E., which has now gone into its sixth edition.

This Radio Hobbies Exhibition was well worth a visit by all radio hobbyists, and particularly, by J. Smith, Q2DUG, of Cheddleton, who was lucky enough to win the Eddystone Communication receiver. The Silver Trophy was won by J. Le Compte, G2CM, of Romford, and each prizes offered by members of the Exhibition Committee were awarded by C. Kenny of Hove, C. H. F. Hubbard of Chatham, and G. B. Nisst of Sheffield. The Clyde Award, went to E. Vernon of Swindon. A.J.T.

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Available for the first time in this country, these are the product of a famous manufacturer. The following values are now in stock:

<table>
<thead>
<tr>
<th>Value</th>
<th>Density</th>
<th>Vol.</th>
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<tr>
<td>25uf</td>
<td>6V</td>
<td>35uf</td>
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<td>12uf</td>
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<tr>
<td>4uf</td>
<td>12V</td>
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(Take on page 232 Nov.)

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As featured in August issue and described on page 28

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