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CONTENTS

86 Suggested Circuits: A Simple Burglar Alarm,
by G. A. French

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

TECHNICAL QUERIES should be submitted in writing. 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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fact that petty pilfering, especially from small business premises, is on the increase these days, and it is this point, combined with the evident interest shown by some readers, that has finally prompted the writer to produce the Suggested Circuit which is published in this month's issue.

Circuit Operation
The circuit of the burglar alarm is illustrated in Fig. 1. As may be seen, it is extremely straightforward in operation, and it employs no electronic techniques whatsoever. The design of the circuit is based on the assumption that only the equipment immediately adjacent to the alarm bell may be considered as being vulnerable, the remainder—wiring, contacts, etc.—constituting the "sensitive" part of the device. If desired, the components around the alarm bell may be housed in a protective control box fitted with key-operated switches.

External Wiring
The fact that the alarm functions when a circuit is broken makes the design of contacts in the external wirings look a fairly simple process. As an example, Fig. 2 shows a suggested method for connecting a door into the loop. In Fig. 2 one contact is fitted to the door post and the other to the door itself, the wire to the latter travelling across the width of the door. Opening a door

![Diagram of a simple burglar alarm circuit](image-url)
Alternative methods of providing protection readily suggest themselves. For instance, thin enamelled wire could be very conveniently stretched across points where entry may be attempted. If this wire were broken, the alarm circuit would be interrupted, and the alarm would sound.

The Control Unit
Apart from the fact that it houses the relay, battery and bell, the control unit shown in Fig. 1 also includes the switches needed to switch the alarm on and off, and to set up the relay.

The alarm is switched by S1, this coupling the lower battery terminal to the complete circuit from the alarm bell. S2 connects the battery directly to the relay coil, thereby energising it. When the alarm is initially switched on it is necessary to press S1 to energise the relay, after which it may be released. Provided that the external circuit is complete, the relay will then remain energised.

It is presumed that the control unit will be kept in a secure place close to the owner of the premises. A typical instance would be the siting of the control unit in the owner's bedroom. In such a case there may be little point in making the unit itself "burglar- proof," with the result that ordinary switches can be employed in the S1 and S2 positions, and the small number of components required can be mounted in any convenient manner. If, however, it is decided to make the control unit less vulnerable, the associated components can be mounted in a locked case, key-operated switches being employed for S1 and S2.

Only the two leads from the external wiring loop need enter such a case.

Components
Due to the extreme simplicity of the circuit, little difficulty should be encountered in obtaining the components needed for its manufacture.

The relay may be of any reliable type which is capable of being energised by the battery. There is no point in employing a relay having heavy contacts, as the currents involved should be quite small.

A disadvantage of the circuit is that a current is continually drawn from the battery when the alarm is switched on. However, such a disadvantage is inevitable if the essential feature of the device (wherein alarm indication is given when a circuit is broken) is to be achieved. The use of a battery, as opposed to operation from the mains, is also unavoidable, since it is necessary to be independent of power failures and the like. An economic method of running the alarm circuit would consist of employing an accumulator in the battery position, this being charged when the alarm is not in use. Alternatively, the battery may be on a complete trickle charge from the mains. It should be noted that, in the case of a completely enclosed control unit, care should be taken to prevent corrosion due to any fumes which may be given off by the battery during charging. It is important, also, to note that no charging circuit should be connected to the battery which may cause either terminal to be at earth potential when the alarm is switched off, due to the possibility of random earth connections in the external wiring loop, such a charging circuit might cause unreliable operation of the alarm.

Can anyone help?
R.C.F. Valve Tester Model 314 and Signal Generator 5252 Ref. No. 1655-1657. G. W. Robinson, 12 Atkinson Road, Honley, Newcastle-upon-Tyne 4, requires any information on these two items of test equipment, willing to purchase or refund expenses. He is able to supply numerous test services on valves, radio and tape recorders and will entertain two items of government equipment, mostly U.S.A. types. S.A.E. for information required.

Panda Cob Transmitter - F. Allan Herridge, G1IDG, 57 Ramden Road, London, E.11, would like to obtain a service sheet on this receiver. Expenses met or exchange value of old receiver.

Marconi "Transatlantic" Receiver type 992-1, R. Gooner, 150 Layer Road, Colchester, Essex, would like to obtain a service sheet on this receiver. Expenses met or exchange value of old receiver.

R1124C Receiver - G. Gallamore, Spring Grove, Loch Lane, Partington, Urmston, Manchester, would like to communicate with anyone who has modified this receiver, particularly with reference to frequency coverage, alterations made to the front panel etc.

W/S No: 19 Mk II - F. K. Hanning, 57 Fairthorpe Road, Clitheroe, Lancs., would be grateful for any information about this receiver, and especially data of the "H" set and wiring of the bottom plug.

UHF Calibration Receiver type TE554 with Prescaler and Chassis Complete manufacturers UNLTD. The receiver covers 0.01-150 MHz and any information from readers will be gratefully acknowledged and costs defrayed by A. J. M. Smith, 31 Shepherds Bush Green, London, W.12.

Recording Unit 10D106188 - H. C. Murfin, 97 The Avenue, Nunthorpe, Middlesbrough, Yorks., would like to hear from anyone who has information on this unit, which has used one, or knows where the film cassette or a complete such unit can be obtained. The unit consists of a 16.6 cm. camera with a 1 inch Kinie Anastigmat with an f/3.5 lens, fitted on a 1 inch CRT, VCR, 529. Valves used are: 7 x EF50, 2 x EF55, 1 x EF54, VU102, and VU58.

Recording Unit 11D106188 - H. Harris, 12 Eastfield Road, Cowden, Bishops Stortford 6, requires the original circuit to be switched between "R" and "P" with details and circuit of conversion to a t.v. scope. All expenses met and postage paid.

ECO Receiver type AW98 (1939) - C. M. Chapman, 12 Belgrave Road, London, E.11, requires the service data sheet or circuit of this receiver. Expenses reimbursed.

1147B Receiver - L. Lamb, 25 Moorville Street, Leeds 14, would like to receive information of the type of valves used in this receiver, their positions, and the frequency covering. Also details of conversion to 2 metre operation. All costs met and expenses gladly refunded.

P40 Receiver - J. Allen, 35 Darnick House, Flower House Estate, London, S.E.6, would much appreciate any information, circuit and frequency of stn.

Murphy TV Model V14116 - R. W. Sheppard, "Spring House," Hatfield, Herts, would like the list of a service sheet for this television. All costs met.

Radio Section of Marconi Canal VRC7414. - J. Harvey, 2a The Avenue, Ryde, Nr. Birmingham, requires service data, all expenses refunded.

Circuit required - G. B. Smith, 39 Priory Road, Teddington, Middlesex, has an Osmon coaxial pack (type MTS) and requires replacement parts, using miniature valves, to suit this pack.

R1392 - N. A. Watson, 1 Strathbraem Road, London S.W.19, has just acquired this ex-service VHF receiver and would like any small information, circuit, manual etc. All expenses met.

Acoustical Amplifier type OA415/P - H. Harter, 59 Kingsway, Staines, Middlesex, would like to buy or borrow service sheet. Expenses gladly paid.


Pre Communication Receiver PCR2 and W/S 19 Mk II - D. R. James, 33 Wellington Gardens, Charlton, S.E.7. Would like a complete diagram of the former receiver and conversion of the latter to amateur band coverage with added bandspread facilities.

Ex-WD Indicator Unit 277 - W. J. Bone, 3 Audley Gardens, Seven Kings, Essex, wishes to borrow or purchase any information on this unit as he wishes to construct a portable 'scope. All expenses gladly paid.

THE RADIO CONSTRUCTOR

SEPTEMBER 1959

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www.americanradiohistory.com
In your Workshop

This month Smithy and Dick discuss ideas sent in by readers.

"But that I am forbid," said Dick, entering the Workshop, "to tell the secrets of my prison house, I could a tale unfold, whose lightest words
Would harrow up thy soul; freeze thy young blood;
Make thy two eyes, like stars, start from their spheres."

Dick stopped, and shuddered violently.
"Cor," he remarked to Smithy, "Fair glows in the crooks, does it not?
Smithy the Serviceman recognised the signs and chuckled.
"Yes," he said, "that the Thankful Thespians have once more condescended to include you in their company."

"If, laddie," replied Dick, "you are referring to the local Dramatic Society, I can inform you that they have, as is usual, called in my services for one of the more exacting parts in a forthcoming production. We shall shortly be presenting," he added grandiloquently, "the play Hamlet, Prince of Denmark."

"By William Shakespeare?"
"Who else?"
"And what part do you take?"
"I," said Dick, with a gesture, "am the Ghost of Hamlet's Father."
Smithy suppressed a smile.
"Well, I hope your fan-mail is sent to the right address," he remarked.

1. Submitted by Mr. R. Bloomer, Shildon, Co. Durham.
2. A provisional patent has been granted for the "Slim-Grip" described in this article. Trade enquiries should be addressed to Mr. W. O. Root, 44 Grange Drive, Glen Mills, Leicestershire.

Tips and Wrinkles
Dick forgot his historic career for the moment as Smithy's remark jogged a memory in his mind.
"Talking of fan-mail," he said, "haven't we in the Workshop got a few letters outstanding which are due for airing?"
"We have indeed," said the Serviceman.
"Quite a number of people have sent us tips and wrinkles over the last few months, and I think we ought to have a look at some of those right away, shall we?"
"We have, for instance, been given details of a very neat little test prod which is intended for piercing the insulation of rubber or p.v.c. wire so that readings may be taken from the conductor inside. The thing which does the piercing is the business end of a sewing needle, and the hole it leaves in the insulation closes up almost completely after it has been removed. The hole should certainly close up well enough for any normal radio or t.v. application.

"As you may see (Fig. 1), the construction of the probe is quite simple, and the parts should be found in most junk-boxes. In the prototype, the insulating sleeve consisted of the lower half of a ball-pen, and the 4BA brass stud was found holding the ball lower in an old receiver. I don't know where the brass bush came from but I should imagine that it was a fitting on the ball-pen, and that the designer tapped it out 4BA. All in all, I feel that the most important part of the device is the sewing needle itself, together with its ability to pierce insulating coverings. I'm quite certain that the average constructor will have no difficulty whatsoever in providing suitable insulated mountings basically similar to that used in the prototype."

"The idea of piercing insulated coverings is also a neat trick, commented Dick, "it should certainly prove useful. Take the opposite extreme, I often feel that I need a prod which, instead of piercing through insulation, clips on to wires and stays there."

"Well, we have an extremely neat idea for that application," said the Serviceman, "and it is known as the 'Slim-Grip'." The 'Slim-Grip' consists of three specially-shaped blades pivoted near one end, the whole being covered by a rubber sleeve. (Fig. 2) The centre blade has a hole, behind the pivot, to enable a wire to be soldered to it. The insulation on such a wire passes inside the rubber sleeve so that there need be no break in the continuity of the insulation. When the working end of the device is pushed on to an insulated wire the two outer blades open out in one direction, while the centre blade opens out in the other direction; with the result that the blades clip firmly on to the wire. The beauty of the design is that the rubber sleeve provides insulation all the way up to the wire. The clip is attached to, so that there is no risk of shorts to adjacent conductors. It is, in fact, possible to run screening braid over the outside of the clip, should this be desired, so that only a very small section, at the business end, is unscreened. An ingenious feature of the clip is that, apart from providing insulation, the rubber sleeve also provides the tension which pulls the blades inwards. If I add that the dimensions of the clip with sleeve are approximately 1½ inches long by ½ by 4 inch you may begin to appreciate the Slim part of its name. This slimness, together with its excellent grip and the rubber sleeve insulation make the Slim-Grip more useful in this particular application than anything else I've seen."

