*Published in Great Britain by the Proprietors and Publishers*
Data Publications Ltd 57 Maida Vale London W9
Printed by A. Quick & Co. (Printers) Ltd 125 High Holborn London WC1 England *also at* Clacton-on-Sea
*Obtainable abroad through the following* Collets Subscription Service Continental Publishers & Distributors Ltd William Dawson & Sons Ltd *Australia and New Zealand* Gordon & Gotch Ltd *South Africa* Central News Agency *Holland* "Radio Electronica"
*Registered for transmission by Magazine Post to Canada (including Newfoundland)*

THE JASON OG.10 GENERAL PURPOSE 'SCOPE, Part 2

VOLUME 13
NUMBER 2
SEPTEMBER
1959

# The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS


*Included in this issue*

TESTMETERS AND THEIR CIRCUITS
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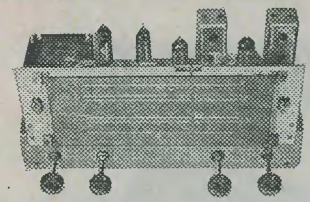

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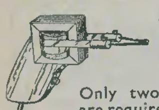

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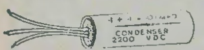


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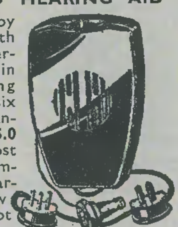

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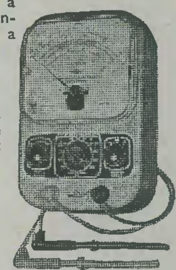

Undoubtedly a most useful instrument by a firm long famous for fine instruments, entirely redesigned, it has a square movement with diacon plastic cover, this makes for a brighter, more readable scale, extra scale length and wider angle of vision. With the test set is included a pair of combined test prods and crocodile clips also a stand for inclining the meter at the best reading positions. Ranges A.C. Volts: 0–10, 0–25, 0–100, 0–250, 0–500, 0–1,000, ditto D.C. A.C. Current 0–100mA. D.C. Current 0–2.5, 0–10, 0–100, 0–500mA. Resistance: 0–1M and 0–10K. All at 10,000 ohms per volt—Price **£12.7.6** or **£1** deposit and 24 Fortnightly payments of **10/–**, non-callers add 5/– carriage and insurance.

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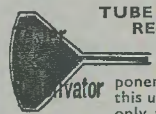


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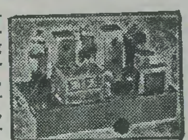

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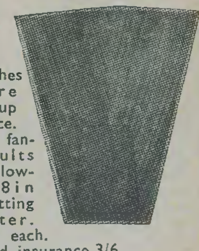

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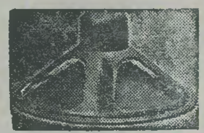

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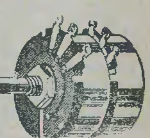

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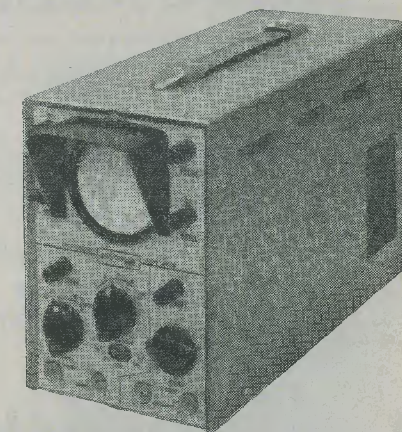

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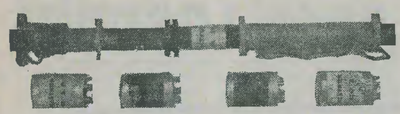

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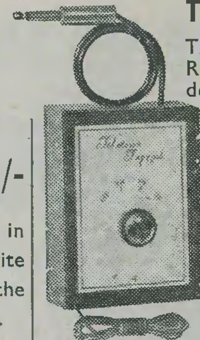

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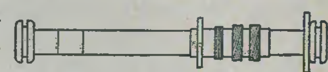

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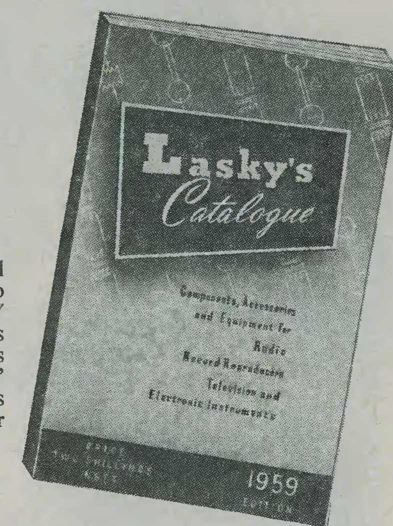


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# The Radio Constructor

*Incorporating* THE RADIO AMATEUR

Vol. 13 No. 2 SEPTEMBER 1959 ANNUAL SUBSCRIPTION 25/– (*including postage*)


## CONTENTS




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ARTICLES appearing in this magazine which describe kits are inserted only on condition that such kits, or special components thereof, are freely available at a trade discount to all retail advertisers.

OPINIONS expressed by contributors are not necessarily those of the Editor or proprietors.

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

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

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

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.

ALL CORRESPONDENCE should be addressed to THE RADIO CONSTRUCTOR 57 Maida Vale London W9
REMITTANCES should be made payable to "DATA PUBLICATIONS LTD."

No. 106

A Simple Burglar Alarm

# suggested circuits

The circuits presented in this series have been designed by G. A. FRENCH, specially for the enthusiast who needs only the circuit and essential relevant data

RATHER TO HIS SURPRISE, THE WRITER HAS received several requests recently to give details of a simple and reliable burglar alarm. The writer remarks on his surprise because he does not visualise a burglar alarm system as falling quite into the same category as have previous circuits in this series. It may be that his correspondents have been thinking of an alarm system in terms of a rather elaborate electronic device; whereas, in reality, the most suitable alarm circuit employs very few components and works on simple electrical principles only. At any event it seems to be an established 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.

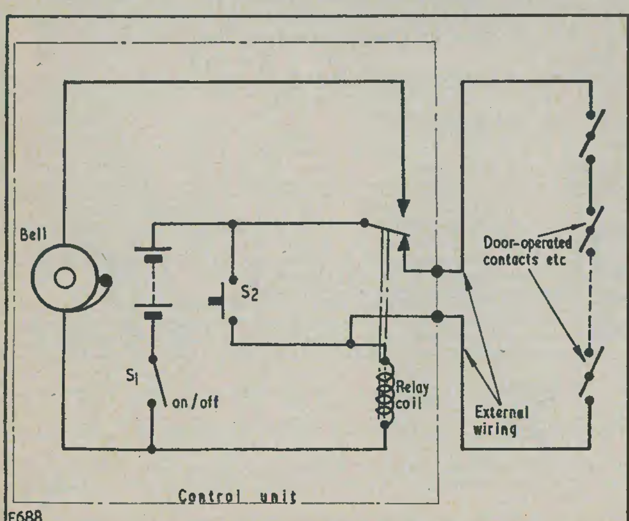



*Fig. 1. The circuit of the burglar alarm*



### 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.

In Fig. 1 the alarm is shown switched on and in the "guard" condition. In this state a circuit is completed from the upper terminal of the battery, through the change-over contact (energised) of the relay, the external wiring loop, the coil of the relay and the on/off switch to the lower terminal of the battery. Due to the presence of this circuit current flows through the coil of the relay which continues to be energised. If, due to the ingress of an intruder, any of the external circuit is broken, the energising current to the relay immediately ceases. The relay de-energises and its change-over contact connects the battery to the bell, which then commences to ring. The alarm bell will continue to ring even if the external circuit is completed again shortly afterwards, because the initial circuit via the change-over contact of the relay has now become broken.

It will be noted that the whole principle of alarm operation revolves around the fact that it is a *break* in the external circuit which sets it off, and that this break need be of a momentary nature only. Because of this basic principle it is not possible to put the alarm out of action by cutting any of the external wiring; such an act would, in fact, set off the alarm.

### External Wiring

The fact that the alarm functions when a circuit is broken makes the design of contacts in the external wiring 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 wired up in this manner would very obviously break the circuit and set off the alarm. Fig. 3 shows a similar idea applied to a sash window. Two sets of contacts are used here, the wire joining these travelling the width of the window.

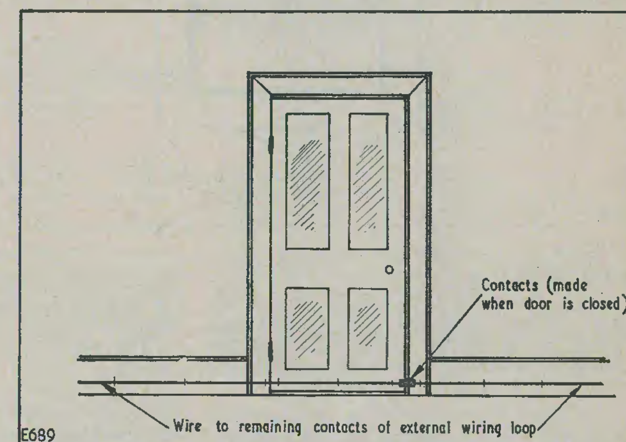



*Fig. 2. A set of contacts fitted to a door*

It will be noted in Figs. 2 and 3 that the external wiring is routed in such a manner that the two wires to an individual set of contacts approach it from opposite directions. Such a wiring layout is desirable since it reduces the possibility of deliberate short-circuits before a set of contacts is broken. It it were intended to protect, say, a garage removed from a house, this would be preferably carried out by running two well-spaced separate wires to the garage, rather than by using a single length of twin cable between the garage and the house.

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 external circuit would be interrupted, and the alarm would sound.

able the associated components can be mounted in a locked case, key-operated switches being employed for $S_1$ and $S_2$.* Only the two leads from the external wiring loop need enter such a case.

**Components**

Due to the extreme simplicity of the

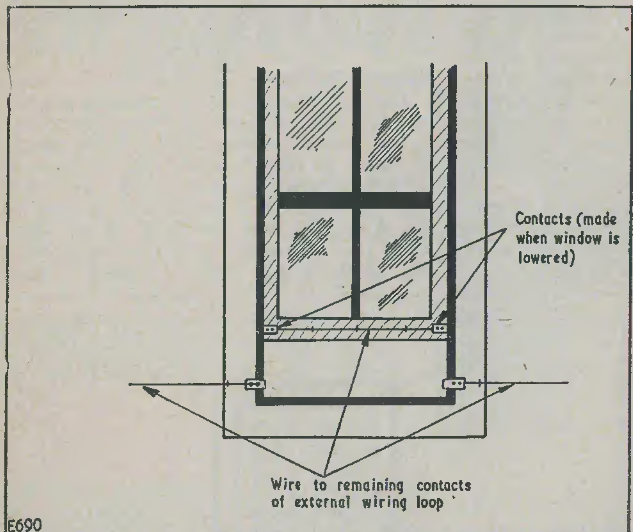



*Fig. 3. A set of contacts fitted to a sash window. The contacts here, and in Fig. 2, may be made from any suitable springy metal bent to the required shape*

### 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 $S_1$, this coupling the lower battery terminal to the complete circuit. When depressed, push-button $S_2$ connects the battery direct to the relay coil, thereby energising it. When the alarm is initially switched on it is necessary to press $S_2$ 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 $S_1$ and $S_2$ 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 vulner-

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 it necessary to be independent of power failures and the like. An economic method of running the alarm 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 continual trickle charge from the mains. It should be remembered 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 on. Due to the possibility of random earth connections in the external wiring loop, such a charging circuit might cause unreliable operation of the alarm.

*Suitable key-operated switches are manufactured by A. F. Bulgin & Co. Ltd. That employed in the $S_1$ position should be capable of having its key removed in either the "on" or the "off" position. A spring-loaded key switch is not available for exact replacement of the push-button $S_2$, but a reasonable alternative should be provided by a switch whose key may only be removed when it is in the "off" position.



# Can anyone help?

**R.C.P. Valve Tester Model 314 and Signal Generator 52X2 Ref. No: 10SB/165.**—D. W. Robson, 125 Atkinson Road, Benwell, Newcastle-on-Tyne 4, requires any information on these two items of test equipment, willing to purchase or refund expenses. He is able to supply numerous service sheets on t.v's, radios and tape recorders and one or two items of ex-government equipment, mostly U.S.A. types. S.a.e. for information required.

* * *

**Panda Cub Transmitter.**—F. Allan Herridge, G3IDG, 95 Ramsden Road, London, S.W.12, would like to hear from any reader who owns, and has carried out any modifications to, the above transmitter.

* * *

**Marconi "Transatlantic" Receiver type 993.**—J. R. Gomer, 150 Layer Road, Colchester, Essex, would like to obtain a service sheet on this receiver. Expenses met or exchange valves, odd meters, etc.

* * *

**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 and the valve line-up etc.

* * *

**W/S No: 19 Mk II.**—F. K. Hanna, 57 Hatherly Road, Cheltenham, Glos., would be grateful for any information about this receiver, and especially data of the "B" set and wiring of the bottom plug.

* * *

**UHF Calibration Receiver type TF564 with Preselector and Frequency Changer TM2578.**—This receiver covers 10–150 Mc/s; and any information from readers will be gratefully acknowledged and costs defrayed by A. Melhuish, 31 Shepherds Bush Green, London, W.12.

* * *

**Recording Unit 10D/16188.**—H. C. Murfitt, 97 The Avenue, Nunthorpe, Middlesbrough, Yorks., would like to hear from anyone who has information on this unit, has used one, or knows where the film cassettes or a complete unit can be obtained. The unit consists of a 16 mm. camera with 1 inch Kinic Anastigmat which photographs the trace on a 3½ inch CRT, VCR-529. Valves used are: 7 x EF50, 2 x EF55, 5U4G, VU120 and VR92.

* * *

**BC 929A Indicator Unit.**—H. Harris, 12 Eastfield Road, Cotham, Bristol 6, requires the original circuit together with details and circuit of the conversion to a t.v. scope. All expenses met and postage paid.

**Ekco 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.

* * *

**R1147B Receiver.**—L. Lumb, 25 Moorville Street, Leeds 11, would like to receive information of the types of valves used in this receiver, their positions, and the frequency coverage. Also details of conversion to 2 metre operation. All letters answered and any expenses gladly refunded.

* * *

**P40 Receiver.**—J. Allen, 35 Damask House, Flower House Estate, London S.E.6, would much appreciate any information, circuit and frequency of xtal.

* * *

**Murphy TV Model V114-116.**—R. W. Sheppard, "Spring House", Hadlow, Kent, would like the loan of a service sheet for this televisor. All costs met.

* * *

**Radio Section of Marconi Consul VRC74DA.**—J. Harvey, 2a The Avenue, Rubery, Nr. Birmingham, requires service data, all expenses refunded.

* * *

**Circuit required.**—G. E. Smith, 39 Princes Road, Teddington, Middx, has an Osmor coil pack, type MTS, and requires a good circuit, using miniature valves, to suit this pack.

* * *

**R1392.**—N. A. Watson, 1 Strathearn Road, London S.W.19, has just acquired this ex-service VHF receiver and would like any information, circuit, manual etc.; all expenses met.

* * *

**Acoustical Amplifier type QA12/P.**—P. Harper, 59 Kingsway, Staines, Middx, would like to buy or borrow service sheet. Expenses gladly repaid.

* * *

**R.A.F. Receiver Unit 153A, Ref. No: 8465.**—681751 LAC. Lea-Jones, Electronics Centre, R.A.F., Finningley, Doncaster, wishes to borrow, beg or buy the circuit of this receiver.

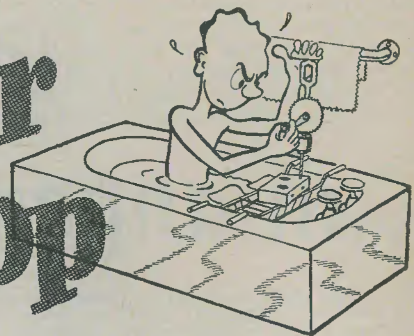
* * *

**Pye Communication Receiver PCR2 and W/S 19 Mk II**—D. Ransom, 33 Wellington Gardens, Charlton, S.E.7. Would like a circuit diagram of the former receiver and conversion of the latter to amateur band coverage with added bandspread details.

* * *

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

# 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 word*
*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 gives you the creeps, don't it?"

Smithy the Serviceman recognised the signs and chuckled.

"I see," 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.