Fig. 1. A simple test prod capable of piercing rubber or p.v.c. insulation

Fig. 2. (a) The three blades which make up the "Slim-Grip." (b) The blades riveted together. (c) A rubber sleeve fitted over the assembly provides insulation. (d) The clip fitted to a conductor. The blades open out against the tension of the sleeve.
"It's certainly a knobby idea," agreed Dick.

Valve Caddy

"And here," said Smithy, "is another knobby idea: what the Americans sometimes call a valve caddy. It's a smart, compact case suitable for carrying valves on either bench or field work. I've got a photograph of it here."

One thing I've noticed," remarked Dick, "is that the valves on the lid interfere with the valves fitted to the bottom when the lid is closed. With the intention, I presume, of giving you a case which is check-full of valves when it's closed and which has them well spaced-out for ease of removal when it's open."

"That's right," confirmed Smithy. "By the way, I had better add that you've got the job of knitting up a case like this for the Workshop as soon as you have a little spare time."

"I thought there'd be a catch in it somewhere," grinned Dick. "Still, it won't take very long. Have any more bright ideas come in?"

"Yes, I've got another one here," replied Smithy. "This one is quite a useful gadget for the chappie who does a little servicing now and again on the kitchen table. The main idea of the device is that it enables you to get light, soldering iron and mains socket for the set being repaired and for test gear all at one point, instead of having lots of wires trailing around all over the floor. I've got some photographs of the gadget and you can see that it consists fundamentally of a base with a pole sticking up. (Fig. 3). The base is some nine to twelve inches square and the pole appears to be six feet high or thereabouts. A light, complete with shade, is fitted to a bracket on the pole, as also is a large 'Terry clip' for the soldering iron. There is, in addition, a smaller clip for holding bits of solder and such-like. The smaller clip can alternatively be used for holding bits of wire steady for tinning, and it is liable to stop drops of solder falling onto the sort of highly polished table-tops you find in desirable residences such as my own."

"We have cloths on ours," interjected Dick.

"You'll notice," continued Smithy, ignoring his assistant, "that the bracket carrying the light has a clamp which enables its height on the pole to be adjusted. On the base of the device are as many mains sockets as you care to fit, together with a switch which will locate them. The light and soldering iron can have separate switches, if desired. Also on the pole are two bolsters for 43 feet up the pole which couples up the whole arrangement to the mains whenever it is in use.

"Fair enough," said Dick. "Yet another useful and simple idea that the publicity it deserves! Any more tips?"

"No," said Smithy, "that's the lot. There were one or two others, for which I am very grateful indeed, but I am afraid that they have fallen by the wayside. So far as the future is concerned we would quite definitely be interested in some more tips and wrinkles, including, especially, any which deal with out-of-the-way techniques. To give an idea of the sort of thing we like to see, how about a gubbins for magnetising and demagnetising screwdrivers?"

"I don't follow you.

"Well," said Smithy, "if you had something which enabled you to quickly magnetise a screwdriver you could then use that screwdriver to pick up odds and ends which fell into awkward corners.

"That shouldn't be too difficult," commented Dick. "All you need is a coil which could be quite easily energised from the mains. For demagnetising you would apply raw a.c. to the coil and put your screwdriver inside the coil. For magnetising you would rectify the a.c. before you applied it to the coil. It's certainly easy enough in theory."

"And it shouldn't be too difficult in practice," commented Smithy, "but I must point out that I only mentioned this idea to give people an instance of the type of thing we want."

"Some weeks ago I bumped into another idea which falls into the same category," Dick said. "I wandered into a friend's house and found him sitting at the back of his t.v. set with a length of 3-inch polythene tubing held up against his ear."

"I suppose," remarked Smithy, dryly, "that's as good a way as any, these days, of enjoying a t.v. programme."

"What had happened," continued Dick, doggedly, "was that his set had developed a corona and he was trying to locate its source. He moved the free end of the tubing over all the e.h.t. parts of the receiver until he located the place where the sizzling sounded loudest."

"Hm," said the Serviceman reflectively, "It's a new one on me. I can't see why it shouldn't work, though."

"It worked very well in this case," said Dick. "I tried it myself."

"O.K.," remarked Smithy. "Then I think we can count that technique as a second example of the sort of thing we like to hear about."

Photograph. A view showing the interior layout of the "Valve Caddy".

3 Contributed by Mr. Geralit Dittrich, Dundee, Scotland.

4 Contributed by Mr. H. A. Keable, Selby, Yorks.

More Hamlet

With this remark Smithy indicated that a little work would not come amiss, whereupon his assistant obediently turned to his bench. The normal bustle of the Workshop soon made itself evident. With the difference, on this particular morning, that Dick broke the silence with intermittent and impassioned bursts of oratory as he practised for the local Dramatic Society's next presentation. Smithy suffered this state of affairs.

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Fig. 3

M675

Clip

Clamp Screw

Lamp

Bolster

Switch

Sockets

Fig. 3. A novel, but useful, device which brings mains voltages, etc., to a single location for occasional servicing sessions.
The long-suffering Serviceman jumped, and turned round peevishly.

"I do wish you wouldn't suddenly shout out like that," he complained, irritably. "I'm certainly not at least half a pint of adrenaline each time."

**Deflector Yokes**

"Sorry, Smithy," apologised Dick. "What happened was that the frame timebase suddenly cut out and I switched off quickly.

As it turned out, the Serviceman had jumped at the sight of a deflector yoke, which he saw as an indication of the Serviceman's frustration.

"I didn't know that," confessed Dick. "I suppose that, after cracking, the two halves have to be kept together in pairs until they join up again in the completed yoke."

"That's right. The cracked surfaces are bound to be irregular and so it is possible only to mate up the two halves of an original ring. If, by the way, you should ever cause the two halves of a deflector yoke ring to come apart during servicing, you must always make certain that they mate up to each other perfectly when you re-clamp the assembly. Otherwise you'll get a distorted picture shape. You'll also get a distorted picture shape if there's a slight gap at either or both junctions of the two halves—even if that gap is of the order of a few 'thou' only."

"I see," remarked Dick. "I presume that the two coils which come in a flare at the front of the assembly are the line coils."

"Correct."

"I notice that they have the stiff feeling such coils normally have. Are they what are known as bonded coils?"

"That's right," said Smithy. "The wire these coils are wound with is called self-bonding wire, and it consists of copper wire coated with synthetic enamel and an outside covering of glue. Immediately after the coil has been wound a heavy current is passed through it. This causes the coil to heat up to avoid stripping the tube."

"Well, that's fair enough," said the Serviceman, somewhat mollified. "Even with present-day enamelled tubes it's still advisable to be on the safe side if you want to prevent the very bright horizontal line which is left when the frame timebase collapses from burning the screen phosphors."

Dick turned the brilliance control of his receiver fully back and switched on again. After a short while the line output stage commenced working and Dick cautiously advanced the brilliance control until the central horizontal line achieved an average brightness level.

"I think there's a broken connection in the deflector yoke," he remarked, "it was when I happened to wangle one of the lead-out wires that the picture lost its vertical scan."

"Cautionally he moved the wire in question, whereupon the picture opened out momentarily and then collapsed once more.

"Yes," conceded Dick, "there definitely seems to be a bad joint inside the works. Well, there's nothing for it but to get the yoke off."

**Cracks in Core**

Fig. 4. In 110-degree deflector yokes the frame coils are wound directly on the magnetic core

**Fig. 5.** One of the most useful items of equipment when servicing television receivers is a mirror fitted to a stand, as shown here. This enables adjustments to be made at the rear of the receiver whilst the screen is observed via the mirror. The sides of the mirror may be some 1 to 2 feet long.

"They don't. The rings come in two halves and the coils are wound on these. After winding, the two halves are brought together, with a bit of sticky stuff between the surfaces which join, and then held with a clamp. I should mention, though, that the magnetic material is originally made in one complete ring because it's easier to do it that way. The complete ring is then cracked on opposite sides to give you the two halves."

"I didn't know that," admitted the Serviceman. "I suppose that, after cracking, the two halves have to be kept together in pairs until they join up again in the completed yoke."

"That's right. The cracking surfaces are bound to be irregular and so it is possible only to mate up the two halves of an original ring. If, by the way, you should ever cause the two halves of a deflector yoke ring to come apart during servicing, you must always make certain that they mate up to each other perfectly when you re-clamp the assembly. Otherwise you'll get a distorted picture shape. You'll also get a distorted picture shape if there's a slight gap at either or both junctions of the two halves—even if that gap is of the order of a few 'thou' only."

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fully examining the yoke he had just removed. "In the meantime I think I've found my bad connection."

He quickly applied a soldering iron to the offending yoke and, after a few exploratory tugs at the wire which had caused all the trouble, pronounced himself satisfied with his work. He then fitted the yoke over the neck of the tube, re-applied the tube socket and switched on.

As soon as the set had warmed up the picture reappeared, with full vertical scan. Please, Dick positioned the receiver so that he could adjust the yoke whilst examining the picture with the aid of one of the mirrors which were stock equipment in the Workshop. (Fig. 5.) He first of all squared the raster with the edges of the mask by rotating the yoke assembly, after which he centred the picture.

"That's not too bad," remarked Smithy, whose interest in the yoke had caused him to remain and watch its re-installation in the chassis. "You may notice, if you look closely at the individual corners of the raster, that you get the impression of very slight pin-cushioning. This is all to the good with these 110 degree tubes because, with their extra screen curvature, very slight pin-cushioning gives the effect of a nice rectangular raster when the picture is viewed from a distance," Smithy suddenly looked more closely at the screen.

"The only thing I don't like about your picture," he remarked, severely, "is that you've got your line coils connected back-to-front. The letter 'C' in the Test Card is right way round in the mirror only!"

Dick switched off the receiver and re-verified the line coil connections.

"Dear, dear," continued the Serviceman, "you'll never learn! Why on earth don't you do what I and almost every other service engineer in the country does? That is: just jot down on a scrap of paper the connections to an unfamiliar component before you remove it. There's nothing clever in trying to remember connections, because you're bound to make a mistake at some time or another. And a mistake in wiring could quite easily have disastrous results."

More Hamlet

"In this case, for instance," grinned Dick, "I might have had to 'shuffle off this mortal coil' again."

The Serviceman groaned.

"Cracks of your own making are bad enough," he complained, "but when you borrow them from Shakespeare they become terrible."

But Smithy's reference to Shakespeare and to borrowing had caused Dick, once more, to transplant himself into his own private world of the footlights.

"Neither a borrower nor a lender be," he intoned.

"For loan oft loses both itself and friend; And borrowing has caused Dick, once more, to transplant himself into his own private world of the footlights."

"And borrowing has caused Dick, once more, to transplant himself into his own private world of the footlights."

Dick paused for a moment.

"That's part of Polonius's speech in Act II," he remarked, in a patronising manner.

"If you don't look out," replied Smithy, threateningly, "you'll come to the same end as Polonius did in Act III."

"We haven't got so far as that yet," exclaimed Dick, alarmed. "What happened to Polonius?"

"Hamlet stabbed him," said the wrathful Smithy, "through the arras."

FORREST

Transistor Transformers

H. W. Forrest (Transformers) Ltd., 349 Hashucks Green Road, Shirley, Solihull, Warks, have submitted samples of two types of Transistor Transformers now added to the well-known range of such components.

The windings are wound on a new type of core on which the company are able to produce a wide range of ratios for either single-ended or push-pull stages. These two new types make a total of six different core sizes now manufactured for this type of transformer.

The first of the types submitted measures some 1.5 in. x 1.5 in. x 1.5 in. and the second 2 in. x 2 in. x 2 in.

The company specialise in manufacturing transformers of all types, singly or for use by constructors or in production runs for manufacturers. Most types can be produced extremely quickly and a large stock of transformers is held. A stock range of these transformers have been suitably modified to suit the majority of requirements called for in transistor circuit arrangements available in return.

THE RADIO CONSTRUCTOR

SEPTEMBER 1959

TELEVISION

UNDERSTANDING

TELEVISION

By W. G. MORLEY

The twentieth in a series of articles which, starting from first principles, describes the basic theory and practice of television.

I N THE LAST ARTICLE IN THIS SERIES WE continued with the video amplifier stage, and we discussed the various circuit devices which may be employed to ensure that a faithful reproduction of the video signal is obtained from this stage. We then commenced to examine the coupling between the video amplifier and the cathode ray tube, pointing out that it is usual in modern receivers to apply the video signal to the cathode of the cathode ray tube rather than to the grid.

Brilliance and Contrast

In order that a cathode ray tube may adequately handle the signal passed to its modulating electrode by the video amplifier, it is necessary for two basic requirements to be satisfied. Firstly, the video signal must have an amplitude which enables the range of intermediate shades in the picture to be reproduced clearly and properly, and secondly, the cathode ray tube must operate at an acceptable bias level in a stable manner.

As a result almost all signal levels above that which corresponds to zero grid voltage are reproduced on the screen at maximum brilliance. Fig. 112 (c) indicates the state of affairs which results when the video signal has been裁与’s amplitude. In this case both black and peak white levels appear at their correct positions and the characteristic, intermediate levels corresponding to black and white, are as they should be, in intermediate brightness levels.

In practice, it is necessary to set a cut-off point for the television receiver which is capable of varying the amplitude of the signal applied to the cathode ray tube. This cut-off is known as the contrast control. The contrast is too high in amplitude. It will be seen from the diagram that whilst black level appears at approximately the correct point on the grid voltage/brightness characteristic, peak white corresponds to a markedly low brightness level. In Fig. 112 (b) we see a signal which, this time, is too large in amplitude. Whilst black level is, once again, applied to approximately the correct part of the characteristic, peak white level now appears at a point well outside the range of input voltages which the tube can handle.
control is actually a gain control; and it varies the overall gain, between aerial and cathode ray tube, of the receiver. If the contrast control is set to too low a level the gain of the receiver becomes reduced and the signal applied to the cathode ray tube may have the appearance of that shown in Fig. 112 (c). Such a picture would be described as having low, or insufficient, contrast. If the contrast control is set too high the gain of the receiver becomes excessive, with the result that the signal applied to the cathode ray tube may resemble that of Fig. 112 (b). In this case the resultant picture would be described as having excessive contrast. When the contrast control is set to its proper level the gain of the receiver becomes such that a signal of correct amplitude, as in Fig. 112 (c), is applied to the cathode ray tube.

The manner in which the contrast control varies the gain of the receiver is liable to vary somewhat between receivers of different manufacture and design. Generally, the basic method of operation is as follows: having cut off the video signal, set the contrast control to approximately the correct point on the grid voltage/brightness characteristic, but peak white corresponds to a very low-brightness level. In this diagram a signal of excessive amplitude is applied to the cathode ray tube. Once again it is assumed that black level appears at approximately the correct point on the characteristic. However, most of that part of the signal to the right of zero grid voltage level will be reproduced at maximum brightness. When a signal of correct amplitude is applied to the cathode ray tube, both black and white levels appear at their correct points on the characteristic. The correct cathode ray tube grid bias is demonstrated in Fig. 113. In Fig. 113 (a) a video signal of correct contrast level is applied to the cathode ray tube, but an acceptable picture is not reproduced because the tube is over-biased. The result is that only half of the video signal becomes applied to the grid/brightness curve, and that part of the signal which falls outside cut-off voltage does not appear on the screen at all. In Fig. 113 (b) the cathode ray tube is under-biased. In the absence of the video signal being reproduced at a single level only — that of maximum brightness. Also, the sync pulses now become visible in the picture. It is only when the tube is correctly biased that we can obtain the state of affairs which we saw in Fig. 112 (c), wherein the peak white and black levels took up their correct positions on the characteristic.

To ensure that the cathode ray tube is correctly biased it is necessary for the television receiver to be provided with a control which varies the voltage on either its grid or its cathode. Such a control is known as the brightness or brilliance control. It is usual when the cathode ray tube is cathode modulated to apply the variable bias provided by the brightness control to the grid and vice versa. The circuit arrangements employed for providing the variable grid bias are very similar, a typical example being illustrated in Fig. 114 (a). In this diagram the cathode ray tube is cathode modulated and the variable grid bias is obtained from a potentiometer connected in series with two fixed resistors across the receiver h.t. supply. It is assumed that the cathode has a potential which lies between chassis and the h.t. positive line. When the brightness control varies the grid voltage, it does so in Fig. 114 (a), the combined resistance of the variable and fixed resistors in series normally lies between 200 kΩ and 1 MΩ. The use of relatively high resistance values of this order is desirable because, apart from keeping current consumption and heat dissipation in the three resistors to a low value, it also prevents the flow of excessive grid current if the brightness control is set to too high a level. At normal settings of the control, grid current is negligible. The condenser bypassing the slider of the brightness control to chassis ensures that the grid of the cathode ray tube remains at a steady potential (from the point of view of video frequencies) relative to cathode. In Fig. 114 (b) we see a brightness control circuit applied to the cathode of a grid-modulated tube. The method of operation here is similar to that of Fig. 114 (d) with the exception that the cathode current of the cathode ray tube now flows through that part of the brightness control network which appears between the grid and cathode. The cathode current of a cathode ray tube is normally of the order of 100 to 200 A, only but this is still sufficiently high to make it desirable to use slightly lower resistance values in the brightness control network. In Fig. 114 (b) the combined resistance of the variable and fixed resistors in series would normally be in the region of 100 to 200 kΩ. Again a bypass condenser connects between the brightness control slider and chassis. In both Figs. 114 (a) and (b) this bypass condenser would have a value of 0.01 to 0.1 μF.

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**Fig. 112 (a)** The effects of applying a video signal of low amplitude to the cathode ray tube. In this instance black level appears at approximately the correct point on the grid voltage/brightness characteristic, but peak white corresponds to a very low-brightness level. (b) In this diagram a signal of excessive amplitude is applied to the cathode ray tube. Once again it is assumed that black level appears at approximately the correct point on the characteristic. However, most of that part of the signal to the right of zero grid voltage level will be reproduced at maximum brightness. (c) When a signal of correct amplitude is applied to the cathode ray tube, both black and white levels appear at their correct points on the characteristic.

**Fig. 113 (a)** In this diagram a signal of correct contrast level is applied to the cathode ray tube. In consequence, only part of the signal to the right of cut-off level is reproduced. (b) The effect when the cathode ray tube is under-biased. All parts of the signal are reproduced at an elevated brightness level, most of that part to the right of zero grid voltage level giving maximum brightness. It should be noted that signal amplitudes in this diagram and in (a) are correct and that combinations of incorrect biasing and incorrect amplitude would give further variations on the examples illustrated in this diagram.
It frequently happens that, in practical receivers, a relatively low value resistor is connected between the slider of the brightness control and the cathode of the cathode ray tube. Such a resistor would be fitted at the points marked with a cross in Figs. 114 (a) and (b). The purpose of this resistor is to prevent the occurrence of excessive grid current during certain transitory conditions, such as occur immediately after switching off the receiver. The series resistor normally has a value around 30k.

The voltage between heater and cathode of the cathode ray tube is to a safe level (in order to prevent breakdown between these two electrodes) it is necessary to take special precautions in the circuit arrangements which couple the video amplifier anode to the modulating electrode of the cathode ray tube.

Fig. 115 (a) illustrates the case in which the video amplifier anode connects directly to the cathode ray tube. Under these conditions the cathode is liable to rise almost to full h.t. potential during the period when the video amplifier anode is near cut-off. The cathode may rise to an even higher potential during warm-up time if the full h.t. voltage appears before the video amplifier valve draws its full working current. It should not be forgotten also that the heater of the cathode ray tube may attain a negative potential with respect to chassis and that when cathode heater voltages are being evaluated, this negative voltage should be added to the positive potential above chassis held by the cathode. In the example shown in Fig. 115 (a) two amplifier is near cut-off. The cathode may rise to an even higher potential during warm-up time if the full h.t. voltage appears before the video amplifier valve draws its full working current. It should not be forgotten also that the heater of the cathode ray tube may attain a negative potential with respect to chassis and that when cathode heater voltages are being evaluated, this negative voltage should be added to the positive potential above chassis held by the cathode. In the example shown in Fig. 115 (a) two valve heaters appear in the series heater supply "chain" between the cathode ray tube heater and chassis; with the result that the heater of the cathode ray tube will go negative of chassis by a potential equal to the peak voltage dropped across the three heaters once during every cycle of the mains supply.

Fig. 115 (b) shows that much the same grid-supply problem exists when a direct connection is provided between the video amplifier anode and the cathode ray tube grid. To obtain a correct brightness level in this case it is necessary for the cathode of the cathode ray tube to be positive of the grid, whereupon the circuit must obviously take up a potential at least as high as that given by the cathode-modulated circuit of Fig. 115 (a) under normal operating conditions.

Next month
In next month's article we shall see how the cathode-heater voltage problem is solved in modern receivers and shall carry on to consider a.c. and d.c. couplings.

The limiting safe voltage permissible between cathode and heater of a typical cathode ray tube is normally 200 volts only. In consequence, the h.t. voltage applied to the video amplifier anode of Fig. 115 (a) would need to be markedly lower than this figure if cathode-heater breakdown in the cathode ray tube were to be avoided. Whilst it would not be possible to design a video amplifier capable of working at an h.t. voltage considerably lower than 200, it is much simpler to reduce the potential on the cathode of the cathode ray tube by other means whilst still maintaining a satisfactory coupling for the video signal.
The JASON OG.10
General Purpose Oscilloscope
by G. Blundell and M. Smutny

Part Two

Since Part 1 of this article appeared, improved accuracy on the voltage calibrator has been achieved by substituting the following values for those given in the Components List: R1 = 220kΩ 5%, hi-stab; R2 = 39kΩ 5%, hi-stab; R3 = 1kΩ 5%, hi-stab.

An error occurred in the Components List—C1 should have read 0.05μF 750V wkg.

X Amplifier
The X amplifier consists of V3 (ECC82), a double triode connected as a “long-tailed pair.” When the signal applied to the input grid is such that the anode current in the first triode increases, the anode potential falls and the voltage appearing across R2 and R3 increases making the grid of the second triode more negative in relation to the cathode, and so decreasing the current and raising the potential at the second anode. In other words, the signals appearing at the anodes are in push-pull, the component values being so chosen that they are substantially equal. The grid of the second triode is held at a steady potential which can be varied by means of VR3 to provide a horizontal shift of approximately 5mm (1 screen diameter). The horizontal deflection plates of V3 (D97-91) are directly coupled to the anodes of V6. Although the shift voltage is applied to one grid only, as explained previously, the current in both halves of the valve is shifted, and therefore a push-pull shift voltage is obtained without an expensive twin potentiometer.