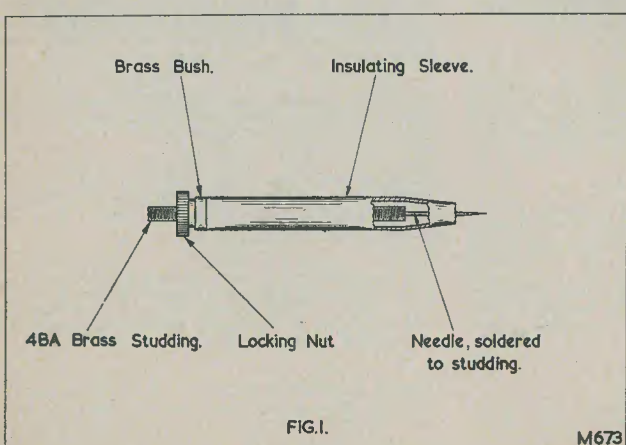



*Fig. 1. A simple test prod capable of piercing rubber or p.v.c. insulation*



**Tips and Wrinkles**

Dick forgot his histrionic 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 these right now.

"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.[1] 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 prod 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 studding was found holding the heater dropper 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 rather smart," commented Dick, "and it should certainly prove useful. To 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'.[2] 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 braiding 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 $1\frac{1}{2}$ inches long by $\frac{5}{32}$ by $\frac{1}{8}$ 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."

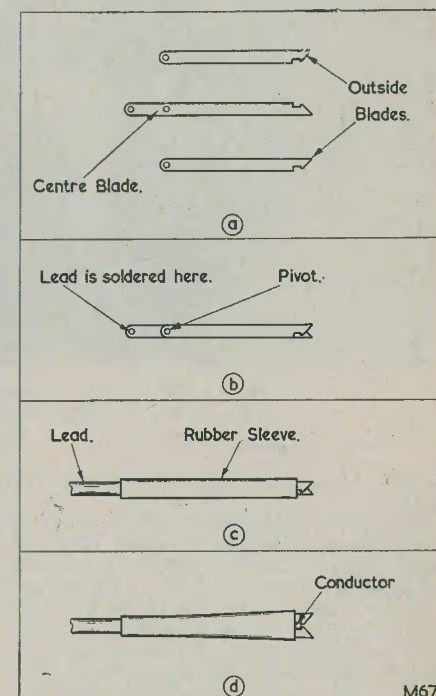



*Fig. 2 (a) The three blades which make up the "Slim-Grip." (b) The blades riveted together. (c) A rubber sleeve fitted over the assembly provides insulation. (d) The clip fitted to a conductor. The blades open out against the tension of the sleeve*

[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, Leicester.

"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.[3] I've got a photograph of it here."

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

"Hmm, it looks quite neat," commented Dick.

"It *is* neat," said Smithy. "The caddy in the photograph carries fifty-eight B9A and eight B7G valves, and the case, which originally housed an old mains/battery portable, measures 11½ by 7½ by 4 inches. Any other case of similar proportions could be used instead. The individual valves fit into Mullard pin protectors screwed to the bottom and to the lid, and a large yellow label alongside each position indicates the valve type. You can see at a glance what valve is what and whether any 'refills' are needed."

"One thing I've noticed," remarked Dick, "is that the valves on the lid interleave with the valves fitted to the bottom when the lid is closed. With the intention, I presume, of giving you a case which is chock-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 knocking 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.[4] 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 knocks them all off. The light and soldering iron can have separate switches, if desired. Also on the pole are two bollards for coiling up the lead which couples up the whole arrangement to the mains whenever it is in use."

"Fair enough," said Dick. "Yet another useful and simple idea gets 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 into the middle. 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 ⅛-inch polythene tubing held up against his ear."

"I suppose," remarked Smithy, drily, "that 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 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".

"Hmm," 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."

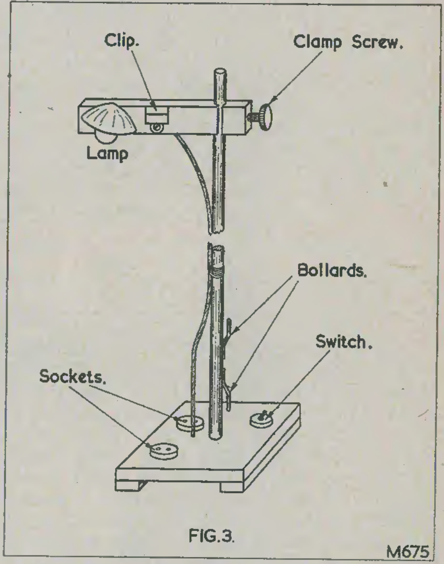



*Fig. 3. A novel, but useful, device which brings mains voltages, etc., to a single location for occasional servicing sessions*

**More Hamlet**

With this remark Smithy indicated that a little work would not now 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

[3] Contributed by Mr. Gerald Dittrich, Dundee, Scotland.

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

for as long as he could, but his patience finally broke when, for the fifth time in succession, the words "*slings and arrows of outrageous fortune*," uttered very sonorously indeed, penetrated his consciousness.

"For the love of Mike," he called out irritably, "give it a rest! It's bad enough your practising the part of the Ghost, but I'm damned if I see why I should have to put up with your practising Hamlet's part as well. Isn't one part good enough for you?"

The long-suffering Serviceman jumped, and turned round peevishly.

"I do wish you wouldn't suddenly shout out like that," he complained irascibly. "I'm certain I secrete at least half a pint of adrenalin each time."

**Deflector Yokes**

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

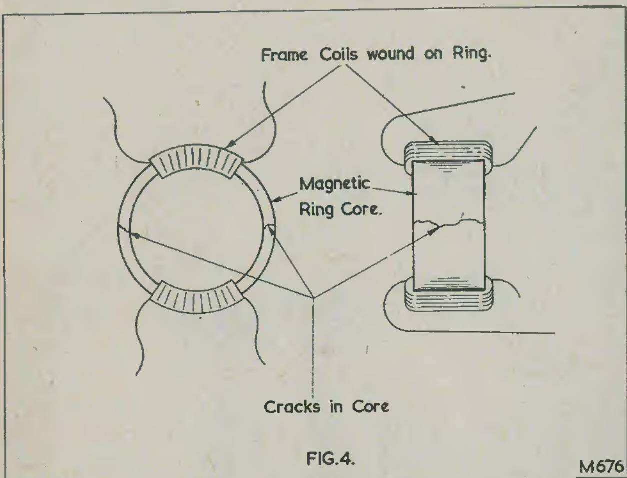



*Fig. 4. In 110-degree deflector yokes the frame coils are wound directly on the magnetic cores*

to avoid striping the tube."

"Sorry, Smithy," said Dick contritely. "It's just that I'm so completely fascinated by Hamlet's soliloquy that I can't help trying it out myself. You know the bit I mean: it starts off '*To be or not to be.*' Somehow," (here Dick struck a pose which he obviously intended to be indicative of great compassion), "I really *feel* for Hamlet when he makes that speech. Just think of that poor kid standing all by himself in the middle of the stage and bitching away quietly to himself because his Ma's shacked up with his old man's brother."

Smithy was horrified.

"Please, *please*, don't go any further," he protested. "With your peculiar genius for explaining things, you'd get even Noddy banned from the public libraries."

Dick looked hurt, but he turned back to his bench without comment. The Workshop grew quiet once more as he became immersed in the faulty 110 degree television receiver in front of him. However, Dick was not a person to keep silent for long.

"Whoops, Gertie!" he called out suddenly, as he very hastily switched off the set he was repairing.

"Well, that's fair enough," said the Serviceman, somewhat mollified. "Even with present-day aluminised 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 waggle one of the lead-out wires that the picture lost its vertical scan."

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

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



Dick commenced to remove the scanning yoke. Finding that its leads were rather short, he unsoldered these at their chassis terminations. Smithy, despite himself, had been watching his assistant's actions with some interest.

"I've been meaning," he remarked, in explanation of this interest, "to have a look at the yoke of any 110 degree set that passes through our hands whenever the opportunity presents itself. So far as I'm concerned, 110 degree deflection is still new enough for me to be interested in the methods manufacturers use for making their yokes."

"Well, this particular example certainly seems to be a fairly intricate bit of work," commented Dick, surveying the yoke which now lay on his bench. "There are several sections fitting inside each other—rather like those Chinese boxes which hold smaller boxes and so on."

"That's true," agreed Smithy, "but the basic construction seems to follow the usual lines. You have a ring of magnetic material, just like we had in 90 degree yokes. With all the 110 degree yokes I've seen, however, the frame coils are wound directly on the magnetic material itself (Fig. 4) instead of on formers."

"How do they manage to wind through the hole in the ring?"

"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 core 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."

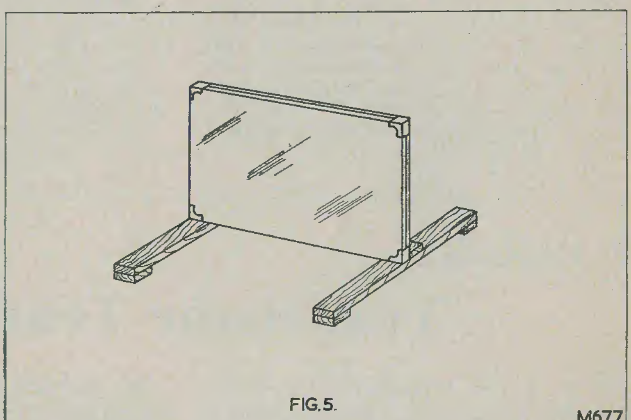
"I see," remarked Dick. "I presume that the two coils which come out in a flare at the front of the assembly are the line coils."

"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

*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 Stickite 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."

and activates the glue covering, after which the current is switched off again. As soon as the wire has cooled off and the glue has set, the coil becomes self-supporting and retains the shape in which it was wound."

"Doesn't the cooking process damage the enamel insulation underneath the glue?"

"Not if the heating is carefully controlled," replied the Serviceman.

"Fair enough," said Dick, who was carefully 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 re-appeared, with full vertical scan. Pleased, 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 pincushioning. This is all to the good with these 110 degree tubes because, with their extra screen curvature, very slight pincushioning 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 reversed 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 dulls the edge of husbandry.*"

Dick paused for a moment.

"That's part of Polonius's speech in Act I," 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 as 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 Haslucks Green Road, Shirley, Solihull, Warks, have submitted samples of two types of Transistor Transformers newly added to their 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 $1\frac{2}{5}$in. x $1\frac{1}{10}$in. x $\frac{3}{5}$in. and the second $\frac{3}{5}$in. x $\frac{4}{5}$in. x $\frac{1}{2}$in.

The company specialise in manufacturing transformers of all types, singly 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 transistor transformers to suit the majority of requirements called for in transistor circuits is available by return.





# UNDERSTANDING TELEVISION

PART 20

By W. G. MORLEY

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

In 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 suitable frequency response 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 between black to white to be reproduced correctly, and secondly, the cathode ray tube must operate under correct bias conditions. These two points will now be considered separately.

To help in illustrating the first requirement, Fig. 112 (*a*) shows an instance where the video signal applied to the cathode ray tube is too small 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. As a result almost all signal levels above that which corresponds to zero grid voltage are reproduced on the screen at maximum brightness. Fig. 112 (*c*) indicates the state of affairs which results when the video signal has correct amplitude. In this case both black and peak white levels appear at their correct points on the characteristic, intermediate levels corresponding, as they should do, to intermediate brightness levels.

In practice, it is necessary to fit a control to the television receiver which is capable of varying the amplitude of the signal applied to the cathode ray tube. This control is known as the *contrast* control. The contrast



3A

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 (*a*). 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*).[1] 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 consists of having the contrast control alter the grid bias of one or more valves in the i.f. strip or tuner unit, thereby varying the gain provided in this part of the circuit and, hence, the overall gain of the receiver. An occasionally met variant consists of making the anode load of the video amplifier a variable potentiometer; whereupon this potentiometer becomes the contrast control. The slider of the potentiometer couples to the modulating electrode of the cathode ray tube in much the same manner as the slider of a volume control connects to the grid of an a.f. amplifier valve. Contrast control circuits of this type require especial care in design to ensure that stray capacities do not cause alterations in frequency response at different contrast levels.

The second of the requirements for correct handling of the video signal (that of ensuring 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 voltage/brightness curve, and that 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 this instance half the video signal becomes reproduced at a single level only—that of maximum brightness. Also, the sync pulses now become fully 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.

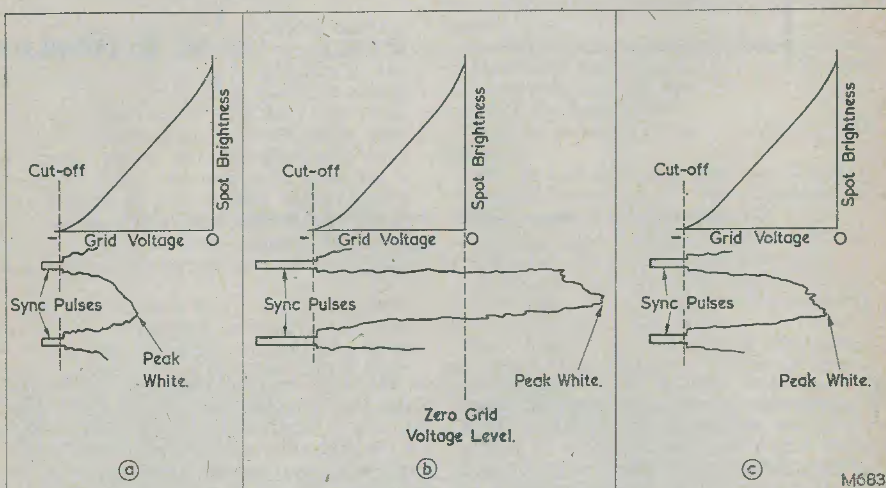



*Fig. 112 (a) The effects of applying a video signal of low amplitude to the cathode ray tube. In this instance black level appears at approximately the correct point on the grid voltage/brightness characteristic, but peak white corresponds to a very low brightness level. (b) In this diagram a signal 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*

[1] This assumes that overloading does not take place in the video amplifier stage. Such overloading would result in compression of that part of the signal which approaches peak white.



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.[2] The circuit arrangements employed for providing the variable bias voltage are basically very simple, a typical example being illustrated in Fig. 114 (*a*). In this diagram the cathode ray tube is cathode-modulated and the variable bias voltage 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 grid voltage, as it does in Fig. 114 (*a*), the combined resistance of the variable and fixed resistors in series normally lies between 200kΩ and 1MΩ. The use of relatively high resistance values of this order is desirable because, apart from keeping h.t. 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 by-passing the slider of the brightness control to chassis ensures that the grid of the cathode ray tube stays 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 (*a*) 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 slider and chassis. The cathode current of a cathode ray tube is normally of the order of 100 to 200μA 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 0.1μF.

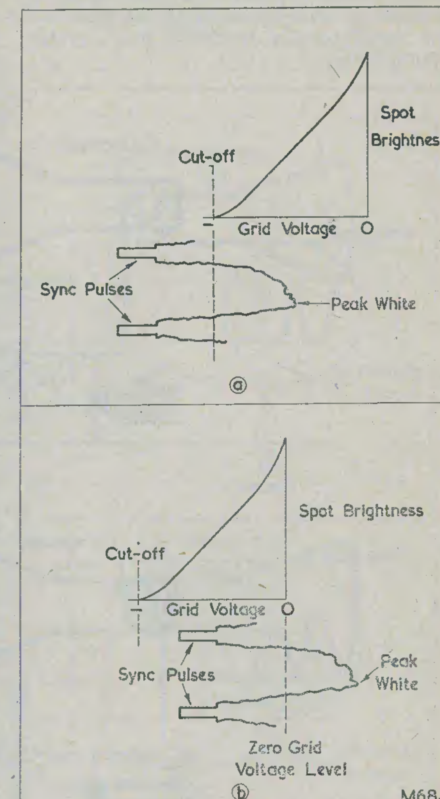



*Fig. 113 (a) In this diagram a signal of correct amplitude is applied to an over-biased cathode ray tube. In consequence, only that part of the signal to the right of cut-off level is reproduced. (b) The effect given when the cathode ray tube is under-biased. All parts of the signal are reproduced at 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*

[2] In American receivers, however, it is frequent practice to apply the variable bias to the cathode of cathode-modulated tubes. In this case the video signal is applied via a series condenser.