Y Amplifier
The Y amplifier built into the oscilloscope makes use of three valves V1 and V3 (ECF80) and V2 (EF80).

The triode portion of V1 is connected as a cathode follower, its grid being connected to two panel sockets, one giving a ten-to-one reduction in sensitivity by means of the attenuator formed by R1 and R2. C1 is connected across R1 to provide a flat frequency response. The output of the cathode follower is coupled via an electrolytic capacitor (C3) to a potentiometer (VR3) which provides a continuously variable gain control. The slider of the potentiometer is connected to the grid of the pentode portion of V1. High frequency response correction is applied to this stage in two ways. Firstly, the bias resistor (R4) is bypassed by a small capacitor (C4) of 1,000pF which begins to be effective at about 1 Mc/s. Secondly the anode load is made up of an inductor (L6) and a resistor (R6) in series. As the operating frequency increases, the impedance of L6 increases to offset losses caused by stray capacitance to earth and the input capacitance.
of the following stage. These stray capacitances shunt the resistive portion of the anode lead. V2 (EF80) and the pentode portion of V1 (EC810) are again connected as a "long-tailed pair." Frequency compensation is again obtained by means of inductors L1 in the anode circuits. A vertical shift of about 6cm (1 screen diameter) is provided by VR2. The vertical deflection plates of V7 (DY59) are directly coupled to the anodes of V2 and V3 by means of leads running through thick walled p.v.c. sleeving to reduce anode-to-anode capacitance by ensuring that the leads are adequately spaced. A frequency response within I dB from 10 c/s to 1 Mc/s and within 3dB to 2 Mc/s, together with a sensitivity of 6mV r.m.s./cm, are obtained.

Notes on Assembly

The assembly follows normal practice for fixing valveholders, tags, etc., details showing the disposition of parts being shown in Figs. 2 to 4, and only a few points require explanation.

(a) Mains Transformer.—The mains transformer must be mounted exactly as shown in Fig. 2, i.e., not turned through 180°; otherwise the magnetic fields will be adding instead of cancelling. The white lead coded red on transformer MT5 must be connected to chassis.

(b) Front Panel.—The front panel is secured to the chassis by eight 6BA x 8in screws which also hold the four coaxial sockets in position. It will be found easier to fit all components to the front panel before it is screwed to the chassis.

The 4in long 6BA screws provided must be used for fixing the preset type potentiometers, as longer screws will lock the centres. The condensers together with flying leads as shown on Fig. 5 should be soldered to switch S1 before it is fixed to the panel. Flying leads should also be soldered to the "CAL" socket before this is screwed to the panel. The two switches and the Y gain control (VR1) are each provided with two nuts. These should be located one in front and one behind the panel and set so that the end of the fixing bush is just level with the front nut.

(c) Condensers C6 and C7 are mounted so that the three lugs pass through the appropriate slots in the chassis. These are then twisted with a pair of flat nosed pliers to anchor the component firmly. Only a small twist is required as there is danger of breaking these tags.

(d) Cathode Ray Tube.—One length of the plastic foam tape provided should be stuck around the neck of the tube near the metal end and a second length around the conical portion just where it joins the neck. These will hold the tube firmly in place when it is slid inside the mu metal shield. The mu metal shield is screwed to the chassis by 4BA self-tapping screws. The tube is placed in the shield before it is fixed to the chassis.

(e) The black p.v.c. extrusion is fitted round the edge of the large front panel hole to provide a mask for the cathode ray tube. The upturned flange on the light shield is pushed through the slot at the top of the front panel and screwed in place.

(f) The cover and base are fixed to the chassis with the same four 4BA self-tapping screws. The foam rubber feet are first inserted in the four holes in the corners of the base. This is then placed in position inside the chassis so that the four fixing holes line up with the corresponding holes in the chassis. The cover can then be slipped over the instrument and fixed in place by means of two 4BA self-tapping screws on each side screwing into the flange on the base. To hold the front panel firmly in place, two 4BA self-tapping screws are used which pass through the top of the cover and screw into the horizontal flange on the panel.

Wiring Notes

(a) The components shown on the wiring diagram of Fig. 2 and front panel diagram of Fig. 3 are not drawn to scale, but indicate the connection and appropriate position taken up by each component.

(b) The wiring diagram should be followed during assembly, but to gain familiarity with the instrument it should at every stage of the assembly be compared with the circuit diagram.

(c) Wires and component leads should be pushed through and wrapped around tags and valveholder pins to ensure a firm mechanical connection. No tag or valveholder pin should be soldered until all the leads and components on that particular tag or pin are in place and have been checked.

(d) Connecting wires should be straight with sharp distinct bends and be run flat touching the chassis.

Wiring Procedure

(a) Earth the centre spigot and appropriate pins on each valveholder to a soldering tag as shown in Fig. 2. In general, this can be done with bare wire.

(b) Run the wire connections as shown in the wiring diagrams Figs. 2 and 3. It is easier to do this before the components are wired in. Connections running from the under side to the top of the chassis are lettered to facilitate tracing on the drawings. Leads running to the cathode ray tube should be of flexible wire.

(e) Connect up the remaining components.
Testing Procedure

(a) Check all wiring carefully. Time spent in careful checking of wiring is always well spent, as any mistakes can be rectified without any damage to components.

(b) With the valves and cathode ray tube in place, the X and Y shift controls and width and focus controls set about half-way, and the brilliance control set fully clockwise, a blurred horizontal line should be visible on the screen. Centre the line on the tube by means of the X and Y shift controls and reduce the brilliance to a normal level.

Measure the voltages appearing on the anodes of V6. If they are not equal, turn the X shift control slightly until they are. Carry out the same procedure at the anodes of V2 and V3a. The two voltages should be almost the same (150V). Next connect the meter to the slider of the astigmatism control (VR3) and turn the spindle until the voltage obtained is the mean of the previous two. It will now be possible to obtain perfect focus.

The following voltages, which were measured with a 10,000 ohm V/meter, should be obtained. Due to variations in components, the actual voltages measured will differ slightly from those given.

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</thead>
<tbody>
<tr>
<td>310V</td>
<td>250V</td>
<td>20V</td>
<td>130V</td>
<td>75V</td>
<td>70V</td>
<td>63V</td>
<td>20V</td>
<td>150V</td>
<td>-320V</td>
<td>-440V</td>
<td>-620V</td>
<td>-680V</td>
</tr>
</tbody>
</table>

* Note.—These are negative voltages and must be measured with the positive terminal of the meter connected to chassis.

If no meter is available, the following procedure should be followed. Turn the coarse speed control clockwise to the position...
marked EXT. A dot will appear on the screen and by adjusting the astigmatism and focus controls simultaneously, and reducing brilliance as required, a good focus will be obtained.

The instrument should not be operated for any length of time with the spot stationary as this may cause local burning of the screen.

When the performance of the instrument has been checked, the screwing bracket (Fig. 8) should be screwed into place. The cover and base may now be put into place and the instrument is ready for use.

If built according to instructions, the oscilloscope will function perfectly; but if for any reason difficulty in achieving this is experienced, the Jason Motor & Electronic Co. will undertake any checking required. It should be emphasised that the component parts should be obtained from a supplier retailing either Jason or other manufacturers' equivalents which are "designer approved."

Operating Instructions

For most purposes, the internal timebase will be used to provide a horizontal sweep synchronized with the signal being examined. The "Synchron" switch should be set to "INT" and the "Coarse Speed" switch set to one of the required speeds, 1 to 4. On turning the "Fine Speed" control, the picture will lock and give a stationary trace. The width may be adjusted by means of the "Wave" control which gives a maximum trace width of about three screen diameters.

For some purposes, mainly when examining television receiver wave forms at frame frequency, the "Synchron" switch may be set to 350 c/s or alternatively to "Ext," when a synchronising signal derived from the sync separator or other suitable portion of the receiver may be fed to the socket marked "Synchron." The impedance at this socket is approximately 1 MΩ in parallel with 15 pF. With the "Synchron" switch set to the 350 c/s position, a sinusoidal sweep of mains frequency with a width of about 6 cm which is not affected by the "Wave" control will be obtained. This can be used with voltmeters, such as the Jason Type W1 which utilises a sine wave mains-derived sweep to display 465 kcs a.m.f./s, 10.7 Mc/s f.m. i.f.s and t.v. i.f.s within the 10-40 Mc/s range, also r.f. response curves using harmonics in Band I, II and III. F.M. discriminator curves may also be displayed. The mains frequency also provides a readily obtainable accurately maintained frequency source which may for example be used for checking the frequency accuracy of audio generators and similar equipment.

With the "Fine Speed" switch set to EXT an external sweep voltage may be fed into the socket marked "X Amp" to provide any type of timebase required. With the internal timebase running, a sawtooth voltage of about 25V peak is available at the "X Amp" socket.

Defects in Line Output Valves

The LINE OUTPUT VALVE in a TELEVISION receiver does an excellent job under most arduous conditions but, unfortunately, as soon as it develops some minor defects it usually becomes apparent on the picture. In general, the eye is more sensitive to valve defects than the ear, and as a result there must be many sound output valves which are operating with faults which would have rendered a line output with a similar fault quite unusable. Also, the valve in the line output stage is subjected to peak voltages on its anode which may well be in the region of 5.5 kV. A fault which introduces a further series of faults which would not be apparent should they be present in an audio valve.

A great deal of development effort has been spent in making the line valve as trouble-free as possible, and it is very much to the credit of the designers that in general these valves give an exceptionally good life. There are, however, some rather odd defects which can occur, and these will be discussed in their most probable order of importance.

Reduced Width

Like many other output stages, the line amplifier has to provide a certain output power into a transformer which, in turn, is coupled to the deflection coils to produce the horizontal scan on the picture tube. The power output is a product of the change in anode voltage and the change in anode current. The anode voltage swing for this calculation is the amount by which the anode falls below the h.t. voltage during each scanning cycle. This swing is thus limited in one direction by h.t. supply, and in the other by the lower sweep. This is usually prescribed by the manufacturer as a function of the "knee" on the I₅/V₅ characteristic of the valve. This knee voltage, as it is known, is a characteristic of the valve which is dependent upon the physical dimensions of the electrodes and is thus a factor which is determined by the designer. For all practical considerations, the knee voltage may be considered to remain constant during the life of a valve, and thus any reduction in output will occur at the expense of a reduction in the anode current swing. This will be due to the fact that the valve case will no longer be able to provide the peak current required at the end of the scanning cycle, but this reduction in peak current may have very little effect upon the mean or average current which the valve passes, so that it is not easy to detect with the aid of meters. Furthermore, a line output valve may be incapable of passing this peak current but will easily be able to supply the d.c. current required of it on a valve tester to show up as a good valve. This is a point which should not be overlooked when this class of valve is being tested to determine whether or not it is still capable of giving a full line scan. Fortunately, it is usually possible to gain confirmation that the emission of the valve is falling by observing the raster for any signs of cramping at the extreme right-hand side.