It frequently happens that, in practical receivers, a relatively low value resistor is connected between the slider of the brightness control and the controlled electrode. 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.[3] The series resistor normally has a value around 30kΩ

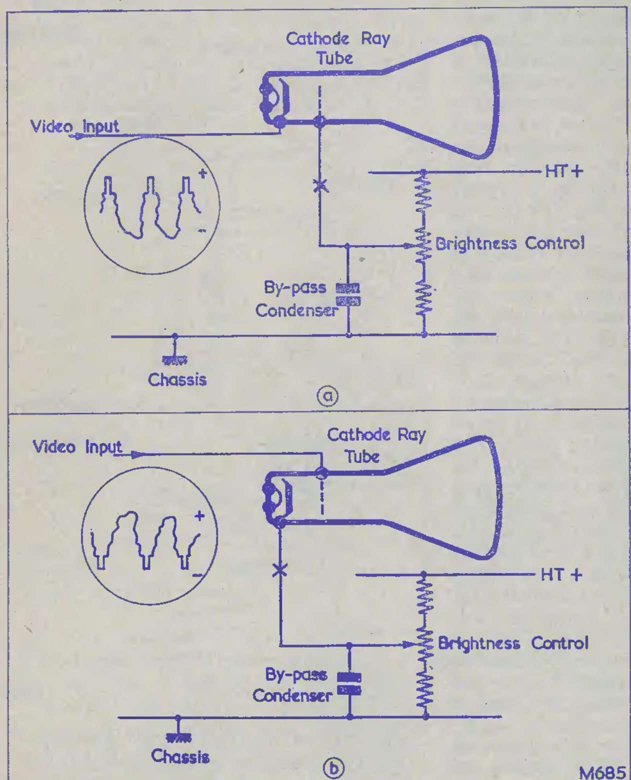



*Fig.* 114 (*a*) *A simple brightness control circuit for a cathode-modulated tube. It is assumed that the cathode has a potential lying between chassis and the h.t. positive line.* (*b*) *A brightness control circuit for a grid-modulated tube. It is assumed in this case that the grid has a potential lying between chassis and the h.t. positive line.*

### Cathode-Heater Voltage

Due, mainly, to the necessity of keeping the voltage between heater and cathode of the cathode ray tube 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 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.

[3] With some circuit arrangements it is possible, immediately after switching off, for the potential on the cathode ray tube cathode to fall at a greater rate than the potential on the grid. This effect could occur, for instance, if the potential on the cathode of Fig. 114 (*a*) were proportional to the main h.t. voltage. The voltage across the main h.t. smoothing condenser (and hence the potential on the cathode) might then fall, immediately after switching off, at a greater rate than the voltage across the brightness control bypass condenser, this being due to different rates of discharge in the two condensers.



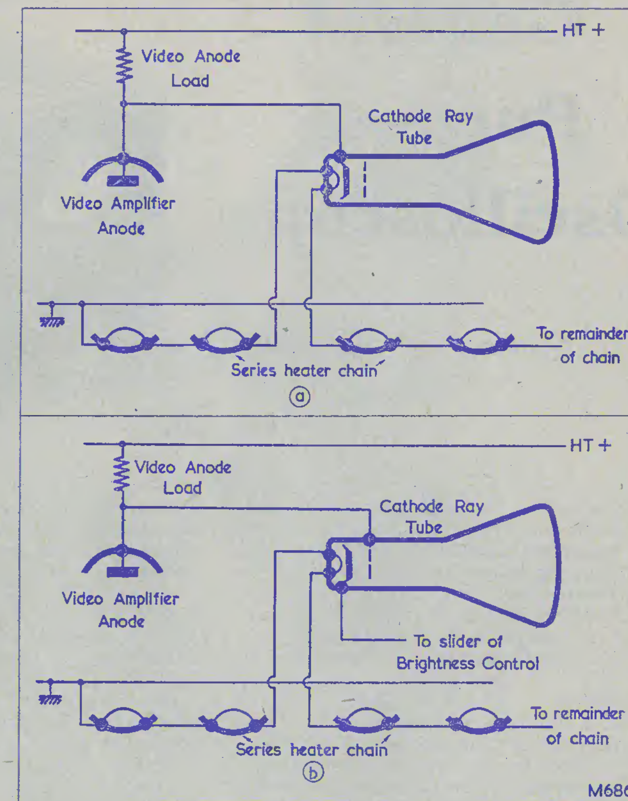



*Fig.* 115 (*a*) *Whilst a direct connection between video amplifier anode and tube cathode is very desirable, it introduces high cathode-heater potential differences which could cause breakdown between these two electrodes.* (*b*) *High cathode-heater potential differences still exist when the cathode ray tube is grid-modulated by a direct connection to the video amplifier anode. This is because, for correct operation, it is necessary for the brightness control to provide a potential for the cathode which is higher than that held by the grid*

The limiting safe voltage permissible between cathode and heater of a typical cathode ray tube is normally 200 volts only.[4] 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 impossible to design a video amplifier stage 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.

Fig. 115 (*b*) shows that much the same cathode-heater voltage 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 this electrode 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.

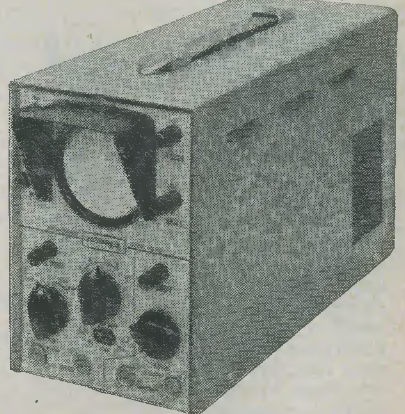
### Next month

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.

[4] This figure applies when the heater is negative of the cathode and is quoted by Mullard for most cathode ray tubes in their range.

# 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: $R_{23}$ 220kΩ 5% hi-stab; $R_{24}$ 39kΩ 5% hi-stab; $R_{25}$ 10kΩ 5% hi-stab. An error occurred in the Components List—$C_{13}$ should have read 0.05μF 750V wkg.

### X Amplifier

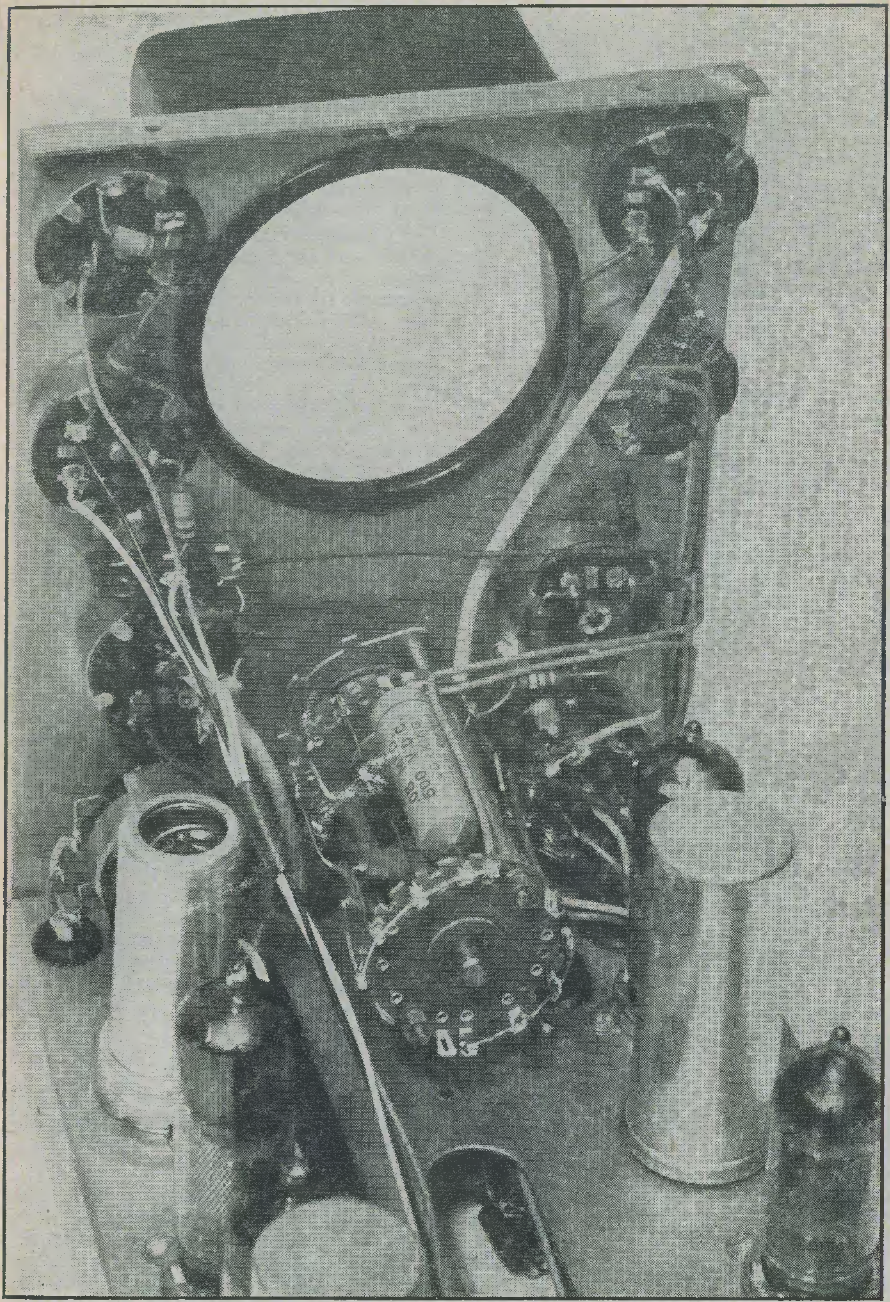
The X amplifier consists of $V_6$ (ECC82), a double triode connected as a "long-tailed pair." When the signal applied to the input grid is such that the anode current in the first triode increases, the anode potential falls and the voltage appearing across $R_{45}$ and $R_{46}$ increases making the grid 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 $VR_8$ to provide a horizontal shift of approximately 6cms (1 screen diameter). The horizontal deflection plates of $V_7$ (DH7–91) are directly coupled to the anodes of $V_6$. 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 $V_1$ and $V_3$ (ECF80) and $V_2$ (EF80).

The triode portion of $V_1$ 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 $R_1$ and $R_2$. $C_1$ is connected across $R_1$ to provide a flat frequency response. The output of the cathode follower is coupled via an electrolytic capacitor ($C_3$) to a potentiometer ($VR_1$) which provides a continuously variable gain control. The slider of the potentiometer is connected to the grid of the pentode portion of $V_1$. High frequency response correction is applied to this stage in two ways. Firstly the bias resistor ($R_8$) is bypassed by a small capacitor ($C_4$) of 1,000pF which begins to be effective at about 1 Mc/s. Secondly the anode load is made up of an inductor ($L_{42}$) and a resistor ($R_6$) in series. As the operating frequency increases, the impedance of $L_{42}$ increases to offset losses caused by stray capacitance to earth and the input capacitance





*This illustration shows the switch, detailed in Fig. 5, mounted on the front panel detailed in Fig. 3* of the following stage. These stray capacitances shunt the resistive portion $R_6$ of the anode load. $V_2$ (EF80) and the pentode portion of $V_3$ (ECF80) are again connected as a "long-tailed pair." Frequency compensation is again obtained by means of inductors $L_{43}$ in the anode circuits. A vertical shift of about 6cms (1 screen diameter) is provided by $VR_2$. The vertical deflection plates of $V_7$ (DH7–91) are directly coupled to the anodes of $V_2$ and $V_3$ 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 1dB 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, tagstrips, etc., details showing the disposition of parts being shown in Figs. 2 to 4, and only a few points require explanation.

(*a*) *Mains Transformers.*—The mains transformers 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 MT55 must be connected to chassis.

(*b*) *Front Panel.*—The front panel is secured to the chassis by eight 6BA x ¼in screws which also hold the four co-axial sockets in position. It will be found easier to fit all components to the front panel before it is screwed to the chassis.

The $\frac{3}{16}$in 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 $S_1$ 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 ($VR_1$) 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 $C_6$ and $C_9$ 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 Fig. 2 and front panel diagram 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.

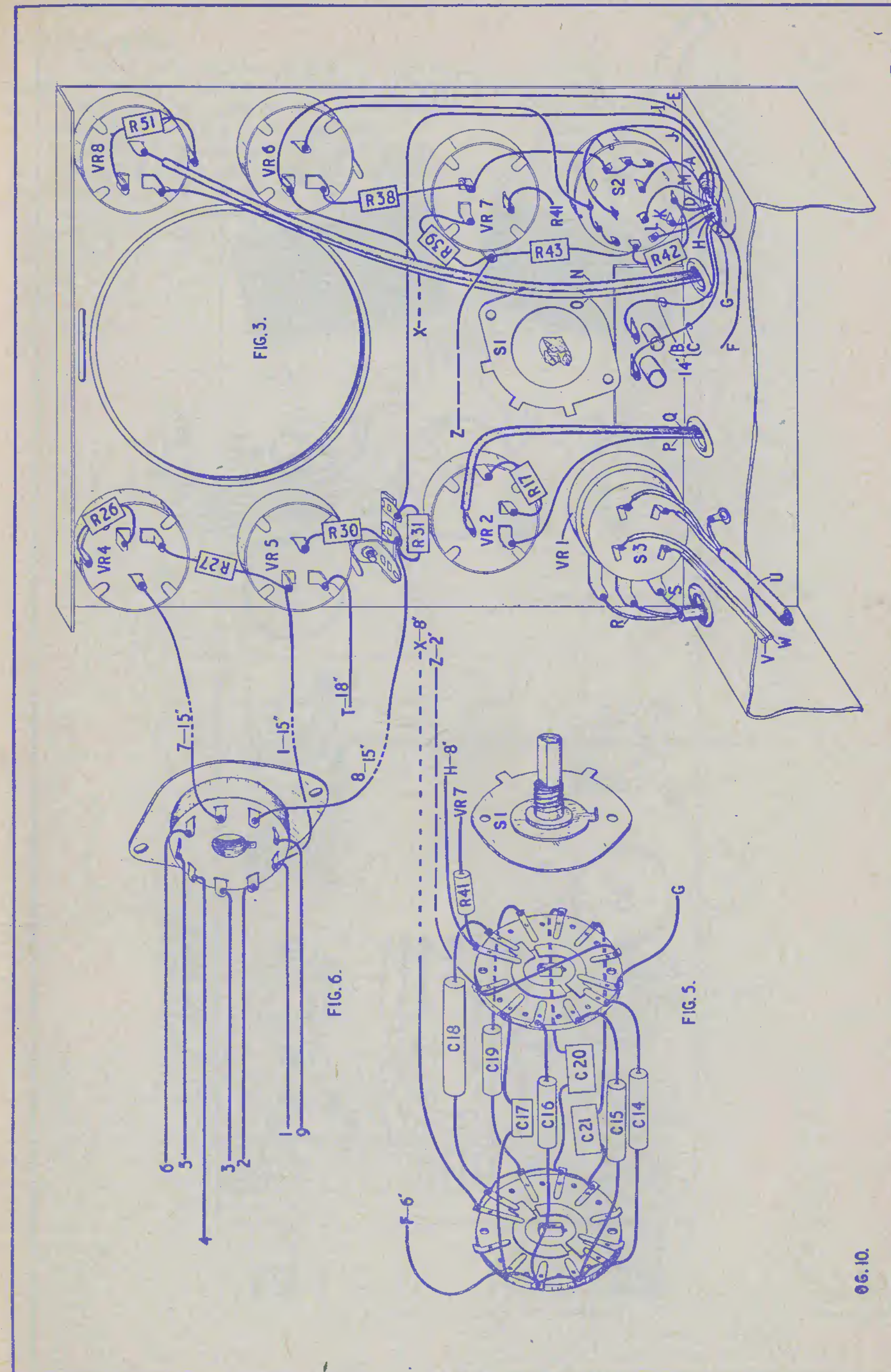
### Wiring Procedure

(*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 underside 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.

(*c*) Connect up the remaining components.





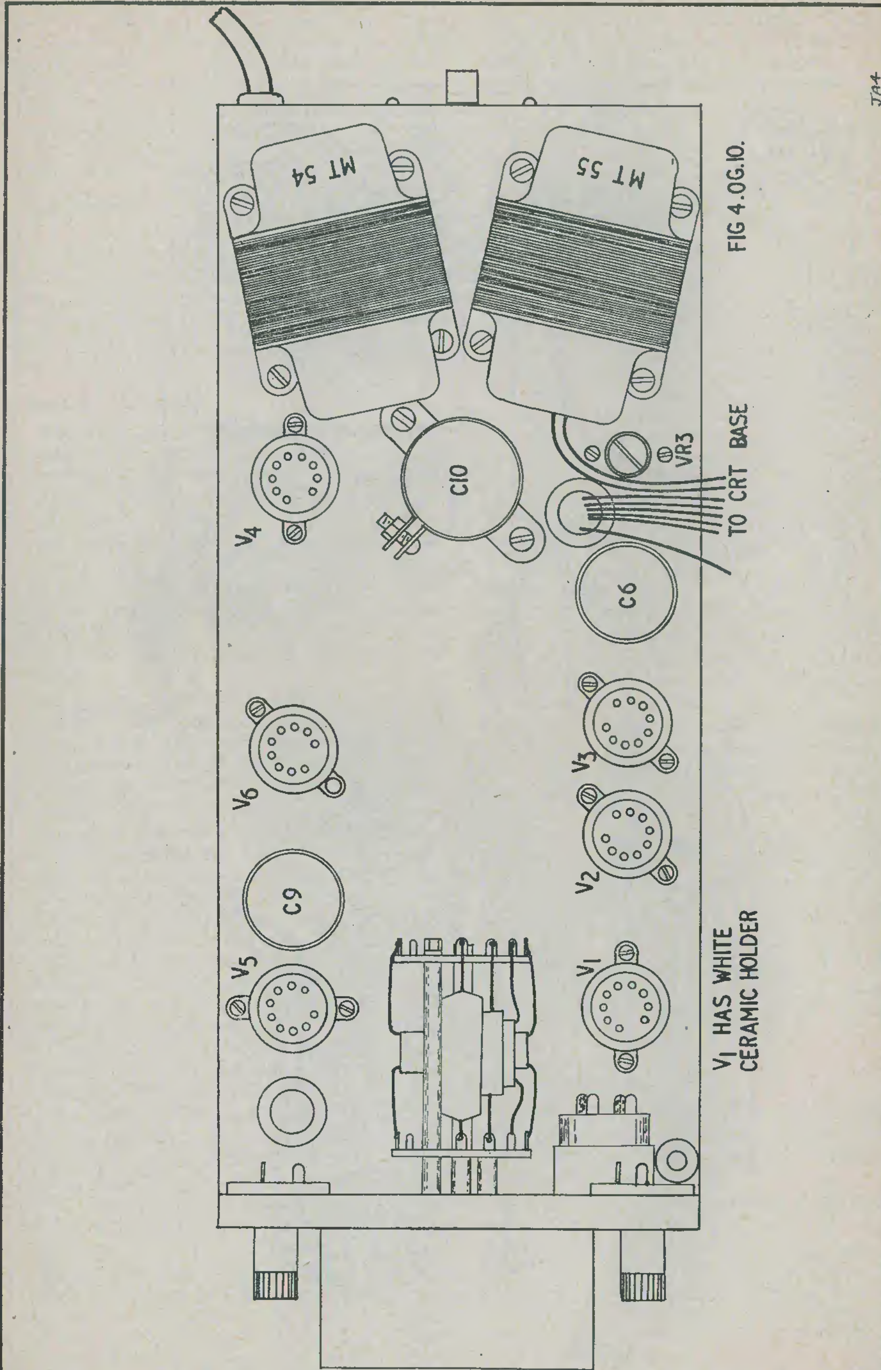


FIG 4.OG.10.



**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.

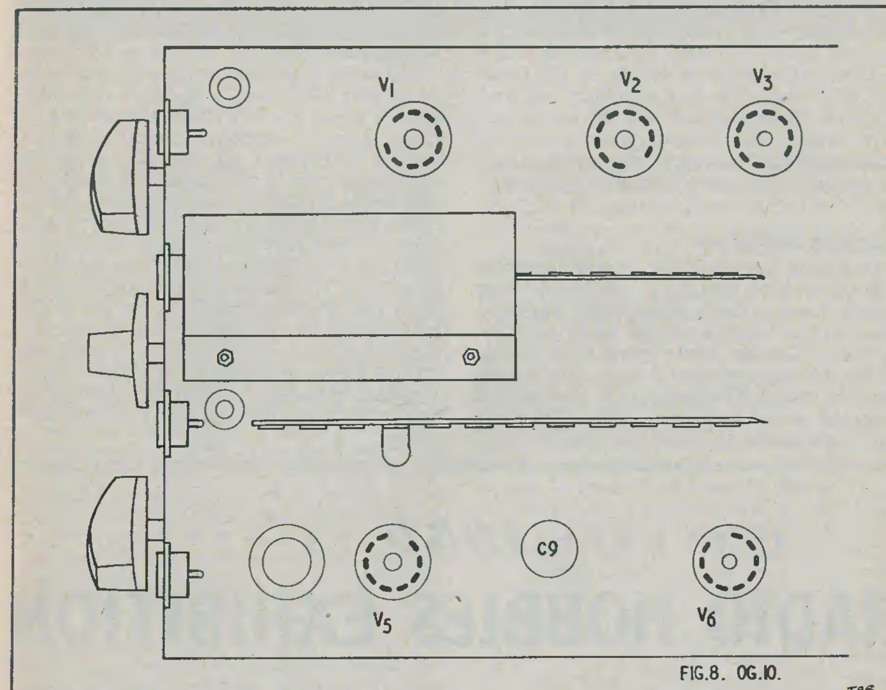


FIG.8. OG.10.

Measure the voltages appearing on the anodes of $V_6$. If they are not equal, turn the X shift control slightly until they are. Carry out the same procedure at the anodes of $V_2$ and $V_{3a}$. The two voltages should be almost the same (150V). Next connect the meter to the slider of the astigmatism control ($VR_3$) and turn the spindle until the voltage obtained is the mean of the previous two. It will now be possible to obtain a 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.

| | |
|---|---|
| Pin 3, $V_4$ .. .. | 310V |
| Junction $R_{19}$-$R_{20}$ .. | 250V |
| $C_{6a}$ .. .. .. | 190V |
| $C_{6b}$ .. .. .. | 90V |
| $C_{9b}$ .. .. .. | 100V |
| Pin 8, $V_1$ .. .. | 40V |
| Pin 7, $V_1$ .. .. | 1V |
| Pin 3, $V_1$ .. .. | 80V |
| Pin 6, $V_1$ .. .. | 50V |
| Pins 1 & 3, $V_2$ / Pin 7, $V_3$ .. | 30V |
| Pin 8, $V_2$ .. / Pin 3, $V_3$ .. | 150V |
| Pin 7, $V_2$ .. / Pin 6, $V_3$ .. | 150V |
| Pin 1, $V_3$ .. .. | 20V |
| Slider $VR_3$ .. .. | 150V |
| Pin 8, $V_5$ .. .. | 75V |
| Junction $R_{32}$-$R_{34}$ .. | 70V |
| Pin 7, $V_5$ .. .. | 63V |
| Pins 8 & 3, $V_6$ .. | 20V |
| Pins 6 & 1, $V_6$ .. | 150V |
| Junction $R_{26}$-$VR_4$* | −320V |
| Junction $VR_4$-$R_{27}$* | −440V |
| Junction $R_{27}$-$VR_5$* | −620V |
| Junction $VR_5$-$C_{12}$* | −680V |

* *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 screening 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 synchronised with the signal being examined. The "SYNCH" switch should be set to "INT" and the "COARSE SPEED" switch set to one of the positions marked 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 "WIDTH" control which gives a maximum trace width of about three screen diameters.

For some purposes, mainly when examining television receiver waveforms at frame frequency, the "SYNCH" switch may be set to "50 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 "SYNCH." The impedance at this socket is approximately 1MΩ in parallel with 15pF.

With the "SYNCH" switch set to the "50 c/s SWEEP" position, a sinusoidal sweep of mains frequency with a width of about 6 cm which is not affected by the "WIDTH" control will be obtained. This can be used with wobbulators, such as the Jason Type W11 which utilise a sine wave mains-derived sweep to display 465 kc/s a.m.-i.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 Bands 1, 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 by means of Lissajou's figures. With the "COARSE 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.

## 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 the world.

Sections will be devoted to amateur construction of both radio, u.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 television 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 services communications 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.).





# Technical Forum

### 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 is 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 5.5kV, a fact 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.

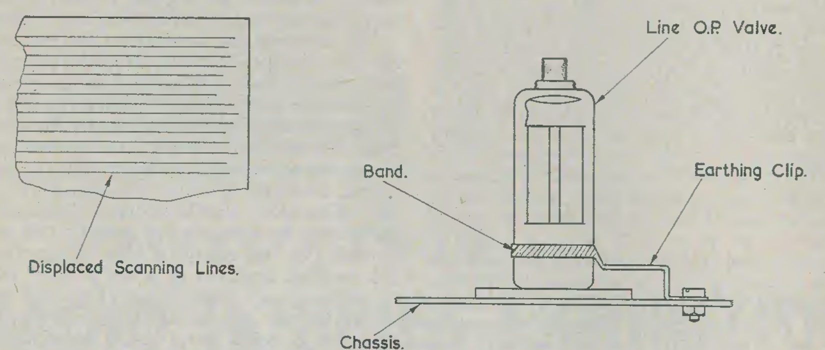
### Reduced Width

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 the h.t. supply and in the lower direction by the position of the 'knee' on the $I_a/V_a$ 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 valve 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 cathode 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 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 random displacement of the lines 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 great length by both circuit and valve engineers, and it was generally tracked down to a leakage of the high potential which appears 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 on to the grid pin will cause a small change in the grid voltage thus causing the spurious signal in the line deflection coils.




The approximate position of the conductive band will be seen from the sketch.

FIG. 1.

M672

The leakage can be prevented from reaching the grid pin by painting a thin band of conductive paint around the bulb about $\frac{1}{8}$in above the pins and earthing it by means of a thin spring 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 mica which is used to support the main electrode assembly.

Another fault which is associated with line output valves is Barkhausen oscillation. This 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. The 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 receivers this lead is reduced to $\frac{1}{4}$in in length. If this does not improve the position, the use of an anode stopper (22Ω) or a grid stopper (1kΩ) should be tried out as an alternative cure.

**Thermal Effects**

We classify under this heading all those effects which become apparent after the valve has been in use for a short period, and has attained its full operating temperature. Usually these defects manifest themselves as either a reduction in scan, or a reduction in e.h.t. voltage, and become apparent after the receiver has been operating for some minutes after being switched on from cold. The cause of the trouble is usually either primary or secondary emission from the control grid, screen grid or anode. Anode emission will usually only have the effect of damping the negative overswing on the anode during the flyback period, because during this time electrons will leave the anode and travel to the screen grid. Unless very severe, this fault will not show up on the picture but will simply result in a small loss of e.h.t. Emission from the screen grid can, however, be rather more serious as in this case the electrons will leave the screen and flow towards the anode during the part of the flyback period when the anode is highly positive. This will reduce the amount of energy fed into both the scanning coils and the e.h.t. circuit, causing a reduction in both width and e.h.t. potential. As a reduction in e.h.t. will increase the deflection sensitivity of the picture tube, these two effects are partially self-cancelling as regards the width of the picture, but there will be a tendency for the height to increase. As the screen emission becomes worse, the e.h.t. voltage will decrease still more with a further increase in height and a deterioration in picture brightness. Emission from the control grid of the valve is least likely to occur, but when it does it will manifest itself as a reduction in width and worsening of the line linearity which will become apparent some minutes after the receiver has warmed up. As with the other faults listed under this heading, the only cure is to renew the valve.

**Insulation**

The majority of line output valves run at fairly high temperatures, the bulb temperature often being in the region of 200°C, and under these conditions there is always a tendency for metallic deposits to be formed on the insulating parts within the valve. These insulating parts are normally for the purpose of either supporting or spacing the electrodes correctly, and the deposits as they build up will become apparent as a darkening of these parts of the valve. Such metallic deposits are conductive, so that after many thousands of hours use they may impair the inter-electrode insulation of the valve. This will in time become apparent by either producing internal sparking within the valve or by a reduction in the control grid insulation. This latter will show up first because of its adverse effect upon both the line 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.

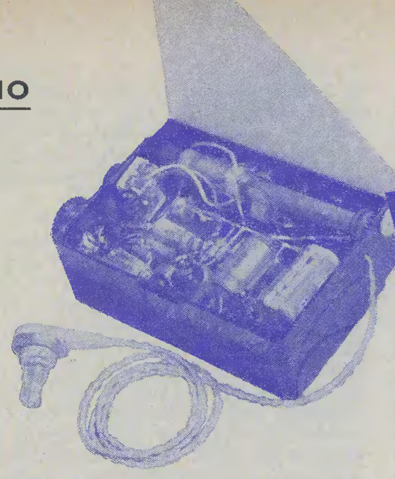
# Courses for Radio Amateurs Examinations

### *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 Holloway L.C.C. Evening Institutes for official courses in the Radio Amateurs Examination and Morse (both for beginners) to be held this winter at the Montem School, Hornsey Road, Holloway, London, N.7. The classes will meet on Mondays, with a repeat lecture on Tuesdays and Wednesdays, commencing Monday, 28th September, for the Radio Amateurs course at 7–9 p.m. (Instructors: S. H. Iles, G3BWQ; P. F. Bernal, G3KQZ; R. C. Hills, G3HRH), followed by the Morse at 9–10 p.m. (Instructors: L. Barber and A. Ralph). The fee for either course is 20s., or 22s. 6d. for the two, and application in the first instance should be made to the Hon. Secretary of the Grafton Radio Society: A. W. H. Wennell (G2CJN) 145 Uxendon Hill, Wembley Park, Middlesex, so that a place may be assured. In the City & Guilds examination held last May another 26 passes were obtained, making the grand total of 111 in the six years this course has run. In addition to the above, the club meets on Friday evenings commencing 4th September for the usual club activity and new members and visitors are especially welcome.



# *The* MAJOR THREE Personal Transistor Receiver

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

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 very popular with the home constructor fraternity. In the present design, three transistors—all Ediswan 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 4⅜in x 3in x 1¼in. 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 $TR_1$ functions primarily as an r.f. amplifier, the resultant r.f. signal being fed, via $C_7$, to the crystal diode. The signal is rectified here and then fed back, via the volume control and $C_4$, into the ferrite secondary winding and from thence into the base of the same transistor. The audio signal applied to the base of $TR_1$ is now amplified by the transistor and fed, from the collector and via the r.f. choke and $C_5$, into the base of $TR_2$. The amplified signal obtained from this second stage is now passed, from the collector and via the inter-stage transformer, to the base of $TR_3$. 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 into position $TR_1$ holder (centre pin to one end of double solder tag).

(3) Connect $C_2$ (red to positive bar) and $R_2$ (black/brown/red) into circuit.

(4) Ensuring that the leads of $RFC_1$ are approximately 1in in length, solder this component into circuit, together with $R_4$ (yellow/mauve/red) and $C_5$ (0.1μF).

(5) Solder into position $C_7$ (47pF), and $RFC_2$.

(6) Connect the plain end of the diode to one end of $C_7$. Leave the red or dot end unconnected at this stage.

(7) Solder into position both $R_5$ (grey/yellow/blue) and $R_6$ (brown/black/orange).



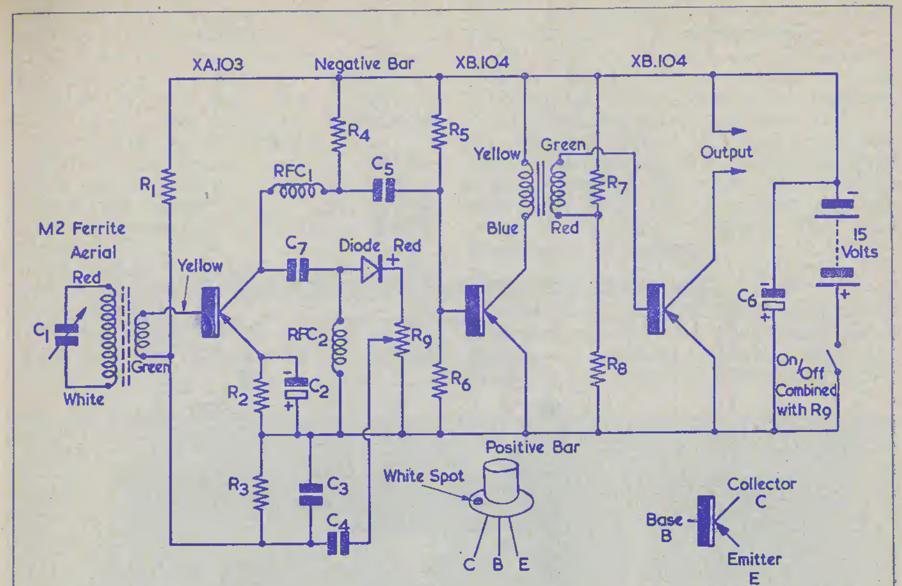



FIG.1.
Circuit of the 'Major-Three' Transistor Receiver M681

### Components List

*Resistors*
- $R_1$ 100kΩ
- $R_2$ 1kΩ
- $R_3$ 10kΩ
- $R_4$ 4.7kΩ
- $R_5$ 680kΩ
- $R_6$ 10kΩ
- $R_7$ 100kΩ
- $R_8$ 4.7kΩ
- $R_9$ 10kΩ potentiometer w/switch

*Condensers*
- $C_1$ 500pF trimmer
- $C_2$ 25μF electrolytic
- $C_3$ 0.005μF
- $C_4$ 0.1μF
- $C_5$ 0.1μF
- $C_6$ 100μF 18V wkg, electrolytic
- $C_7$ 47pF

*Transistors*
- $TR_1$ Ediswan XA103
- $TR_2$, $TR_3$ Ediswan XB104

*Miscellaneous*
- $RFC_1$, $RFC_2$ Henry's Radio Ltd.
- Ferrite Aerial, Type M2. Henry's Radio Ltd.
- Transformer type D240. Henry's Radio Ltd.
- 15V battery—Ever-Ready type B121
- Crystal diode
- Transistor holders
- Drilled cabinet and chassis. Henry's Radio Ltd.
- Deaf-Aid Insert. Henry's Radio Ltd.

To the junction of these two components, connect the other end of $C_5$ (0.1μF).