Line Interference

There are several valve defects which can cause either horizontal displacement of the scanning lines, or produce a form of interference pattern on the picture. These will be considered individually, but not necessarily in the order in which they are most likely to be encountered. Arcing within the valve is usually of a random nature and produces an occasional flashing on the screen. The effect is usually aggravated by gently tapping the side of the valve with an insulated rod whilst

1959 RADIO HOBBIES EXHIBITION

Of special interest to do-it-yourself radio and television enthusiasts will be this year's R.S.G.B. International Radio Hobbies Exhibition at the Royal Horticultural Society's Old Hall, Westminster. A special feature will allow visitors to operate and compare communications receivers of all kinds.

Sections will be devoted to amateur construction of both radio, h.f. and television transmitters and low noise receivers. Demonstrations of Hi-Fi equipment and of transistor mobile components, receivers and power supplies will be featured.

This annual event is sponsored by the Radio Society of Great Britain, who award prizes for outstanding examples of home-constructed equipment and who display many items of interest to amateurs.

The commercial exhibits will include kits and components in great variety for home construction, apparatus ranging from simple radio receivers to much more ambitious transmitters and equipment. A variety of aerials for home assembly, kits for car radios, oscilloscopes, etc., will be on show together with test equipment and accessories.

Displays by R.A.F., Royal Navy and Territorial Army Signals Sections will show the latest servicing equipment.

The show will be open from Wednesday 25th November to Saturday 28th November inclusive, from 11 a.m. until 9 p.m. (Admission is 2s.)

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it is operating. It is usually possible to observe the arcing within the valve by viewing it under darkened conditions where an occasional flashover may be visible, usually at either the top or bottom of the electrode assembly. A similar effect which may be less severe but which is nevertheless most puzzling when encountered for the first time is that which causes the reproduction of the thin streaks on the screen line of the oscilloscope as shown in Fig. 1. Although in the majority of modern receivers the vertical sides of the raster are not visible this horizontal shift of some of the scanning lines will cause the vertical edges in a picture to become ragged. This effect has been investigated at greater length by both circuit and valve engineers, and it was generally tracked down to a leakage at the anode top cap travelling down the glass bulb to the base. This charge will go to earth via the valve pins, and that which leaks out to the grid pin will cause a slow change in the grid voltage thus causing the spurious signal in the line deflection coils.

has the effect of producing a fairly well defined narrow white band from top to bottom of the picture and is usually in the left half section. Some readers will no doubt remember this form of oscillation being described in some of the introductory books on radio theory where it was shown to be produced by electrons oscillating at high velocity about the control grid; a condition which can occur when either the screen grid or anode falls below the potential of the control grid. During the line flyback period, the negative overshoot on the anode of a line output valve is often in the region of 1,000V, which is more than sufficient to produce Barkhausen oscillation. This oscillation occurs at an exceptionally high frequency and the tuned circuits associated with it can be formed by the leads to the anode, control grid or cathode of the valve. The cathode is usually earthed, and the effect of Barkhausen oscillation on the picture can often be eliminated by reducing the length of the cathode lead and making sure that it is well bonded down to the chassis. In many cases the effects of Barkhausen oscillation can be reduced by improving the ground return or by using a shielded interconnecting cable between the anode and cathode leads.

The leakage can be prevented from reaching the grid pin by painting a thin film of conductive paint around the bulb about I in above the pins and earthing it by means of a taping clip which is screwed down to the chassis. Aluminium paint is suitable for the band but care should be taken to ensure that there is no paint on the bulb above the level of the bottom index which is used to support the main electrode assembly.

Another fault which is associated with line output valves is Barkhausen oscillation. This receiver has a tendency to oscillate due to the effects of Barkhausen oscillation. This is observed as a reduction in width and worsening of the linearity with time which can occur after the receiver has been operating for some minutes after being switched on from cold. The cause of this problem is usually either primary or secondary frequency emission from the control grid, screen grid or anode. Anode emission will usually only have the effect of damping the negative overshoot on the anode during the flyback period, because during this time electrons will leave the anode and travel to the control grid. Unless very severe, this fault will not show up on the picture but will simply result in a loss of e.h.t. Emission from the screen grid can, however, be rather more serious, in that case the electrons will leave the screen and flow towards the anode during the part of the flyback period when their velocity is at a minimum, so that additional hours use they may impair the inter-electrode insulating characteristic of the valve. This will in time become apparent by either producing normal sparking within the valve or by a reduction in the control grid insulation. This latter will show up first because of the adverse effect upon both the linearity and width of the scan. Once again the only cure is to renew the valve.

We hope that this short survey of the faults which may occur in line output valves will assist readers in diagnosing the causes for one or more of the defects which have been described.

Courses for Radio Amateurs Examinations

Bradford Technical College
A course in preparation for the City & Guilds of London Institute's Radio Amateurs Examination will be held at Bradford Technical College on Thursday evenings from 7 to 9 p.m. Registration takes place on September 16, 17 and 18, 1959. Prospective students should contact the College for further details. Telephone 21748.

Grafton Radio Society
Grafton Radio Society announce that they have again made arrangements with the Holland U.G.C. Evening Institutes for official courses in the Radio Amateurs Examination and Morse (both for beginners) to be held this winter at the Monton School, Horsely Road, Hallown, London, N.7. The

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The pocket portable transistor receiver about to be described here is in logical sequence to the two earlier designs which were described in previous issues of this magazine. ("The Minor-One" and "The Major-Two”—see page 204, October 1958 issue.—Ed.) These were one- and two-transistor receivers respectively, which proved popular with the home constructor fraternity. In the present design, three transistors—all Edisan types—have been included, the circuit being that of a five-stage reflex receiver.

The "Major-Three" is fully tunable over the Medium wave range, and portability is ensured by the use of a Ferrite rod aerial together with the usual battery h.t. supply. Some three to six months of life may be expected from the battery specified—subject, of course, to the amount of usage. The whole receiver weighs only some 4 ounces and the "pocketability" may be judged by the overall size of 4½ x 3½ x 1½ in. It is contained in an attractive black and white moulded plastic case. The protruding controls are on/off switch and volume control combined, and tuning knob.

Circuit

This is shown in Fig. 1, from which it will be seen that it is a three-transistor five-stage reflex design. The transistor TR1, functions primarily as an r.f. amplifier, the resultant r.f. signal being fed, via C3, to the crystal diode. The signal is rectified here and then fed back, via the volume control and C4, into the ferrite secondary winding and from thence into the base of the same transistor. The audio signal applied to the base of TR1 is now amplified by the transistor and fed, from the collector and via the r.f. choke and C5, into the base of TR2. The amplified signal obtained from this second stage is now passed, from the collector and via the inter-stage transformer, to the base of TR3. From here, the audio output is taken via the collector to the deaf-aid insert. All three transistors operate in the earthed emitter mode.

Constructing the "Major-Three"

Constructors should note particularly the colour coding of both the ferrite rod aerial windings and the inter-stage transformer and ensure that these are correct—as given in the circuit diagram—when wiring these components into position. The correct polarity of both the electrolytic condensers and the battery should also be noted. As received, both the cabinet and the chassis are ready drilled and riveted.

With the exception of the volume control and the tuning condenser, the chassis should be wired up outside of the cabinet, the whole being assembled together when the chassis is wired, except for the two aforementioned components.

(1) Solder the bare wire to those solder tags forming the positive bar. Deal similarly with those tags forming the negative bar.

(2) Solder in position R1 holder (centre pin to one end of double solder tag).

(3) Connect C3 (red to positive bar) and R2 (black/brown/red) into circuit.

(4) Ensuring that the leads of RFC1 are approximately 1 in. in length, solder this component into circuit, together with R4 (yellow/mauve/red) and C3 (0.1μF).

(5) Solder in position C3 (47μF), and RFC2.

(6) Connect the plain end of the diode to the end of C3. Leave the red or dot end unconnected at this stage.

(7) Solder in position both R5 (grey/yellow/blue) and R6 (brown/black/orange).

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Designed by D. J. French, Grad.I.E.E. of Henry's Radio Ltd.

Components List

Resistors

R1 100kΩ
R2 1kΩ
R3 1kΩ
R4 27kΩ
R5 680kΩ
R6 1kΩ
R7 10kΩ
R8 4.7kΩ
R9 10kΩ potentiometer w/switch

Condensers

C1 500μF trimmer
C2 25μF electrolytic
C3 0.005μF
C4 0.1μF
C5 0.1μF
C6 10μF 18V wkg, electrolytic
C7 47μF

To the junction of these two components, connect the other end of C3 (0.1μF).

(8) Secure R1 (brown/black/yellow) in position (one end only), and follow this by soldering R3 (brown/black/orange) into circuit.

(9) On top of R3 mount C3 (0.005μF) and solder. Connect one end of C4 (0.1μF) to the junction of R1, C3, leaving the remaining wire for the time being.

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(10) Connect into circuit and join R1 (brown/black/yellow) and R3 (yellow/mauve/red).

(11) Solder in position the holder of TR2 (third transistor).

(12) Secure in position the type D240 transformer and the holder of TR3. Observe here the lead colour code of the transformer.

(13) Solder the deaf-aid insert leads but
leave the actual earpiece unconnected in order to prevent heat damage.

(14) Place the ferrite rod aerial assembly into the mounting clip and connect the secondary winding leads into position as shown on the circuit diagram. Leave these leads somewhat on the long side.

(15) Bolt the volume control and the tuning condenser to the side of the cabinet. Connect the remaining two leads of the ferrite rod primary winding to the tuning condenser.

(16) Connect C6 (100pF) between points "PP" on negative and positive bars. (Black end to positive bar.)

(17) Solder the red or dot end of the crystal diode to "Q" tag of the volume control.

(18) Solder the remaining end of C4 to tag "B" of the volume control and connect tags "A" and "F" of the volume control to the positive bar.

(19) Connect a lead from the positive battery connection to tag "D" of the volume control.

(20) Cut the transistor leads to about half an inch in length and plug these into the transistor holders thus: TR1, XA103; TR2 and TR3, XB104. Ensure that these transistors are placed the correct way round, i.e. white dot at "C" on each holder.

(21) Thoroughly check the wiring before inserting the battery into position. Look especially for component wires touching each other where they should not be in contact at all. Ascertain that no "dry" joints have been made. Carefully check the circuit diagram that the receiver has been correctly wired and with the illustration that the components occupy roughly the same positions as those shown.

Getting the Best Results
Once the receiver has been completed and is in working order, one small adjustment is capable of greatly increasing both the selectivity and sensitivity of the circuit. This is achieved by the careful positioning of the choke RFC1 in relation to the aerial winding on the ferrite rod assembly. This positioning of RFC1 for optimum performance should be carried out with the tuning condenser set to the wavelength of strongest station receivable according to the location of the constructor. Should RFC1 be positioned too near the aerial winding, a "bubbling" will be heard in the deaf-aid insert, in which case the r.f. choke will have to be spaced a greater distance from the winding.
A MID HOME CONSTRUCTOR CIRCLES, interest in the small portable receiver grows apace, evidence of this being the number and variety of such designs appearing in the radio press over the past few years. The portable receiver, as its title implies, must be one hundred per cent portable—which in turn suggests that it must be light in weight, be compact and efficient, and have convenience in stowing. In addition to these factors, it must also be attractive in the sense of "eye appeal."

Such a receiver is the "Tourist"—a very apt name since the above conditions have been fully met on all counts. Utilising the latest type of circuitry, and giving an excellent performance combined with a low battery consumption, this really small and compact portable receiver has a high sensitivity combined with an excellent frequency response.