(8) Secure $R_1$ (brown/black/yellow) in position (one end only), and follow this by soldering $R_3$ (brown/black/orange) into circuit.

(9) On top of $R_3$ mount $C_3$ (0.005μF) and solder. Connect one end of $C_4$ (0.1μF) to the junction of $R_3$, $C_3$, leaving the remaining wire for the time being.

(10) Connect into circuit and join $R_7$ (brown/black/yellow) and $R_8$ (yellow/mauve/red).

(11) Solder into position the holder of $TR_3$ (third transistor).

(12) Secure into position the type D240 transformer and the holder of $TR_2$. Observe here the lead colour code of the transformer.

(13) Solder the deaf-aid insert leads but

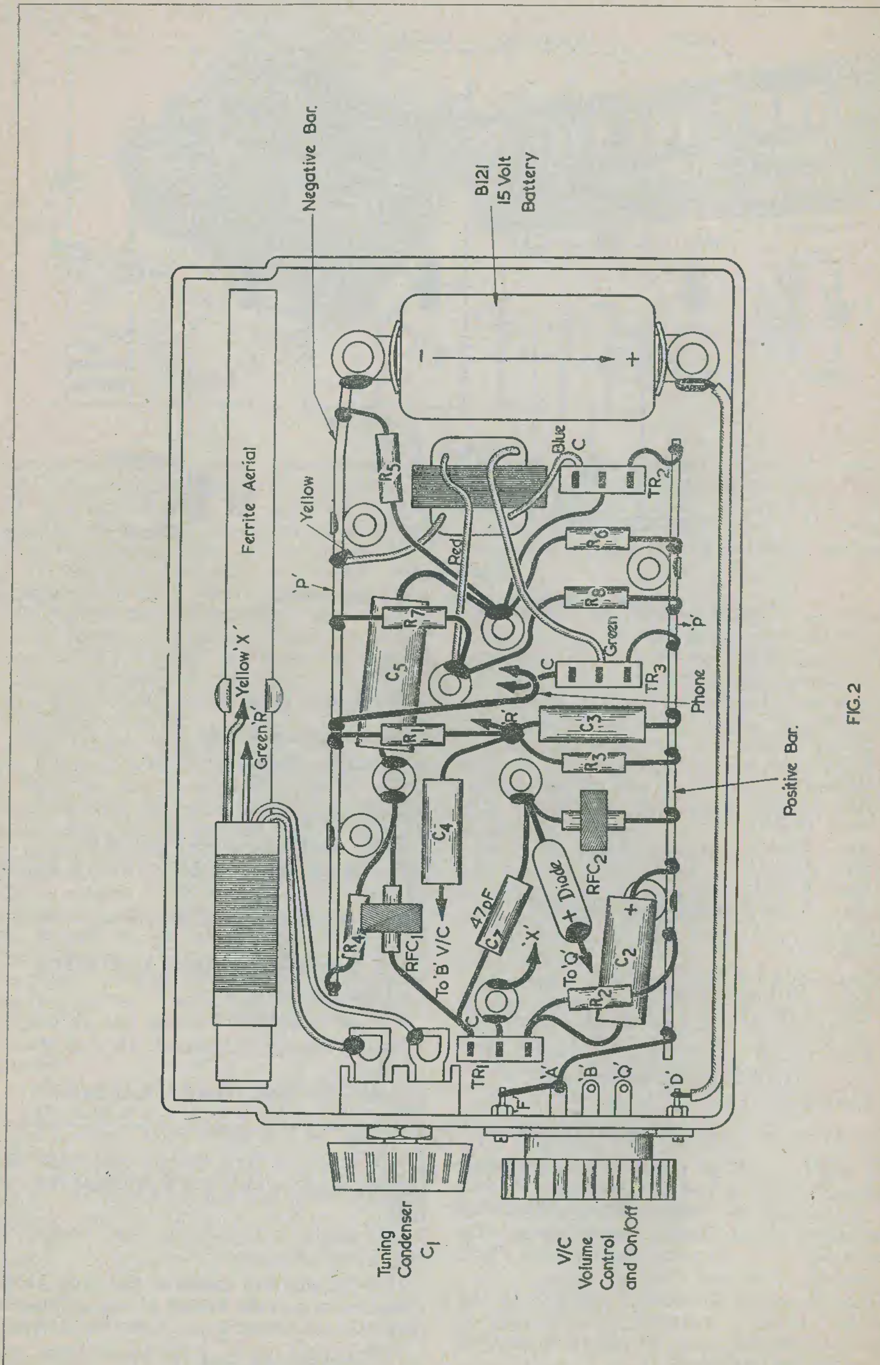



FIG. 2



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 $C_6$ (100μF) between points "PP" on negative and positive bars. (Black end to positive bar.)

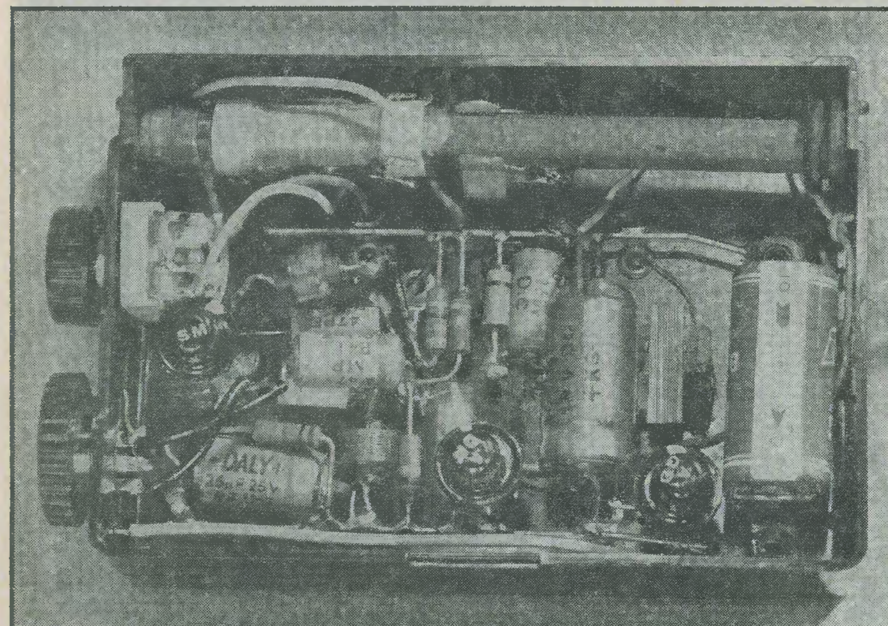
(17) Solder the red or dot end of the crystal diode to "Q" tag of the volume control.

sistors 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 with 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



*Inside view of the "Major-Three". Compare with Fig. 2*

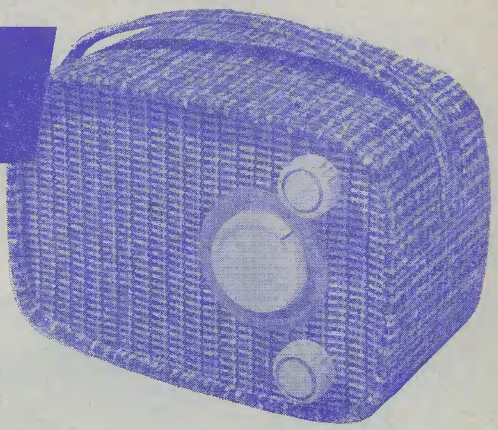
(18) Solder the remaining end of $C_4$ to tag "B" of the volume control and connect tags "A" and "F" of the volume control to the positive bar.

(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: $TR_1$, XA103; $TR_2$ and $TR_3$, XB104. Ensure that these tran-

is achieved by the careful positioning of the choke $RFC_1$ in relation to the aerial winding on the ferrite rod assembly. This positioning of $RFC_1$ 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 $RFC_1$ 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.

# *The* TOURIST Portable Receiver



Described by
**Alan G. Hepworth**

AMID 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 shape. 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 some 8in x 5¼in x 4in, and the total overall carrying weight is only 3½ 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 situ* as received. This means that the constructor is not only saved a great deal of time and trouble but the valveholder orientation 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-waveband receiver, uses the well-known 96 series of low consumption valves and incorporates a ferrite rod aerial. The speaker is a 5-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.

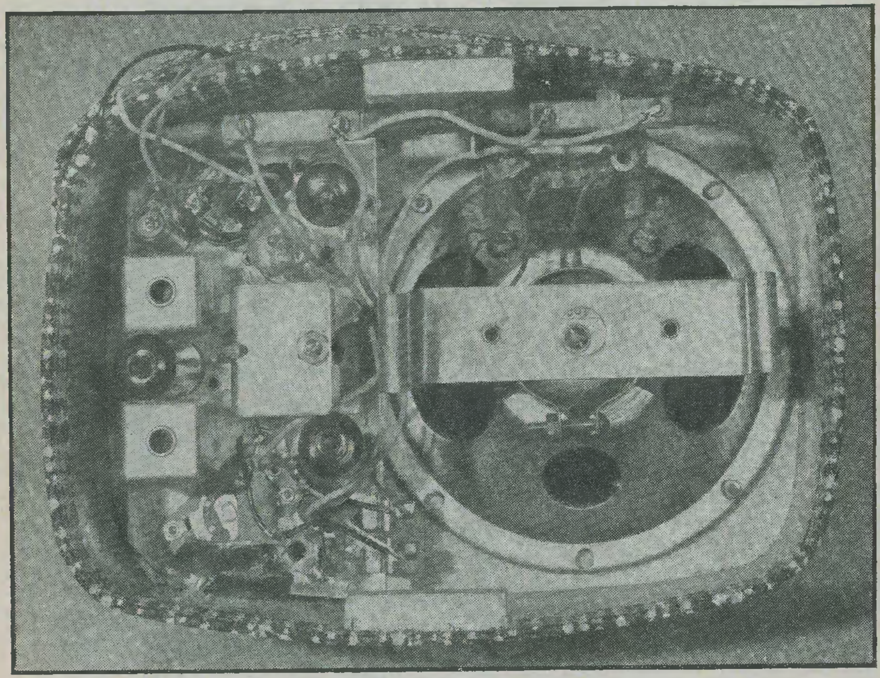
The receiver, as may be seen from the front cover illustration, is housed in an attractive cabinet in modern styling, covered with contemporary leather cloth and contrasting Tygan speaker fret material, calibrated scale and ivory gold-filled knobs which, together with a neat carrying handle, completes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

### Circuit

This is shown in Fig. 1. The frequency changer $V_1$, a DK96 heptode, has the grid connected, via $S_1$ portion of the wavechange 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 $C_2$ and the trimmer condenser $C_3$, the fixed value of $C_1$ being brought into circuit only on the long wave position. The oscillator section of the frequency changer is tuned by the variable condenser $C_{16}$, this being one half of a two-gang component comprising $C_{16}$ and $C_2$. The oscillator trimmer condenser is $C_{15}$, the switch $S_2$ being the requisite wavechange switch, which in the long wave position brings into circuit $C_5$ across the tuned winding. $C_6$ is the padder condenser. The oscillator coil is the well-known Osmor Radio Products Ltd type QO8. The oscillator "anode" h.t. potential is applied via the resistor $R_2$, the condenser $C_7$ 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 $V_2$ is constructed around the DF96 vari-mu pentode, the resultant output from this stage being taken, via $IFT_2$ and $R_3$ into the volume control $R_5$. From that point, the signal is fed, via $C_{10}$, into the grid of the following stage. Rectification, of course, takes place at the diode, the load for which is $R_3$ in series with $R_5$. An a.v.c. voltage is fed, via time constant components $R_4$, $C_9$ and $C_4$ into the i.f. and frequency changer stages respectively. The diode pentode shown is the DAF96 type. The output from the diode pentode is taken into the output stage via the coupling condenser $C_{13}$. Automatic bias for the grid of this stage is developed across $R_{11}$, and applied via the grid leak $R_{10}$. The resistor $R_9$ 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 $R_5$, and the two i.f. transformers $IFT_1$ and $IFT_2$. Radio beginners should note that the on/off switch $S_3$ and $S_4$ 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 same side of the chassis that the control spindles of the volume control



*Showing arrangement of units in cabinet*

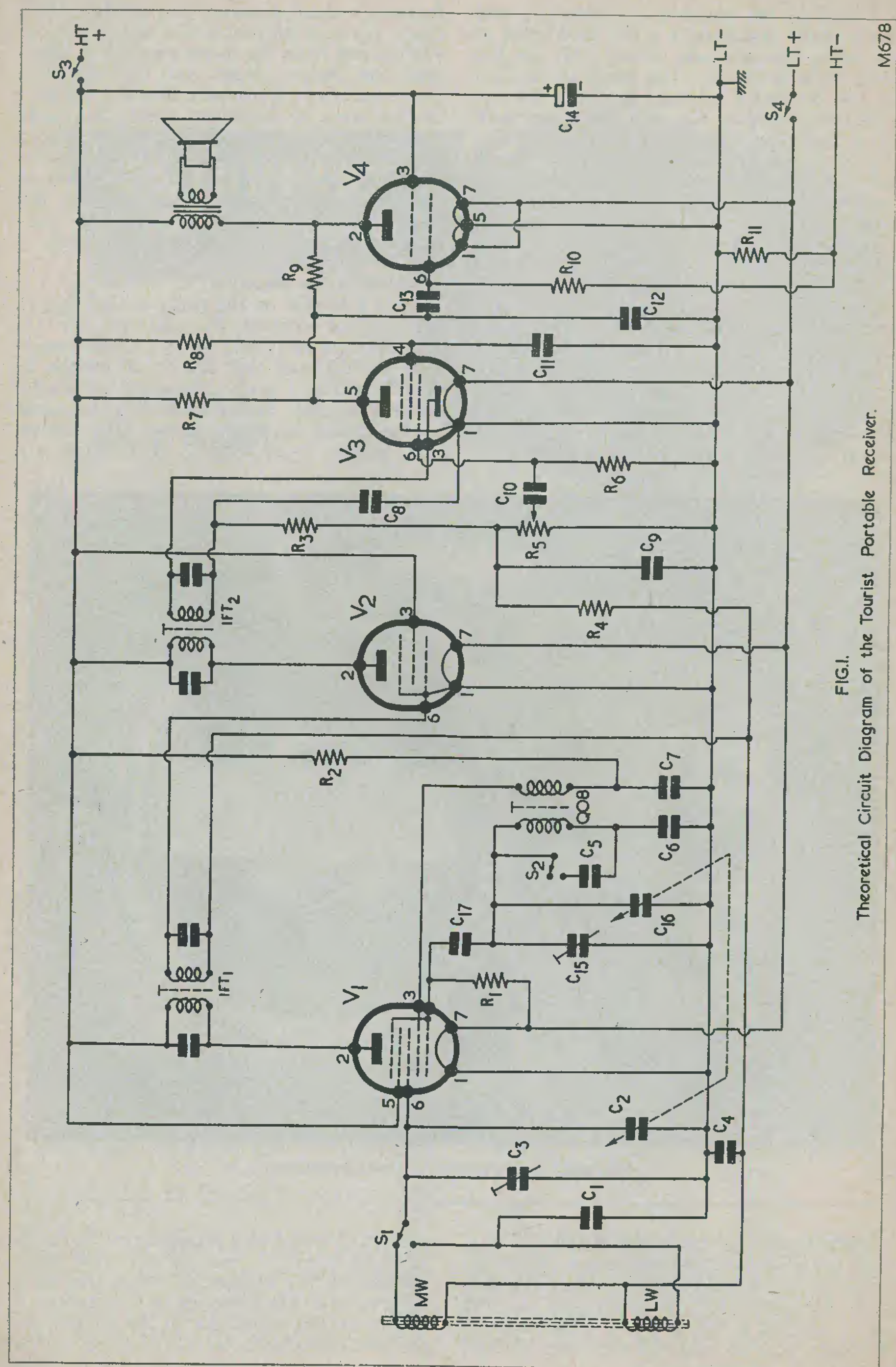



FIG.1. Theoretical Circuit Diagram of the Tourist Portable Receiver.



# THE TOURIST COMPONENTS LIST

**Set out for easy reference to Fig. 1.**

*Condensers*

| | |
|---|---|
| $C_1$ | 130pF silver mica |
| $C_2$, $C_{16}$ | 365pF variable 2-gang |
| $C_3$ | 35pF trimmer |
| $C_4$ | 0.04μF |
| $C_5$ | 450pF silver mica |
| $C_6$ | 450pF silver mica |
| $C_7$ | 0.04μF |
| $C_8$ | 100pF silver mica |
| $C_9$ | 100pF silver mica |
| $C_{10}$ | 0.005μF |
| $C_{11}$ | 0.04μF |
| $C_{12}$ | 100pF silver mica |
| $C_{13}$ | 0.04μF |
| $C_{14}$ | 8μF, electrolytic, 150V wkg. |
| $C_{15}$ | 35pF trimmer |
| $C_{17}$ | 100pF silver mica |

*Resistors*

| | |
|---|---|
| $R_1$ | 100kΩ $\frac{1}{8}$ watt |
| $R_2$ | 15kΩ $\frac{1}{8}$ watt |
| $R_3$ | 47kΩ $\frac{1}{8}$ watt |
| $R_4$ | 2MΩ $\frac{1}{8}$ watt |
| $R_5$ | 500kΩ potentiometer with switch |
| $R_6$ | 10MΩ $\frac{1}{8}$ watt |
| $R_7$ | 500kΩ $\frac{1}{8}$ watt |
| $R_8$ | 4.7MΩ $\frac{1}{8}$ watt |
| $R_9$ | 22MΩ $\frac{1}{8}$ watt |
| $R_{10}$ | 2MΩ $\frac{1}{8}$ watt |
| $R_{11}$ | 560Ω $\frac{1}{8}$ watt |

*Valves*

| | |
|---|---|
| $V_1$ | DK96 |
| $V_2$ | DF96 |
| $V_3$ | DAF96 |
| $V_4$ | DL96 |

*Miscellaneous*

Chassis with valveholders and grommets —TRS Radio
5in P.M. speaker with O/P transformer —TRS Radio
Battery clip, ferrite clip, ferrite aerial—TRS Radio
Wavechange switch, etc., TRS Radio
I.F. transformers—TRS Radio
QO8 oscillator coil—Osmor Radio Ltd.
Battery plug, cabinet, dial and 3 knobs —TRS Radio
Nuts, screws, wire, etc.

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 $S_1$ and $S_2$; 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 $C_2$ and $C_{16}$ into position (Fig. 3), using the three 4BA x $\frac{1}{8}$ inch screws. (Fig. 2.) Having completed this, the two trimmers $C_3$ and $C_{15}$ may be held in position (Fig. 3) by means of a 6BA screw and nut each. From Fig. 3 ascertain the position of the oscillator coil QO8 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 direct 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.

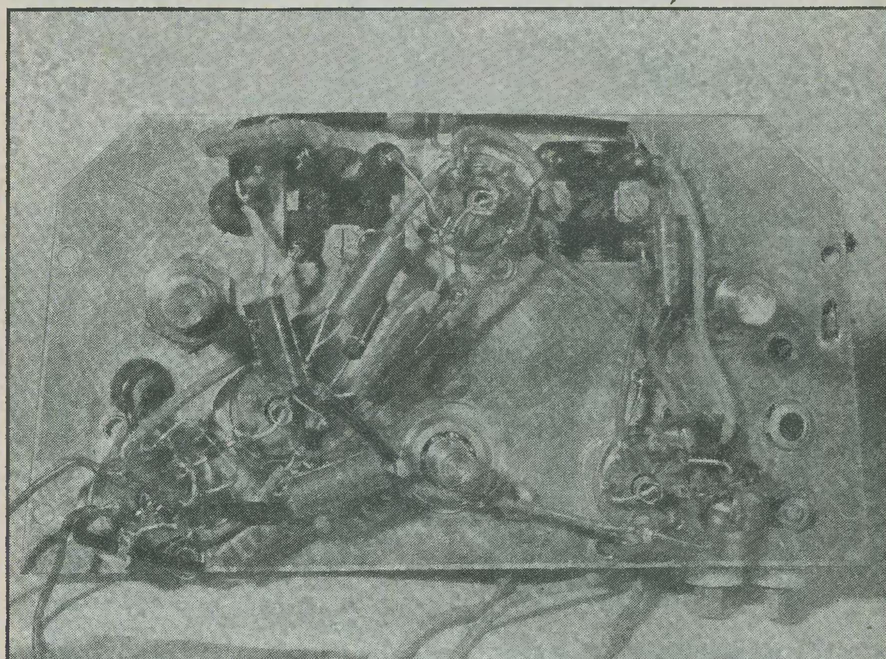
All the resistors used in the receiver, except, of course, for the volume control, are contained on a clearly marked card, each being designated both by the R number in the circuit diagram of Fig. 1, and its respective nominal ohmic value. The condensers are likewise clearly marked and are mounted on 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 $4\frac{1}{2}$ 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

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 C to pin 4 of $V_4$; the end of D to pin 5 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 $V_4$. 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



*Underside of chassis. Compare with Fig. 2 opposite*

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.

one end sufficiently so that pins 1 and 7 of $V_4$ may be connected together. Solder these connections and join the other end of this wire to pin 7 of $V_3$. From this latter pin connect a further length of p.v.c. wire to pin 7 of $V_2$. Returning to pin 7 of $V_3$, connect a further length of p.v.c. wire to this

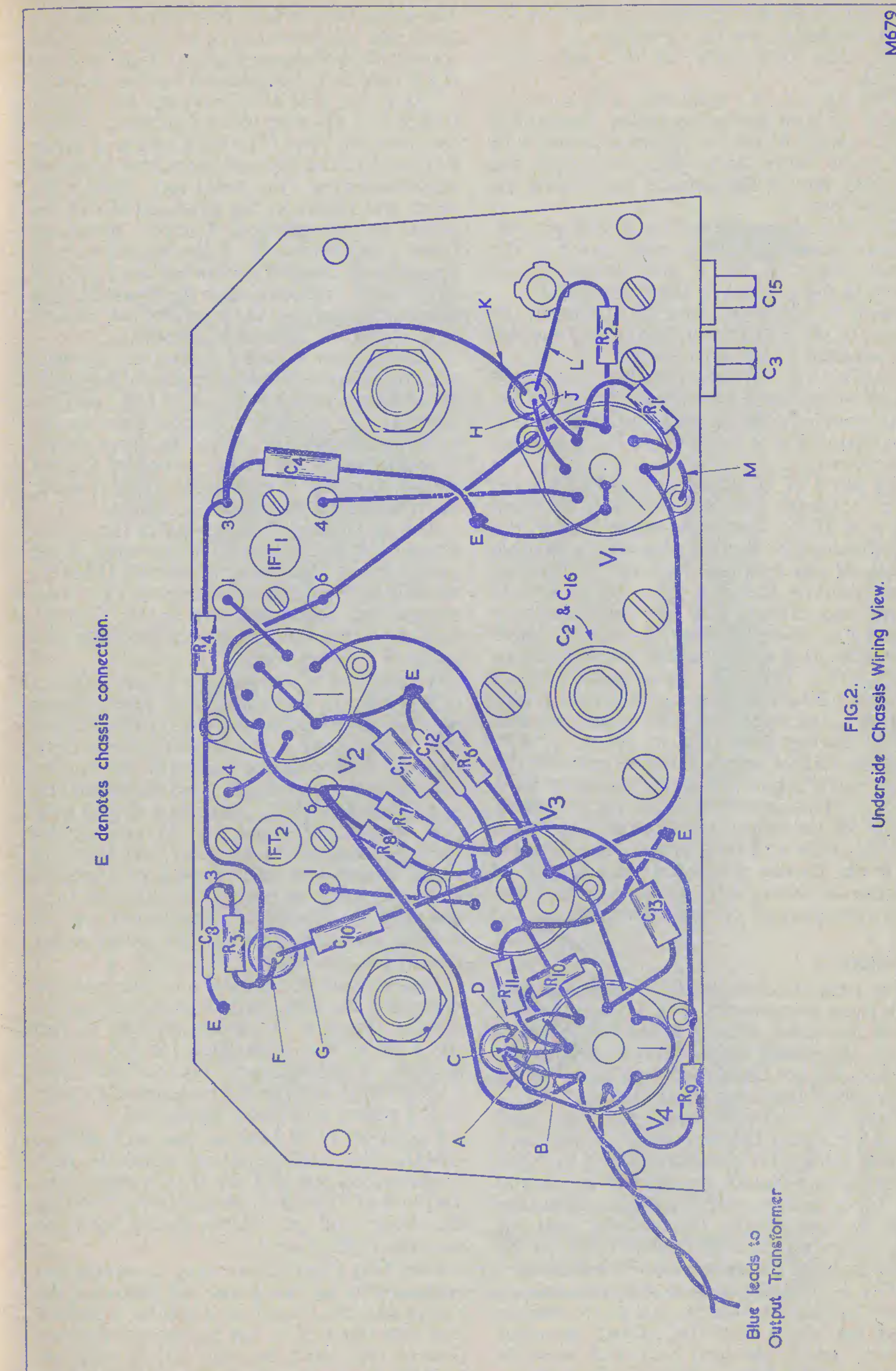



FIG.2. Underside Chassis Wiring View.

pin and solder the other end to pin 7 of $V_1$. This completes the l.t.+ wiring.

We next deal with the h.t. and l.t.− wiring.

Dealing with $V_1$ first, with a bared short length of wire connect together 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 $V_2$, again with a bare 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 $V_3$, using the bare wire, connect the spigot to pin 1 and from there to the earthed tag adjacent to the valveholder.

Lastly, $V_4$, connect together the metal spigot to pin 5 and from there to pin 1 of $V_3$. This completes the minus (−) return wiring. The next step is to bring in the h.t.+ connection points.

To pin 3 of $V_4$ solder one end of a short length of bare wire just sufficient to reach pin 6 of $IFT_2$. Having soldered this to the valveholder pin, slip over the wire a suitable length of red systoflex material. Solder the other end to the i.f.t. connection already mentioned. To pin 6 of $IFT_2$, and similarly covered as above, solder one end of a short wire, the other end of which is connected to pin 3 of $V_2$. From this latter point, connect a further length of wire, again covered with systoflex, and solder the other end to pin 6 of $IFT_1$. Having done this, to pin 6 of $IFT_1$ solder a further length, suitably covered, the other end of which is now connected to pin 5 of $V_1$. 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 $R_1$ (100kΩ) from the card and suitably shorten the wire ends so that each may be soldered to the valve pins of $V_1$. (See illustrations.) Solder one end to pin 4 and the other end to pin 7 of $V_1$. 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 $R_2$ (15kΩ), cut one wire end only in such a manner that the far 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 $V_1$. 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 $IFT_2$, connect $R_3$ (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 i.f.t. metal can. Solder the other end of $R_3$ 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 quite separate from the four tags contained on the rear of the control with which we have already dealt.)

Dealing now with $R_4$, do not cut the wire ends but place over them lengths of systoflex, and solder one end to pin 3 of $IFT_1$ and the other end to the bare wire contained on the rubber grommet end of $R_3$. In other words, connect one end of $R_4$ to one end of $R_3$, but ensure that the correct end of $R_3$ is used, i.e. that nearest the rubber grommet.

The remainder of the wiring to the potentiometer $R_5$ will be left till a later stage in the proceedings. Dealing now with $R_6$ (10MΩ), suitably shorten the wire ends of this component and solder one end to pin 6 of $V_3$ and the other end to the earthed tag just below $V_2$ valveholder.

To pin 5 of $V_3$ valveholder solder one end of $R_7$ (500kΩ), the other end of which should now be connected to pin 6 of $IFT_2$. Follow this by removing $R_8$ (4.7MΩ) from the card, suitably shortening the wire ends and soldering one end to pin 4 of $V_3$ and the remaining end to pin 6 of $IFT_2$. Beginners should note here that $R_6$, $R_7$ and $R_8$ 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 $R_9$ (22MΩ) should now be taken and the wire ends shortened in such a manner that they will reach pin 5 of $V_3$ and pin 2 of $V_4$ (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 $V_4$ solder one end of $R_{10}$ (2MΩ), the other end of which is next connected to pin 4 of the same valveholder. To pin 4 of $V_4$ solder one end of $R_{11}$ (560Ω), the other end of which should now be secured to pin 5 of $V_4$.

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 $V_4$ has no internal connection to the valve, but the pin is used externally as an anchoring and connection



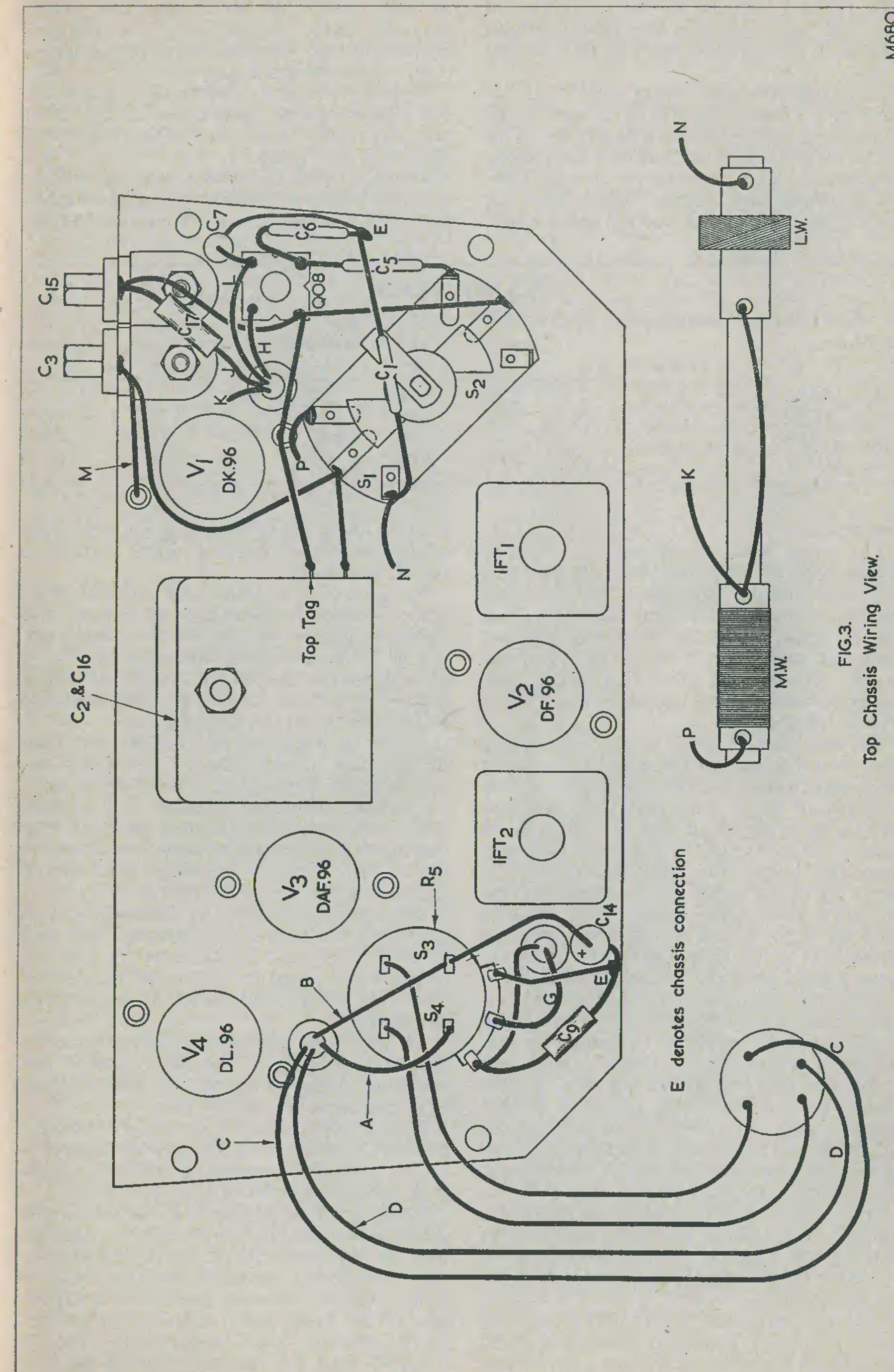



FIG.3. Top Chassis Wiring View.

point for components; in this case $R_{10}$ and $R_{11}$. Pin 5 of $V_4$ has, in this instance, been utilised as the earth connection for one end of $R_{11}$.

This completes the wiring into circuit of the resistors except for the remainder of the connections to the volume control $R_5$. This will be carried out as we deal with the various condensers. The constructor should now, before proceeding further, check that all resistors are correctly connected and located.

the other end to the lower right-hand tag of the coil QO8. Again, note the physical position of this—and the following condenser ($C_6$),—from the photographs.

Similarly prepare $C_6$ (450pF) and connect one wire end to the same tag of the coil QO8 and the other end to that earthing tag alongside the switch.

The condenser $C_7$ (0.04μF) should now be soldered between the earthing tag connection just mentioned and the top right-hand tag of

**VOLTAGE TABLE**

All voltages measured with an AVO "8"—chassis negative.

| *Valve* | | *Pin Numbers* 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| $V_1$ | DK96 .. .. | — | 62V | 33V | 1.2V | 62V | — | 1.4V |
| $V_2$ | DF96 .. .. | — | 62V | 62V | — | — | — | 1.4V |
| $V_3$ | DAF96 .. .. | — | — | 18V | 30V | — | — | 1.4V |
| $V_4$ | DL96 .. .. | 1.4V | 57V | 62V | −5V | — | — | 1.4V |

**Condensers**

The silver mica condenser $C_1$ (130pF) should now be removed from the card, its wire ends suitably shortened and one end soldered to the top left-hand tag of $S_1$. (See Fig. 3.) Ensure that this wire end does not come into contact with any other tag of the switch. Connect the other end of this condenser to the earthing tag near the adjacent edge of the chassis.