The completed receiver, including the battery, is housed within a cabinet measuring only 8 in x 5 1/2 in x 4 in, and the total overall carrying weight is only 3 1/2 pounds. It is apparent that a good deal of forethought and planning by the designers have gone into the production of this little receiver. The metal sub-chassis, as supplied, is completely pre-punched, with the valveholders already fitted into position. Likewise, the earthing metal tags and rubber grommets are already in place, as received. This means that the constructor is not only saved a great deal of time and trouble but the valveholder orienta-

tion of the prototype is exactly adhered to on every production model. The receiver controls protrude through the underside of the chassis, and this method of layout greatly assists short and direct wiring, with consequent stability of performance. A study of the illustrations showing the above- and below-chassis layouts will clarify the method of component assembly upon the sub-chassis.

The "Tourist" is a two-way-band receiver, uses the well-known 96 series of low consumption valves and incorporates a ferrite rod aerial. The speaker is a 3-inch circular extra high flux permanent magnet type, the excellent audio response being assured by the type of output transformer incorporated in the design. This latter component has been specially wound to match the circuit requirements.

The receiver, as may be seen from the front cover illustration, is housed in an attractive cabinet in modern styling, covered with contemporary leather cloth and contrasting Tygon speaker fret material, calibrated scale and ivory gold-filled knobs which, together with a neat carrying handle, completes the very smart appearance.

Circuit

This is shown in Fig. 1. The frequency changer V1, a DK96 lephto, has the grid connected, via S1, portion of the wavechanger switch, to a ferrite rod aerial assembly containing both long and medium wave windings. Each winding, when in circuit, is tuned by the variable condenser C3 and the trimmer condenser C5, the fixed value of C1 being brought into circuit only on the long wave position. The oscillator section of the frequency changer is tuned by the variable condenser C16, this being one half of a two-gang component comprising C15 and C16. The oscillator trimmer condenser is C15, the switch S2 being the requisite wavechange switch, which, in the long wave position brings into circuit C4 across the tuned winding. C4 is the padder condenser. The oscillator coil is the well-known Osmon Radio Products Ltd type Q08. The oscillator "anode" b.f. potential is applied via the resistor R2, the condenser C2 being the bypass component. The i.f. is 470 kc/s and the i.f. transformers are supplied pre-aligned to this frequency. The i.f. stage V2 is constructed around the DF96 vari-mu pentode, the resultant output from this stage being taken, via IFT2 and R3 into the volume control R5.

The diode pentode shown in the DAF96 type. The output from the diode pentode is taken into the output stage via the coupling condenser C13. Automatic bias for the grid of this stage is derived across R15, and applied via the grid leak R16. The resistor R32 provides a certain amount of negative feedback. Audio output to the speaker is fed via the transformer connected into the anode circuit. The output stage is constructed around the DL96 output pentode.

Assembling the Receiver

First assemble on the ready-drilled chassis the volume control R5, and the two i.f. transformers IFT1 and IFT2. Radio beginners should note that the on-off switch S1 and S2 of Fig. 1 is also contained within the volume control. Secure each i.f. transformer to the chassis by means of two 6BA screws, but ensure from Fig. 2 that these are correctly located with respect to pin numbers.

Looking at Fig. 2, you will note that this is the side of the chassis on which the valveholders have the soldering pins exposed. It is also on this side of the chassis that the control spindles of the volume control.
and wavechange switch protrude. The outline shape of the chassis will greatly assist with respect to correct locations of components in both Figs. 2 and 3.

Next, secure in position the wavechange switch S1 and S2; again, this is a combined component. A glance at Fig. 3 will show the approximate locations of these components. Follow this by fixing the variable tuning condenser C3 and C3 into position (Fig. 3), using the three 4BA x 3/4 inch screws. (Fig. 2) Having completed this, the two trimmers C3 and C4 may be held in position (Fig. 3) by means of a 6BA screw and nut each. From Fig. 3 ascertain the position of the oscilator coil Q38 and firmly press this into the aperture provided, ensuring that the straight side of the tag ring is towards the two trimmers previously mounted.

Laying the chassis to one side for the moment, fit the battery retaining clip to the speaker magnet and tighten the 4BA screw and nut already fitted. Ensure that the clip is horizontal when the output transformer (already fitted to the speaker) is positioned at the top. Next, secure the ferrite rod aerial clip to the output transformer by means of a 6BA screw and nut through the left-hand aperture (looking at the rear of the speaker) on the top of the transformer. Fix the speaker, complete with the clip now mounted, into the cabinet by the two long screws already in position and secure with two 6BA nuts provided. Ensure that the output transformer is sited at the top of the receiver cabinet. This completes the assembly details.

Wiring the Circuit

The following instructions are intended for those who have had little or no experience of receiver construction but who are assumed to have mastered the art of soldering. It is also assumed that the intending constructor has a small electric soldering iron and a pair of pliers.

The more experienced constructor will, of course, work directly from the circuit diagram or possibly from Fig. 2 and 3.

Frequent glances at the accompanying illustrations will greatly assist the beginner with respect to the "real" position of components; both Figs. 2 and 3 being "approximate" drawings for purposes of clarity.

All the resistors used in the receiver, except, of course, for the volume control, are contained on a clearly marked card, each being designated both by the R number in the circuit diagram of Fig. 1, and in its respective nominal ohmic value. The condensers are likewise clearly marked and are mounted on two separate cards. Beginners should remove each component as mentioned below and in that order. Do not remove the components from the card until they are mentioned,
otherwise identification will be impossible unless the colour code is known.

We commence by first soldering in the wires necessary to carry the h.t. and l.t. currents. Take two lengths of p.v.c. covered wire, about 44 inches in length, and bare the four ends. Solder the end of one to the top left-hand tag at the rear of the volume control (see Fig. 3). Connect the other end of this wire to the appropriate pin of the four-pin plug, also shown in Fig. 3. To correctly solder this latter connection, pass the bare wire through the pin until it extends from the end furthest from the paxolin shoulder. Solder at this latter point and remove any surplus wire with the aid of a pair of cutters. Dealing with the second wire, solder one end to the top right-hand tag of the volume control and the other end to the top left-hand pin of the four-pin plug. Note here that the view of the plug shown in Fig. 3 is that shown looking at the rear of the component with the pins pointing away from the reader. The position of the pins can be ascertained by the fact that the two top pins are set further apart than the remainder.

Connect into circuit the wires marked C and D shown in Figs. 2 and 3. Bare and connect the end of each to the 4-pin plug, as shown, and then pass these through the rubber grommet and solder the end of each to pin 4 of V3; the end of D to pin 3 of the same valve.

To the lower left-hand tag at the rear of the volume control, solder one end of a short length of p.v.c. wire (A), the other end of which should now be connected to pin 1 of V4. To the lower right-hand tag of the volume control connect a similar length of wire (B) and solder the other end to pin 3 of V4. This completes the h.t. and l.t. inputs to the receiver. We must now connect into circuit other h.t. and l.t. points within the receiver.

Take a short length of p.v.c. wire and bare one end sufficiently so that pins 1 and 7 of V4 may be connected together. Solder these connections and join the other end of this wire to pin 7 of V3. From this latter pin connect a further length of p.v.c. wire to pin 7 of V2. Returning to pin 7 of V3, connect a further length of p.v.c. wire to this
pin and solder the other end to pin 7 of V1. This completes the L.T. wiring.

We next deal with the h.t. and L.T. wiring.

Dealing with V1 first, with a bare short length of wire connect the central metal spigot of the valveholder to pin 1 of the same valve and from thence to the earthing tag on the chassis just above the valveholder.

For V2, again with a bare short length of wire, connect together, in this order, pin 5 to the metal spigot to pin 1 and thence to the earthing tag just below the valveholder.

With V3, using the bare wire, connect the spigot to pin 1 and from there to the earthing tag adjacent to the valveholder.

Lastly, V4, connect together the metal spigot to pin 5 and from there to pin 1 of V1. This completes the minus (−) return wiring.

The next step is to bring in the h.t. + connection points.

To pin 3 of V4 solder one end of a short length of bare wire just sufficient to reach pin 6 of IFT2. Having soldered this to the valveholder pin, slip over the wire a suitable length of red systoflex material. Solder the other end to the h.t. connection already mentioned. To pin 6 of IFT2, and similarly covered as above, solder one end of a short wire, the other end of which is connected to pin 3 of V2. From this latter point, connect a further length of wire, again covered with systoflex, and solder the other end to pin 6 of IFT2. Having done this, to pin 6 of IFT2, solder a further length, suitably covered, the other end of which is now connected to pin 3 of V2. This completes the h.t. + wiring except for the output transformer, which will be dealt with at a later stage. The next job of work, having proceeded thus far, is to commence wiring into circuit all the components contained on the three cards.

Resistors

For ease of construction, it is best to deal with these components first, leaving the two condenser cards strictly alone for the time being. Beginners are advised to follow this method and not cause confusion by removing components from two cards at once.

Take R1 (100kΩ) from the card and suitably shorten the wire ends so that each may be soldered to the valve pins of V1. (See illustrations.) Solder one end to pin 4 and the other end to pin 7 of V1. Note the position occupied by this resistor, and for that matter all the other components, in the photograph of the underside of the chassis.

With R2 (15kΩ), cut one wire end only in such a manner that the end of the resistor is resting up against the rubber grommet through which the long wire end must be passed. Solder the cut wire to pin 5 of V1.

The other wire end of this resistor will now reach the appropriate tag of the coil which should be bent down slightly. This wire end (L) should now be soldered to this coil tag.

From pin 3 of IFT2, connect R3 (47kΩ), this end of the wire being shortened. Cover the other wire end (F) with a length of systoflex and feed this through the rubber grommet adjacent to the h.t. metal can. Solder the other end of R3 to the left-hand tag of the actual volume control. (NOTE: There are three tags connected to the actual volume control and these are mounted on a paxolin strip; these are separate from the four tags contained on the rear of the control with which we have already dealt.)

Dealing now with R4, do not cut the wire ends but place over them lengths of systoflex, and solder one end to pin 3 of IFT2 and the other end to the bare wire contained on the rubber grommet end of R3. In other words, connect one end of R4 to one end of R3, but ensure that the correct end of R3 is used, i.e. that nearest the rubber grommet.

The remainder of the wiring to the potentiometer R5 will be left till a later stage in the proceedings. Dealing now with R5 (10MΩ), suitably shorten the wire ends of this component and solder one end to pin 6 of V2 and the other end to the earthing tag just below V2 valveholder.

To pin 5 of V2 valveholder solder one end of R6 (50kΩ), the other end of which should now be connected to pin 6 of IFT2. Follow this by removing R5 (4.7MΩ) from the card, suitably shortening the wire ends and soldering one end to pin 4 of V2 and the remaining end to pin 6 of IFT2. Beginners should note here that R6, R7 and R8 do not require systoflex material to be fitted over the wire ends. These wire ends should be made as short and direct as possible, at the same time ensuring that none of these wires are in contact with any other metallic points other than those specified.

The resistor R9 (22MΩ) should now be taken and the wire ends shortened in such a manner that they will reach pin 5 of V3 and pin 2 of V4 (see illustration for the correct location of this resistor). Fit over each wire a short length of systoflex material and solder to the points previously mentioned.