We now deal with the connections to $C_2$, this being that part of the variable two-gang condenser nearest the metal chassis. Obtain a length of p.v.c. wire and bare one end sufficiently in length so that the end may be soldered to the tag of $C_2$, and some little way along this bared wire, also soldered to the centre tag of the switch $S_2$. In order that this wire does NOT make contact with the left-hand tag of the switch to which we have just connected $C_1$, this latter tag should be gently pressed away from the bare wire towards the chassis ensuring, of course, that it does not make 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 $C_3$ (35pF 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 $V_1$ valveholder and connected to pin 6 of $V_1$.

From pin 3 of $IFT_1$ solder one end of $C_4$ (0.04μF) and connect the other end to that earthing tag adjacent to the valveholder of $V_1$. Note the position of this condenser from the illustrations.

Dealing next with $C_5$ (450pF), suitably shorten the wire ends and connect one end to the right-hand tag of $S_2$ (see Fig. 3), and

the coil QO8. Note from Fig. 3 the position of this condenser, it being placed vertical to the chassis deck.

To pin 3 of $IFT_2$ solder one wire end of $C_8$ (100pF), suitably shortened, of course, and the remaining end to the nearby earthing tag.

Fig. 3 shows the position of $C_9$ (100pF), and this should be soldered from the left-hand tag of the volume control $R_5$ with the other end connected to the earthing tag.

Take $C_{10}$ (0.005μF) and cut one wire end (G) to such a length that it will reach the centre tag of the volume control $R_5$ through the rubber grommet alongside this control. Cover this wire with systoflex material, feed through the grommet and solder to the centre tag of $R_5$. Connect the other wire end of $C_{10}$ to pin 6 of $V_3$ valveholder.

The next condenser $C_{11}$ (0.04μF) should now have the wire ends shortened; one end of this component should now be soldered to pin 4 of $V_3$ and the other end to pin 1 of $V_2$. This latter point serves as an earthing connection.

To pin 5 of $V_3$ valveholder connect one end of $C_{12}$ (100pF), the other end of this condenser connecting to the earthing tag adjacent to the $V_2$ valveholder.

Solder to pin 6 of $V_4$ one end of the condenser $C_{13}$ and the other wire end to pin 5 of $V_3$, having first covered both wire ends with suitable lengths of systoflex.

Dealing next with $C_{14}$ (8μF), note from the illustrations that this component is mounted in such a manner that it finally occupies a vertical position alongside the metal can of $IFT_2$. Suitably shorten the wire at the *black* end of the component and solder this wire to the earthing tag adjacent to the volume control. The *red* wire end should now be



connected to the lower right-hand tag on the *rear* of the volume control.

The remaining half of the two-gang variable condenser, $C_{16}$ (365pF), must now be wired into circuit. Solder a length of p.v.c. wire to the tag of this condenser and connect the other end to the bottom left-hand tag of the coil QO8. To this latter point also solder two other lengths of p.v.c. wire. The other end of one of these lengths must now be secured to the tag of the trimmer $C_{15}$. The remaining end should next be soldered to the centre tag of the wavechange switch $S_2$.

The last condenser should now be removed from the card and soldered into circuit. $C_{17}$ (100pF) should first have one wire end only shortened, and this should be soldered to the tag of the trimmer condenser $C_{15}$ (35pF). The remaining wire end (J) should now be covered with systoflex, fed through the adjacent rubber grommet, and be soldered to pin 3 of $V_1$.

This completes the wiring-in of the condensers, but the receiver is still not complete with all its wiring, and it is these final details that we must deal with next.

**Final Details**

Returning to the volume control $R_5$, and using a bare length of wire, connect one end to the lower right-hand tag of the actual control itself, i.e. *not* to any of the four tags contained on the rear of the potentiometer. Solder the other end of this wire to the adjacent earthing tag.

Using a suitable length of p.v.c. wire, bare both ends and connect one to the top left-hand tag of the coil QO8. Feed the other end of this wire (H) through the rubber grommet and solder the end to pin 3 of $V_1$.

The output transformer leads should now be shortened somewhat and bared at each end. One wire, it does not matter which, should now be soldered to pin 2 of $V_4$, and the other wire to pin 3 of the same valveho der.

We next deal with the ferrite rod aerial connections. Firstly, with a short length of p.v.c. wire (K), connect the two windings to each other by soldering each end of the wire to the two innermost studs. (See Fig. 3).

Mount the ferrite rod aerial to the metal fixture in such a manner that the fitted large rubber grommet positions securely into the metal bracket.

Obtain a suitable length of p.v.c. wire, bare both ends and solder one to the right-hand stud of the aerial assembly (N of Fig. 3). The other end of this wire should now be connected to the left-hand tag of the wavechange switch $S_1$.

The Medium wave winding connection (P) should now be completed by using p.v.c. wire and connecting one end to the stud provided on the winding and the other end to the right-hand tag of the switch $S_1$. Ensure that both windings are positioned at the ends of the ferrite rod material.

The actual wiring of the receiver is now complete. Beginners should now check that all is correct, both with regard to the foregoing instructions and with regard to Figs. 2 and 3.

Fit the battery plug to the B114 battery (69V+1.5V) and switch on the receiver by rotating the volume control spindle in a clockwise direction. For those in possession of a meter, check the voltages between pins 1 and 7 of each valveholder. This should be 1.5V. (See voltage table for other information.)

Insert the respective valves into the appropriate holders. (See Fig. 3.) Fit the spindle extension to the spindle of the wavechange switch. Mount the chassis into the cabinet and secure into position by means of the four wood-screws provided. These should be driven into the wood blocks fixed to the receiver casing. Finally, fit the knobs to their respective spindles.

**STATION GUIDE FOR CALIBRATION PURPOSES**

| *Station* | *kc/s* | *Metres* |
|---|---|---|
| Moscow .. | 173 | 1734 |
| BBC Light .. | 200 | 1500 |
| Luxembourg .. | 233 | 1286 |
| BBC Third .. | 647 | 464 |
| BBC Scottish .. | 809 | 371 |
| BBC London .. | 908 | 330 |
| BBC Midland .. | 1108 | 276 |
| BBC Light .. | 1214 | 247 |
| Luxembourg .. | 1439 | 208 |

**Aligning the Receiver**

The i.f. transformers are already prealigned to 470 kc/s. Ensure that the wavechange switch is turned anti-clockwise (Medium Wave), and turn the volume control to the maximum position (clockwise).

Adjust the core of the oscillator coil (QO8) from the inside of the receiver cabinet until the core is level with the tag ring. Tune for the Home Service by rotating the tuning control. Move the medium wave coil on the ferrite rod until a position of maximum volume is obtained.

Rotate the tuning control anti-clockwise for another signal, around 200–220 metres, preferably a weak station, and adjust the trimmer $C_3$ for maximum volume. Retune clockwise to about 450 metres for Brussels, etc., or a similar station, and re-adjust the core of the oscillator coil QO8, rocking the tuning condenser slightly whilst obtaining peak output. Readjust the medium wave winding on the ferrite rod for maximum volume. *continued on page 129*

# 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 shedders 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-shedders 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 f.m. or t.v. receiver may well be several weeks in the making. Hence it is nice to have a place where everything 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 specially 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 possessor 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 centre photograph on the next page shows the start of the 9in front and side walls (rear wall 4½in). The damp course can be seen, and the missing brick on the side wall is to provide space for a switched power socket. Three more are fitted to the front wall. The concrete foundation, laid on hard core, is approximately 10in thick and the interior floor dimensions 14ft x 7ft.

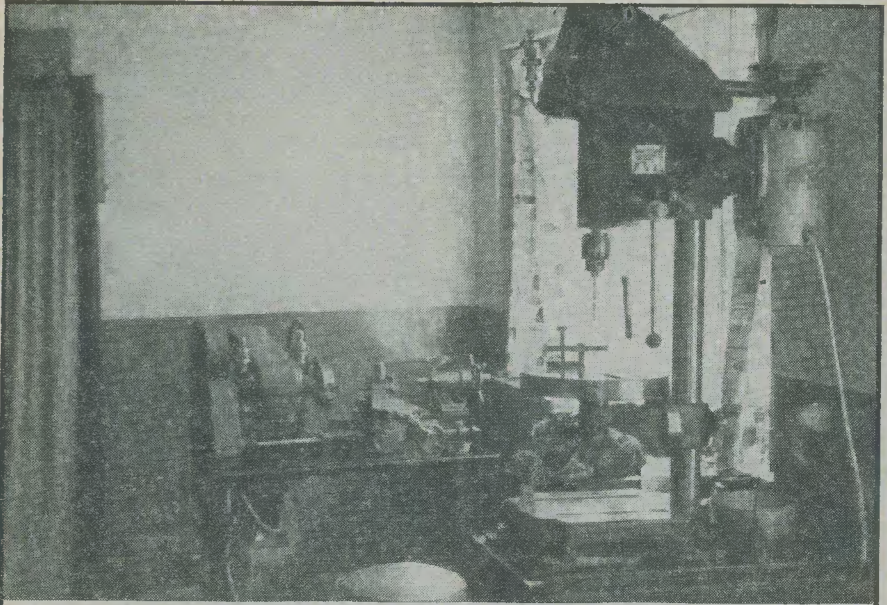
The lower picture shows the building nearing completion, while the top one is of one corner viewed from the doorway. The interior is finished with hardboard fitted to the underside of the roof beams and held to the walls by 1in battening, giving it the effect of "cavity walls." The lathe, incidentally, is 3½in centre height and the bench drill is ½in 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 2ft rule (which is to wipe your feet when you go in!).

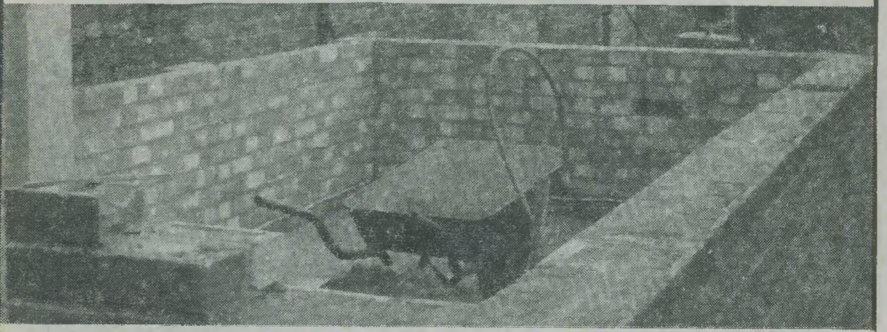
As might be expected from such a "professional type" job, no trouble has arisen from dampness, the only precaution necessary being the light greasing of stored tools, etc. The electric power is drawn from the house using Pyrotenax cable travelling underground.

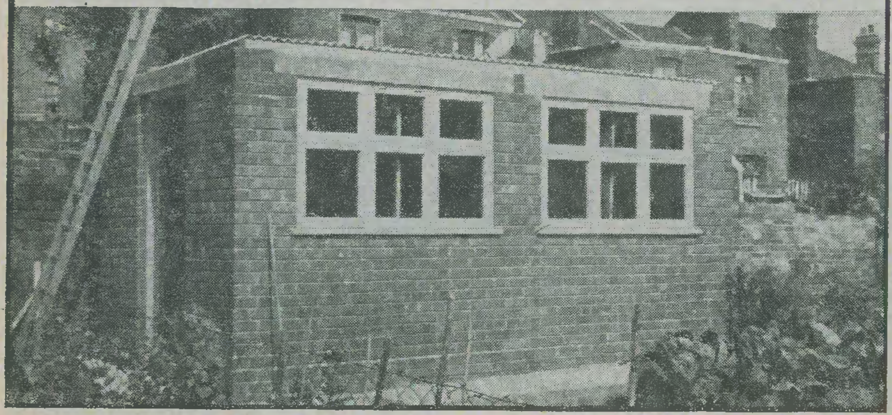
**Your Say**

While on the subject of outdoor workshops, 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 Humex Ventmaster. This device, primarily designed for greenhouses, consists of a chemically filled cylinder which is fitted to the window frame. As the temperature









## Centre Tap talks about items of general interest

varies the fluid contracts or expands, automatically closing or opening the vent, thus needing neither power nor attention. From reports I have had from users, I gather that they are eminently satisfactory and will operate quite heavy ventilators or window frames with certainty. P.H.P. also mentions another device by the same firm, a fan ventilator controlled by a thermostat of which home-made versions might well be contrived by the average reader.

Another interesting letter from A.M.P. (Culcheth) 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 practice of hand stencilling on safety grounds. Hydrofluoric acid etching is dangerous and likely to remove the operator's hands. Perhaps some reader can suggest a less risky etchant with which readers can treat their own valves. This should not be difficult as the time factor is not important, as it would be in a factory process. On the same subject a Mitcham reader (anonymous) cynically 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!

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 bedfast, was adept at making pleated paper cones which he scored lightly with a darning needle, gluing cork to the centre (instead of the sealing wax I mentioned). Also, instead of using stiff wire between the reed and cork, he used a match-stick. He considers (as did many others) that these were the best thing of their time. Later he bought one of the earliest moving coil speakers from Mr. Briggs, whose newly-started business was then in a city centre Bradford basement. This enterprise has now grown into the world-famous Wharfedale business. Incidentally, that speaker gave sterling service 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.c. 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 no one has written specifically on the subject, most correspondents in recent weeks have mentioned their complete agreement with my comments on many of the I.T.V. programmes which spell utter boredom to the intelligent viewer. Whenever I seem to have a little time to spare for casual viewing the screen is filled with interminably dreary Westerns, American quickies and stale films. It is amazing that we should spend dollars on such stuff, and to make it worse I.T.V. are asking the Government for another 21 hours a week—an example followed less eagerly by the B.B.C. Both authorities, especially I.T.V. would be better concerned with putting out improved programmes in their existing hours. It would be nice to have a few "sensible" programmes. I shudder to think what is going to happen during those extra hours and can only imagine that it will be more programmes suitable for backward adolescents just merely to fill out time in order to justify still more advertising.

Many readers feel it would be better, too, if I.T.V. put the money spent on bubble cars, stole wraps, washing machines, bedroom suites, etc., into the programmes. Is it to attract the lower types of mentality that such prizes are lavishly distributed for answering questions which should present no difficulty to school-children?

With the B.B.C. sometimes even outdoing I.T.V. in finding some of the worst of the American bookings, many people, besides myself, are humbly grateful that "steam" radio nowadays still carries a satisfying proportion of worthwhile programmes during peak listening hours. And the pleasure is doubled when one listens to them on F.M.!

Incidentally, three of the I.T.V. programme contractors are increasing their advertising rates by 10% in the autumn, and a fourth on 1st January, but they will charge 20% more during peak hours (7.30 to 10.30 p.m.). The increases are made on the grounds that the audiences are now much larger. With this swelling of revenue no doubt we shall see really big quiz prizes (if you can only answer such questions as "Where does Jamaican rum come from?") instead of such trifles as refrigerators and t.v. sets!

**Lucky For Us**

It is curious when you come to think of it that the additional t.v. hours now asked for exceed the total t.v. hours of a number of European countries. In Austria, for instance, they have three hours each evening except Tuesday, when there is no programme at all. A far higher proportion of their programmes are (if only for this reason) worth while sitting down to watch—instead of merely forming a background of time-filling trivialities which are allowed to drone on while various members of the family carry on doing something else and spare only an occasional glance at the screen.

It is nice, however, to think that we don't have to pay at the same rate for our t.v. Their licences, which are renewable every *month*, cost fifty Austrian shillings (Exchange rate approx. 72 to the £1). Nor must it be overlooked that wages and salaries are considerably lower than they are here. Small wonder no one is expected to pay a year in advance at that rate, but even if one has got the cash a month is the longest period you can take.

Talking about money reminds me—suppose the B.B.C. get the extra hours, where is the additional expenditure coming from? Surely the next move will be to put our licences up to a fiver!

I note also that the House of Commons Public Accounts Committee have turned their attention to I.T.A.'s huge profits and consider that future rentals should represent the contractor's full capacity to pay. At this, the Chairman of Associated-Rediffusion is reported as suggesting that if the commercial t.v. companies have to pay more rent, viewers will get inferior programmes. Which makes me wonder where they are going to find 'em.

# The TOURIST Portable Receiver

continued from page 125

Re-tune to Luxembourg (208 metres) and adjust $C_{15}$ trimmer for the correct calibration of the scale.

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

Turn the wavechange switch clockwise to the long wave position. Tune to the Light Programme (1500 metres) 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 polystyrene cement, etc. The trimmers $C_3$ and $C_{15}$ should also be treated in a like manner.

# PHILIPS Continuous Tape Cassette

Philips Electrical Ltd. are now marketing a Continuous Tape Cassette, type EL3963/00, which is intended for use primarily with their AG8108G Tape Recorder and with certain other models which have a left to right tape sense and facilities for locking the tape turntable in a stationary position during recording/playback.