To pin 6 of V4 solder one end of R10 (2MΩ), the other end of which is next connected to pin 4 of the same valveholder. To pin 4 of V3 solder one end of R11 (560kΩ), the other end of which should now be secured to pin 5 of V4.

This latter instruction may be somewhat confusing to beginners who are following the circuit diagram, therefore it will be explained here that pin 4 of V3 has no internal connection to the valve, but the pin is used externally as an anchoring and connection.
point for components; in this case R₁₀ and R₁₁. Pin 5 of V₄ has, in this instance, been utilized as the earth connection for one end of R₁₂. This completes the wiring into circuit of the resistors except for the remainder of the connections to the volume control R₅. This will be dealt with as we deal with the various condensers. The constructor should now, before proceeding further, check that all resistors are correctly connected and located.

VOLTAGE TABLE

<table>
<thead>
<tr>
<th>Voltage measured with an AVO &quot;8&quot;—chassis negative.</th>
<th>Pin Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>V₁ DK96</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>V₂ DP96</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>V₃ AF96</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>V₄ DL96</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>

Condensers

The silver mica condenser C₁ (130μF) should now be removed from the chassis. The two ends should be shorted together to the ground point at the rear of the chassis (See Fig. 3). Ensure that this wire does not come into contact with any other part of the chassis. Use the other end of this condenser to the earth terminal near the terminal block of the chassis. We now deal with the connections to C₂, it being part of the main two-gang condenser nearest the mid-bus terminal. Obtain a length of p.v.c. wire and bare one end sufficiently in length so that the ends may be soldered to the tag of C₂ and a similar length along this bare wire, also soldered to the earth terminal near the terminal block of the chassis. The length of this wire should be shorted to the ground point of the chassis. The other end of this condenser should now be connected to the earth terminal near the terminal block of the chassis ensuring, of course, that it does not come into contact with the chassis. Only slight pressure will be required to bend this tag. The other end of the p.v.c. wire should now be cut and soldered to the tag of C₁ (35μF) trimmer. To this latter point, a further length of p.v.c. wire (M) should be soldered, the other end of which is fed through the aperture in the chassis near V₁ valveholder and connected to V₁.

From pin 3 of IFT₁, solder one end of C₃ (0.04μF) and connect the other end to the earth terminal near the terminal block of V₁. Note the position of this condenser from the illustrations.

Dealing next with C₄ (500μF), suitably shorten the wire ends and connect one end to the right-hand tag of S₂ (see Fig. 3), and the other end to the lower right-hand tag of the coil Q₀₈. Again, note the physical position of this—and the following condenser (C₁₀)—from the photograph. Similarly prepare C₅ (400μF) and connect one wire end to the upper right-hand tag of the coil Q₀₈ and the other end to that earthing tag along with the various condensers. The constructor should now, before proceeding further, check that all condensers are correctly connected and located.

Additional Information

- **VOLTAGE TABLE**: Table listing various voltages measured with an AVO "8"—chassis negative.
- **Condensers**: Instructions for handling and connecting condensers, including the silver mica condenser C₁ (130μF) and others.
- **Wiring**: Directions for connecting components such as resistors, condensers, and wires to the chassis and mid-bus terminal.

Additional text includes details on adjusting the volume control, wiring the earth connection, and handling condensers. The text continues with various technical specifications and instructions, providing a comprehensive guide for setting up and adjusting the radio receiver.
radio
miscellany

SINCE THIS COLUMN FIRST TOOK AN
interest in the garden-shed workshop I
have been greatly surprised at the very
high proportion of hobbyists who, either by
force of circumstances or choice, have a self-
built workshop. They vary from lean-to's,
erected against a blank wall, and annexes
tacked on behind the garage, to full-blown
independent structures standing proudly in
their own grounds. A few years ago garden
sheds were few and far between, although
many handymen had some sort of out-
building used for storage, keeping the
firewood dry, and rough or dirty work.
Today's garden-sheds are in an altogether
different category, and sturdy modern
buildings with space heating, strip lighting
and curtained windows are apparently
becoming commonplace.

With t.v., f.m., etc., our hobby has become
more and more complicated. The days have
long since gone when one could get by with
a soldering iron and a universal meter with
the kitchen table as a workbench. Nowadays
the keen types think nothing of carrying a
comprehensive range of special tools and
test equipment which would fill two sides of
a medium-sized room. Pre-war, too, one
could practically build a set in a single
evening, but a modern t.v. or f.m. receiver
may well be several weeks in the making.
Hence it is nice to have a place where every-
thing can be left undisturbed with tools and
test gear right to hand. Even those who in
the past have been content with a spare
corner in the house are beginning to turn to
specialy designed garden buildings. While
a brick and concrete workshop is a mighty
expensive proposition if a builder has to be
called in, it is neither too costly nor beyond
the capability of a versatile radio enthusiast
(and most of us are that) especially if one
can get the advice and assistance of someone
in the building line. In fact, I have more
than once been greatly surprised how
economically it has been done.

A Cosy Retreat

Our Editor has recently become the
owner of a handsome self-built workshop
which was designed and erected by himself
and brother-in-law—the latter experienced
in the building trade. The photograph on the
next page shows the start of the
9in front and side walls (rear wall 41in).
The upper picture shows the building near
progress, while the top one is of
one corner viewed from the doorway. The
interior is finished with hardboard fitted to
the underside of the roof beams and held to
the walls by 1in battening, giving it the effect
of "cavity walls." The lathe, incidentally, is
31in centre height and the bench drill is 1in
capacity. Unfortunately the rest of the
interior cannot be seen, but it includes a
workbench, anglepoise lighting, 4in vice,
steel shelving, etc., and also a 21ft rule (which
is to wipe your feet when you go in!).

As might be expected from such a
"professional type" job, no trouble has
arisen from dampness, the only precaution
necessary being the light greasing of stored
equipment. The electric power is drawn from
the house using Pyrotex cable travelling
underground.

Your Say

While on the subject of outdoor work-
shops, an interesting letter comes from
P.H.P. (South Norwood) who expresses
surprise that when the question of ventilation
was under discussion no one mentioned the
Hume Ventmaster. This device, primarily
designed for greenhouses, consists of a
chemically filled cylinder which is fitted to
the window frame. As the temperature
varies the fluid contents or expands automatically closing or opening the vent, thus needing no special attention. From reports I have had from users, I find that they are eminently satisfactory and will operate quite heavy ventilators or window frames with certainty. P.T.P. also mentions another device by the same firm, a fan ventulator controlled by a thermostat of which home versions might well be contrived by the average reader.

Another interesting letter to A.M.P. (Communications) on the subject of "disappearing" valve type numbers. He feels the manufacturers have given the question of more permanent markings much thought but have retained the old practice of having to coDetermine on safety grounds. Hydrofluoric acid etching is dangerous and likely to remove the opera- tor's name from the glass. A. M. P. suggests a somewhat similar system to that used in the Philips system described in our April issue. This should not be difficult as the time factor is not important, as would be in a factory process. On the same subject a Mitcham reader (anonymous) clycally writes that manufacturers deliberately delay the marking until the last thing so they can leave their names off if the tubes fail to come up to standard on their final test.

Centre Tap talks about items of general interest

Finally, more old-time memories, this time from W.G. (Bradford), 3, were revived by my reference to early loudspeakers. His father-in-law, who was both a linguist and a poet, had been at making pleated paper cones which he scored lightly with a darning needle, gluing cork to the cone (instead of the sealing wax I mentioned). Also, instead of using stiff wire between the cone and cork, he used a matchstick. He considers (as did many others) that there were the best thing of their time. Later he bought one of the earliest moving coil speakers from J. Briggs, whose new-fangled business was then in a city centre Bradford basement. This enterprise has since grown into the world-famous Wharfedale business. Incidentally, that speaker gave splendid tone right up to the end of the war and after.

Old Timers will recall how we were apt to regard the early permanent magnet m. speakers with some suspicion, and wondered just how "permanent" the magnets would prove to be. Well, just recently I gave the magnet of a very old one to a youngster as a plaything. Later, when he knocked over a boxful of his mother's dressmaking pins he, childlike, collected them up with his magnet. From then on, of course, every time she picked up her scissors she found scores of pins clinging and dangling all over them! Which only goes to prove we needn't have worried about the permanence of those magnets after all.

Money for Old Rope

Although the subject is of serious interest to many, I have not been able to find any comprehensive reviews of the subject in recent years. There is a wealth of information available in the literature, but much of it is scattered and not always easy to find. The most comprehensive source I have found is the book "The History and Theory of the Telephone" by J. B. Hanford. This book is available in a number of libraries and is a good starting point for anyone interested in the subject of old-time rope.

The TOURIST Portable Receiver

continued from page 125

Re-tune to Luxembourg (208 MHz) and adjust C14 trimmer for the correct calibration of the scale.

The above should be repeated to ensure maximum output with accurate calibration.

Turn the wavechanger switch clockwise to the long wave position and the Light Programme (1500 MHz) and adjust the long wave ferrite aerial winding along the rod to obtain maximum output.

Having completed the lining-up process, it is advisable to seal the windings to the ferrite rod with a fixative material such as polyurethane cement, etc. The trimmers C13 and C14 should also be treated in the same manner.

PHILIPS Continuous Tape Cassette

Philips Electrical Ltd. are now marketing a Continuous Tape Cassette, type EL 9267/00, which is intended for use together with their AG8108G Tape Recorder and with certain other models which have a left to right tape sense and facilities for locking in the tape in a stationary position during recording and playback.

Of clear plastic, the cassette has a diameter of 3 4/5 in. and contains low friction magnetic tape coated on both sides. Playing time is 20 mins. at 15 2/3 l.p.m., 10 mins. at 31 1/2 l.p.m. and 5 mins. at 78 1/2 l.p.m. These times may be doubled by the formation of a "mobius loop" as described in the operating instructions. The EL 9267/00, which sells at £3.0s. 0d., is suitable for application in all situations requiring a continuous operation of directions, messages or signals.
TESTMETERS and their circuits

By W. Cleland

In this article, methods are analysed which enable a meter scale to serve for a number of ranges

The substitution of an equivalent generator for a network is quite revealing when applied to testmeter problems. For example, in a circuit under test there is a certain maximum amount of power "available" between any two given points, and a meter when connected must absorb only a small fraction of this. For radio work, we require a sensitive meter, and for some purposes may even have to increase its sensitivity by using valves or transistors.

![Diagram](https://example.com/diagram1.png)

### Fig. 1. D.C. multipliers. The values to be inserted in the formulae are those for full-scale deflection

- **(a)** Voltage divider
- **(b)** Current range
- **(c)** Load

Strictly speaking, the meter reading applies when the meter resistance is present. If it is to apply in the absence of the meter, the temporary addition of the meter must disturb the circuit as little as possible. A voltmeter with a resistance n times that of the circuit across which it is placed will read low by 1/nth part. The same is true of an ammeter or milliammeter inserted at some point where the meter resistance is 1/nth of the network resistance. If, however, we can estimate the equivalent resistance of the circuit in terms of the d.c. resistances of its linear components and the slope resistances of its non-linear components (such as valves), we can apply a correction; but a high resistance voltmeter is much more convenient.

Current measurements are less common, and a drop of a fraction of a volt across the meter is usually of little importance. In a.c. measurement, however, the potential drop is often rather large.

### Resistance Measurement

The facilities offered by a testmeter for resistance measurement are among its most useful, and it is always a simple matter to check the calibration by using a number of accurate resistors. Circuit details are given in Fig. 2. On each range the circuit reduces to an equivalent generator with a short-circuit current which corresponds to meter f.s.d. We need only multiply the generator e.m.f. and resistance by ten to multiply the scale readings by the same factor. A potential divider can be used to change the generator e.m.f. by the tenfold steps, and the circuit resistance need only be adjusted on each range to give short-circuit f.s.d.

It may only be possible to secure the further reduction in circuit resistance to give the lowest range by placing a shunt across the meter, and this will probably require a heavier current to be supplied by the battery than would suffice for the higher ranges. Another method often used for low resistance readings is to connect the unknown resistances as shunts across the meter, but the scale then becomes backward-reading, which is rather confusing. A better method is shown in Fig. 3, which will allow the equivalent generator resistance to be reduced ten times without altering the e.m.f. It requires an auxiliary network of three resistances on the bottom range, the circuit taking the form of a bridge which is unbalanced by the unknown resistance.

A single forward-reading scale can thus serve all ranges. It is non-linear since it obeys the formula:

\[
\frac{I_n}{I_0} = \frac{R_x}{R_0} + \frac{R_x}{R_0}
\]

where \( R_x \) is the resistance being measured, and \( I_n \) the corresponding meter current, \( I_0 \) the internal resistance which the ohmmeter presents between its terminals on that particular range, and \( I_0 \) is the full-scale current.

Changes of current in the ohmmeter, however complicated the circuit, are always inversely proportional to \( R_x + R_0 \). This is not a difficult to prove and leads directly to the above formula.

In simpler types of ohmmeter, the means of readjusting to short-circuit f.s.d., as the battery deteriorates, over a long period, produces errors in measurement. The internal resistance of the battery may eventually reach hundreds of times its original value of a few ohms, while the e.m.f. may have dropped by 10%, so the method of readjustment ought to be effective against

![Diagram](https://example.com/diagram2.png)

**Fig. 2.** Resistance ranges (a) with equivalent circuit (b). \( R_n \) may be absent, but if temperature errors are to be avoided on the lowest range it is desirable to have enough series resistance to act as a shunt. For the lowest range a shunt may have to be placed across the meter to obtain the required reduction in the value of \( R_0 \).

![Diagram](https://example.com/diagram3.png)

**Fig. 3.** Modified circuit of low resistance range. The value of \( R_3 \) might be 1/9th of the meter resistance, assuming a microammeter with a resistance of several hundred ohms. The value of \( R_x \) is only a fraction of \( R_0 \), and it is included to enable the ohmmeter equivalent resistance \( R_n \) to be adjusted to the exact value required.
to keep the voltage E constant, while on the top range it will be necessary to be able to adjust part of the resistance R<sub>S</sub> on that range to keep the generator resistance at its correct value.

**Alternating Currents**

When we turn to a.c. measurement we have to introduce a bridge-type meter rectifier, under precisely the same conditions on all the voltage ranges. The universal shunt ensures this for the current ranges. If a universal shunt of total value 1 kΩ is used for the current ranges, then replacing it by a series resistance of 1 kΩ will convert readings of milliamps into volts. This is the well-known transformation of a current source into an equivalent voltage source, and

whose resistance varies at different points of the scale. Nevertheless a nearly-linear scale can be obtained at low readings, provided that no low-value series resistance or shunt is used. If, however, a comprehensive series of ranges is to be provided, the condition cannot be met, and the scale will depart considerably from linearity, with scale divisions crowded at low readings; and temperature errors will become appreciable, because the rectifier will constitute a large part of the resistance in series with the meter.

An instrument transformer is normally used for the current ranges, but a universal shunt can be used instead, although this will have a large power consumption on the higher ranges of current. The method is applicable because the current-multiplying factors of a universal shunt do not depend upon the meter resistance, so that any given value of rectified current through the meter will correspond to the current ranges to alternating current inputs to the instrument bearing the fixed ratios to each other set by the universal shunt.

For alternating voltages, a number of ranges can be fitted to a common scale by using combinations of series and shunt resistances, each pair giving the same value when connected in parallel. On the lowest range a single resistance having this value can be used in series, without any shunt resistance. These arrangements constitute a type of attenuator which enables the attenuation to be changed by factors which are independent of the meter resistance as a load, and ensure that the rectifier works would make it possible to use a single scale for alternating current and voltage ranges. However, better characteristics can be obtained if there are separate scales.

The calibration of an a.c. scale with sinusoidal current, in r.m.s. values, will only hold accurately for a sinusoidal waveform, because although the use of a shunt will cause a departure from linearity, it will not be easy to ensure that the rectifier closely follows a square law of deflection.

**Practical Details**

It will be seen that a system of networks can be made which, connected to any suitable type of meter, would convert it into a multi-range test meter. A multiplicity of scales, of course, requires a pointer of the knife-edge type, but there is the alternative of using conversion tables with an existing d.c. scale. The series and parallel elements for range extension should be stable accurate resistances of low temperature coefficient, and of the required current or voltage rating. Because of the low resistance of a shunt, it has to be provided with double leads, one pair to the input and the other to the meter. A double-pole switch is required, but a universal shunt is simpler in a number of respects, and could be used with sockets instead of a switch. The shunt is matched to the meter by adjusting a swamp resistance in series with the meter. This has to be of several times the meter resistance in order to avoid errors arising from the different temperature coefficients of the external resistance and the moving coil.

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**A Receiver Output Matching Box**

*by G5UJ*

The unit here described is both handy and cheap, and has proved itself in use at a friend's station. As the schematic diagram (Fig. 1) shows, it consists of one of the well-known ex-Service FL8 Filter Units, a high/low impedance matching transformer, and three standard jacks. Built inside an Oxo tin, or similar metal box, it can be placed alongside the Rx, where it will provide the answer to the impedance matching problem. The circuitry is quite straightforward as a

Fig. 4. A.C. multipliers with the corresponding input currents and voltages for f.s.d. Diagrams (a) and (b) represent current ranges using a common scale, (c) and (d) are voltage ranges. Note that if we make R<sub>1</sub> = R<sub>2</sub>, then V<sub>r.m.s.</sub> = R<sub>1</sub> I<sub>r.m.s.</sub>

Operation is quite simple, and needs little explanation—on plugging a pair of high-resistance 'phones into J<sub>1</sub>, output is obtained from the 3-position filter—enabling CW to be copied even through quite heavy QRM. J<sub>2</sub>, of course, gives normal receiver output, whilst J<sub>3</sub> is employed in the case of low-resistance 'phones. Several other applications may occur to the reader, which have not been mentioned. The total cost of the parts needed should not exceed £1 or so, as the

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**Fig. 2**

Circuit diagram of impedance matching unit

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FL8 units are available on the surplus market for as little as 7s. 6d. to 8s. 6d.,* whilst in the same market the matching transformer should cost no more than a few shillings. The small outline and time spent in building this useful piece of apparatus will be well repaid by the results obtained.

*The FL8 unit may be obtained from Messrs. N. R. Birdwell, 81 Sellers Street, Sheffield 8.

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Circuit diagram of impedance matching unit

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**Fig. 2**

Circuit diagram of impedance matching unit
A SIMPLE CHASSIS PUNCH

by M. J. MORLEY

This little machine was built to reduce the labour involved in piercing a large number of holes in a chassis before bending the parts. The size chosen was 1\(\text{in}
\) as holes up to 1\(\text{in}
) can easily be drilled using an ordinary hand drill, and because both potentiometers, etc., and valvebase chassis cutters require a 1\(\text{in}
) hole.

Construction is simple and most of the materials can probably be found in the average junk box. The base is a flat steel plate, the size of which determines the available throat depth. Failing this a strong wooden base with a steel insert could be used.

A 1\(\text{in}
) hole must be drilled in this plate, this being filed out underneath to allow clearance for the blank. The main arm is the next part, the strength of this determines the thickness of the material which may be handled. In the original version an arm of 1\(\text{in}
\times 1\(\text{in}
\) (from an old car tyre lever) enabled 18 s.w.g. aluminium to be handled at a throat depth of 3\(\text{in}
\), while 22 s.w.g. could be cut at 6\(\text{in}
\) throat depth. The arm is fixed to the base by four 1\(\text{in}
\) bolts using a 1\(\text{in}
\) packing piece. At the end of the arm a 1\(\text{in}
\) hole must be drilled to act as a bearing for the cutter; this hole must, of course, coincide with that in the base. A bush must be soldered to the arm to make up the bearing length to at least 1\(\text{in}
\). If a 1\(\text{in}
\) thick bar is available it would be ideal for the job.

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Extension of Range and Reduction in Prices

As a result of improved manufacturing techniques it has been found possible to extend considerably the ohmic range of the Jobling Metal Oxide Film Resistor (makers of "Pyrex"). These highly stable resistors are now available in values up to 2 megohms.

Economies resulting from increased sales allows substantial price reductions, effective immediately. These resistors will, in future, be marketed under the registered trade name "Electrozi".

"SIMPLE NOTES ON LEAD AND ITS USES"

It has become necessary to reprint this 4-page brochure which has, for over 4 years, enjoyed a steady demand among students not requiring an extensive or detailed knowledge of the mining, smelting and refining of lead, and who seek a brief account of its manifold uses.

The opportunity has been taken to re-write most of the text and to bring the factual information up to date. The Lead Development Association, 18 Adam Street, London, W.C.2 will be happy to meet demands from readers who are able to put them to good use.

THE RADIO CONSTRUCTOR

SEPTEMBER 1959

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**REPAHCO**

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**Book Reviews**


For a book which is small enough to be carried without discomfort in one's vest pocket, this well-established textbook publication contains a wealth of information in handy reference form. It could very well be used as a sub-site.

In addition to often-needed information on matters generally regarded as "radio" in their application, many tables and formulas are given, such as are frequently required in arithmetic, geometry, measurement and trigonometry, electrical measurements, slide rule gauges, dials, etc., power sources, and properties of metallic elements to mention a few. This latest edition of the book contains a large number of additional material and the opportunity has been taken to revise the contents. In this latter connection the revision is stated to be a full one, but it will be seen that the size on an average page is page 76, has somewhat escaped the eagle eye of the publishers. The 8-page is no longer a permitted book for British amateurs due to its falling within telecommunication allocation, and the 3- and 6-page bands are not mentioned.

The manner in which Kirchoff's Laws and their application are dealt with is certainly deserving of praise. It is surprising to find such a clear exposition looked away in a small book like this one. On the other hand, crystal combinations found on page 46 seem to have historic value only, particularly for grey-haired terrors like the writer of these notes. However, the omission of the smoke-born combination seems inexcusable if only for the sake of history. On the whole, a very comprehensive work, well produced and good value for money.

W. E. Thompson


The service engineers will no doubt find this book useful in many aspects of their work. The treatment of the subject is full of detail and the book contains a wealth of information in handy reference form. It could very well be used as a sub-site.

In the chapters on fault-finding and servicing receivers there are many useful tips. Alignment procedure is shown in a simple manner, which includes the use of the tables which show step by step in which order the tuning circuits should be brought into resonance, and the method of setting up test equipment to achieve the desired results.

The other chapters deal with standards and waveform, a survey of the British television network, basic circuitry, projection television, Band III converters, coupling circuits, receivers, etc. The diagrams are clear and adequately illustrate the matters discussed in the text. The book gives a brief details of cathode ray tubes and valves, and equivalents, are a useful reference.

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