Of clear plastic, the cassette has a diameter of $3\frac{1}{4}$in. and contains low friction magnetic tape coated on both sides. Playing time is 20 mins. at $1\frac{7}{8}$ i.p.s., 10 mins. at $3\frac{3}{4}$ i.p.s. and 5 mins. at $7\frac{1}{2}$ i.p.s. These times may be doubled by the formation of a "mobius loop" as described in the operating instructions.

The EL3963/00, which sells at £5.0s.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.

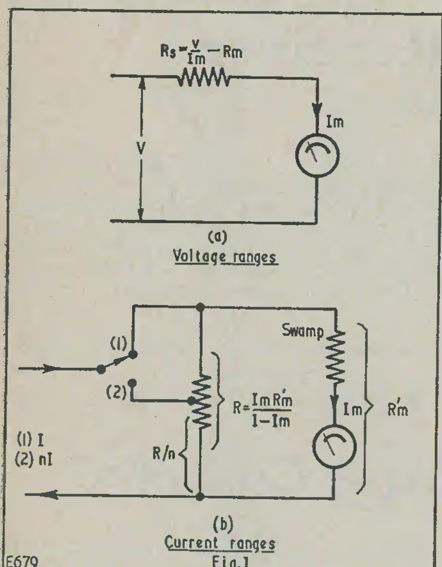



*Fig. 1. D.C. multipliers. The values to be inserted in the formulae are those for full-scale deflection*

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/*n*th part. The same is true of an ammeter or milliameter inserted at some point where the meter resistance is 1/*n*th 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:

$$\frac{I_x}{I}=\frac{R_o}{R_o+R_x};$$

where $R_x$ is the resistance being measured, and $I_x$ the corresponding meter current, $R_o$ the internal resistance which the ohmmeter presents between its terminals on that particular range, and I the full-scale current of the meter, i.e. its current for $R_x=0$.

Changes of current in the ohmmeter, however complicated the circuit, are always inversely proportional to $R_o+R_x$. This is not 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 both these changes. The variable resistance in series with the battery of Fig. 2 can be used

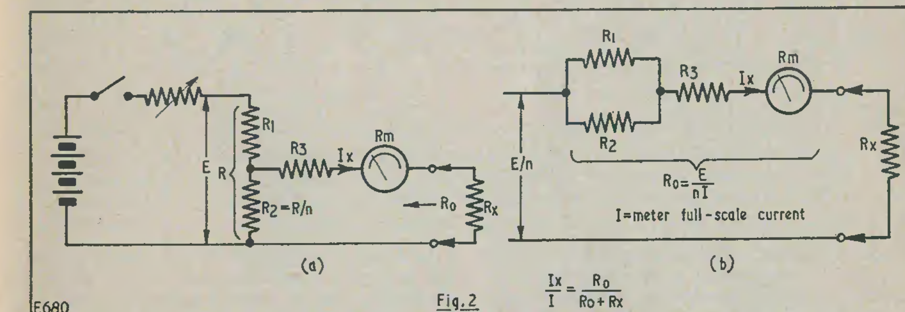



*Fig. 2. Resistance ranges (a) with equivalent circuit (b). $R_3$ may be absent, but if temperature errors are to be avoided on the lowest range it is desirable to have enough series resistance to act as a swamp. For the lowest range a shunt may have to be placed across the meter to obtain the required reduction in the value of $R_o$*

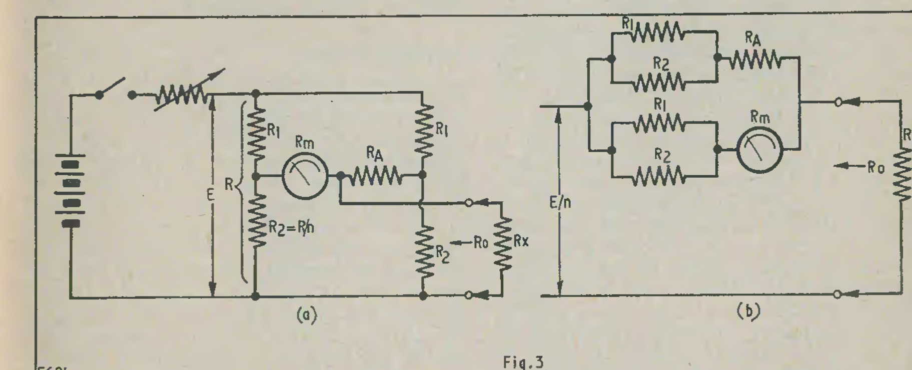



*Fig. 3. Modified circuit of low resistance range. The value of $R_2$ might be 1/9th of the meter resistance, assuming a microammeter with a resistance of several hundred ohms. The value of $R_A$ is only a fraction of $R_2$, and it is included to enable the ohmmeter equivalent resistance $R_o$ to be 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 $R_3$ 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 1kΩ is used for the current ranges, then replacing it by a series resistance of 1kΩ will convert readings of milliamps into volts. This is the well-known transformation of a current source into an equivalent voltage source, and

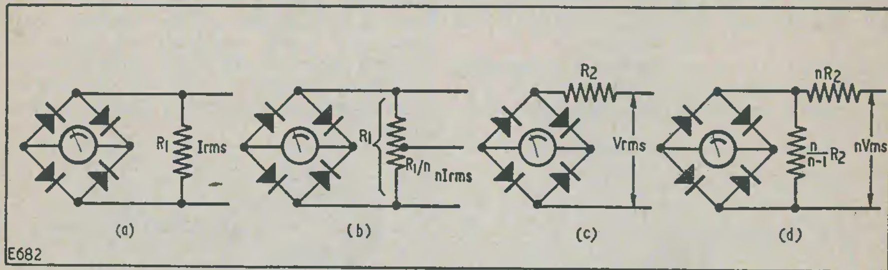



*Fig. 4. A.C. multipliers with the corresponding input currents and voltages for f.s.d. Diagrams (a) and (b) represent current ranges using a common scale, (c) and (d) are voltage ranges. Note that if we make $R_1 = R_2$, then $V_{r.m.s.} = R_1 I_{r.m.s.}$*

whose resistance varies at different points of the scale. Nevertheless a nearly-linear scale can be obtained except 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, this 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 rather 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 on the different ranges to alternating current inputs to the testmeter 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 meter 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 testmeter. 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.





# 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 glance at Fig. 2 will show, and little time should be needed to assemble this handy little unit.

Operation is quite simple, and needs little explanation—on plugging a pair of high-resistance 'phones into $J_1$, output is obtained from the 3-position filter—enabling CW to be copied even through quite heavy QRM. $J_2$, of course, gives normal receiver output, whilst $J_3$ 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

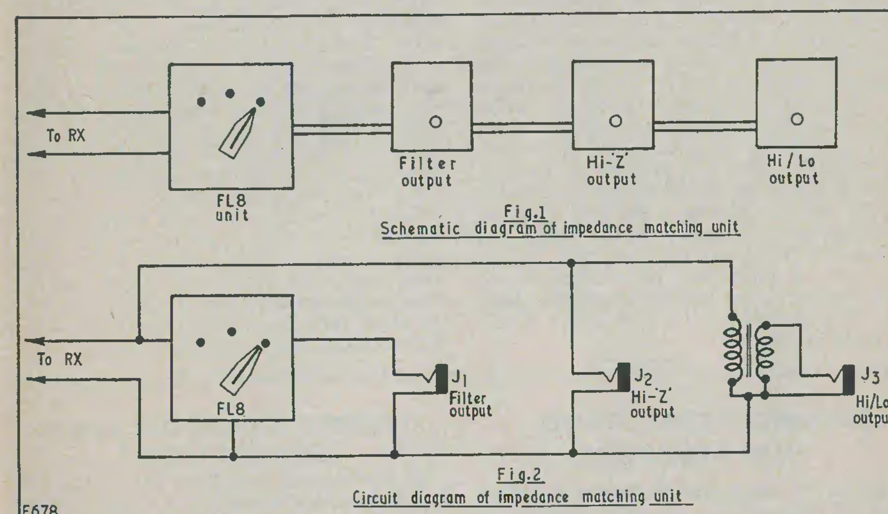



Fig.1 Schematic diagram of impedance matching unit

Fig.2 Circuit diagram of impedance matching unit

Few snags are likely to arise in construction providing care be exercised regarding insulation between the three jack sockets and the metal box. No specific design has been put forward, as it is assumed the reader may have ideas of his own as to layout, etc.

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 outlay 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. Bardwell, 81 Sellars Street, Sheffield 8.

MISCELLANEOUS

# 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 to shape. The size chosen was 3/8in as holes up to 1/4in can easily be drilled using an ordinary hand drill, and because both potentiometers, etc., and valvebase chassis cutters require a 3/8in 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 3/8in 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 determining the thickness of the material which may be handled. In the original version an arm of 1/2in x 1 1/4in (from an old car tyre lever) enabled 18 s.w.g. aluminium to be handled at a throat depth of 3in, while 22 s.w.g. could be cut at 6in throat depth. The arm is fixed to the base by four 3/16in bolts using a 1/8in packing piece. At the end of the arm a 3/8in 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 3/4in. If a 3/4in thick bar is available it would be ideal for the job.

The operating lever is fixed to the arm by a simple double linkage as shown in the diagram. A steel strip of about 1in x 1/8in would be suitable. The cutter is from a piece of 3/8in diameter steel rod. One end is slotted and drilled to attach it to the operating lever; the cutting end is shaped as shown to make the cutting action easier. For work on aluminium the cutter does not need to be very hard; mild steel is quite suitable. Should it be desired to employ a hardened cutter, this is quite a simple thing to make. A length of 3/8in silver steel should be shaped as just described. To harden, it should be heated over a gas ring until the rod becomes "cherry red," when it should be immediately quenched by plunging into a pail of cold water. The silver steel will now be dead hard, and will need to be "let down." To do this, clean the cutting end with emery cloth until it is bright, and then heat again—but this time slowly. As the steel gets hotter, its colour will change. When it reaches a "dark straw," it should again be quenched in cold water. It is now ready for use.

For positioning of the work a grid may be marked on the base; in practice it was found easier to mark the hole and then position the work by sighting through the cutter bearing. The machine has now repaid many times over the short time spent on its construction by the increased ease of "chassis bashing."

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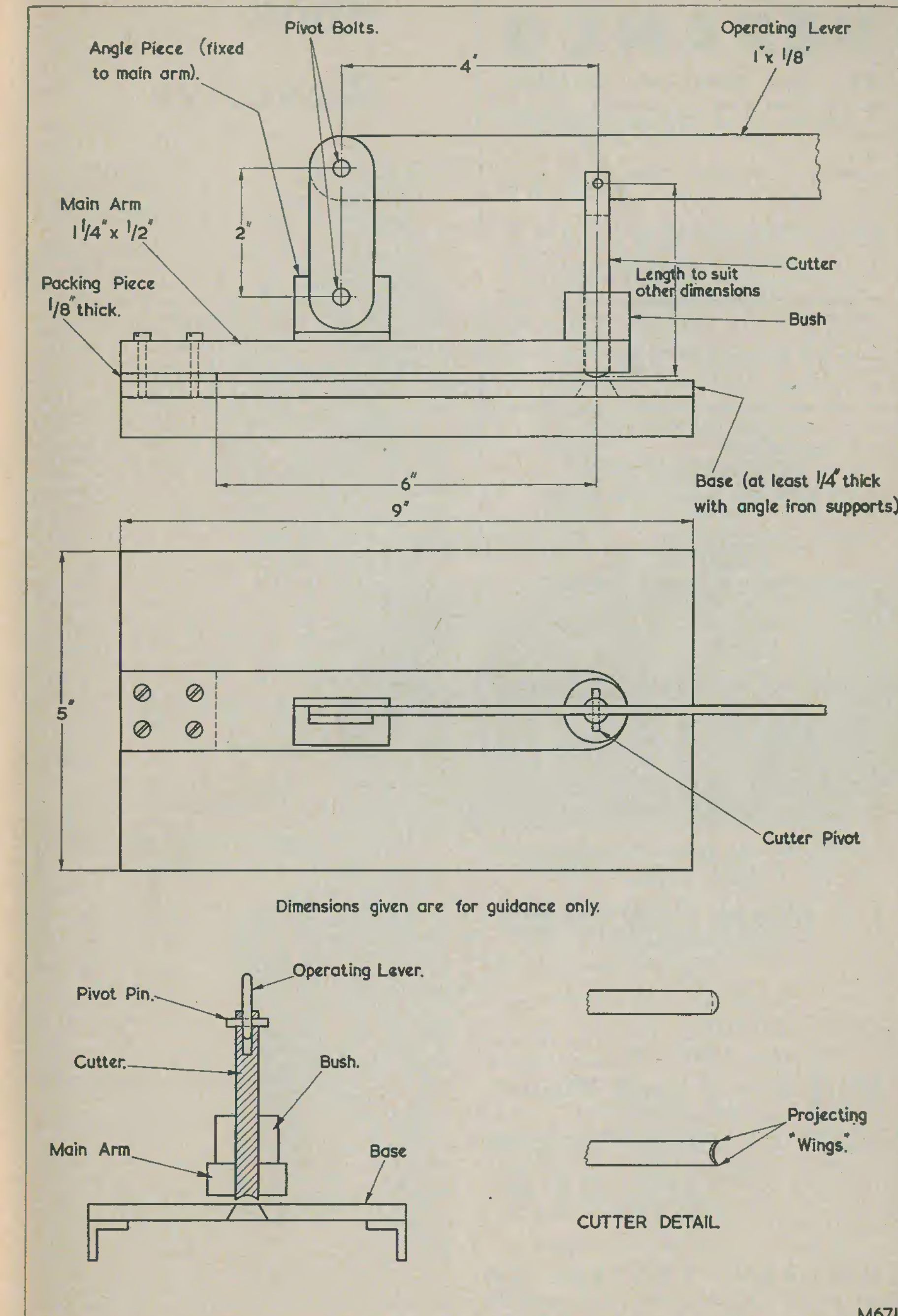
The opportunity has been taken to re-write most of the text and to bring the factual information up to date. The Lead Development Association, 18 Adam Street, London, W.C.2 will be happy to meet demands from readers who are able to put them to good use.





# Book Reviews

RADIO ENGINEER'S POCKET BOOK (12th Edition). Edited by F. J. Camm. 180 pages. Published by George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 6s.

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

In addition to often-needed information on matters entirely "radio" in their application, many tables and formulae are given, such as those frequently required in arithmetic, geometry, mensuration and trigonometry, decimal equivalents, slide rule gauge points, powers and roots, and properties of metallic elements —to mention a mere few. This latest edition of the booklet contains several items 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 would seem that the data on amateur wavebands, page 76, has somehow escaped the eagle eye of the publishers. The 5-metre band is no longer a permitted band for British amateurs due to its falling within television channel allocation, and the 15-metre and 160-metre 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 tucked away in a small book like this one. On the other hand, crystal combinations found on page 46 seem to have nostalgic value only, particularly for grey-haired totterers like the writer of these notes. However, the omission of the zincite-bornite combination seems inexcusable if only for the sake of history!

On the whole, a very useful compendium, well produced and good value for money.

W. E. THOMPSON

TELEVISION ENGINEERS' POCKET BOOK (2nd Edition). Edited by J. P. Hawker. 264 pages, 140 diagrams, tables and illustrations. Published by George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 12s. 6d.

Servicing engineers will no doubt find this book to be useful in many aspects of their work. The treatment in terms of the number of pages devoted to any particular subject is not lengthy, but this does not mean that essentials are glossed over. Brevity is due to information being given briefly yet factually; verbosity finds no place in a book which has obviously taken account of the fact that those who need to consult it will have no time to waste on reading unnecessary padding. One of the most useful features is to be found in the list of intermediate frequencies contained in fifteen pages near the end of the book. Nearly fifty makes of television receivers are mentioned, and the number of models listed runs into about 1,500.

The chapters on fault-finding and aligning receivers contain many useful tips. Alignment procedure is simplified considerably by using the tables which show, step by step, in what order the tuning circuits should be brought into resonance, and the method of setting up test equipment to achieve the desired results.

Other chapters deal with standards and waveforms, a survey of the British television network, basic circuitry, projection television, Band III conversions, installing receivers, receiving aerials, interference, etc. The diagrams are clear and adequately illustrate the matters discussed in the text. The tables giving brief details of cathode ray tubes and valves, and equivalents, are a useful reference.

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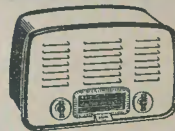

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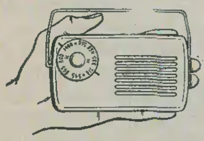

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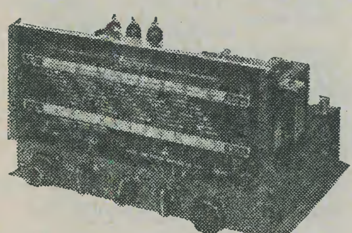

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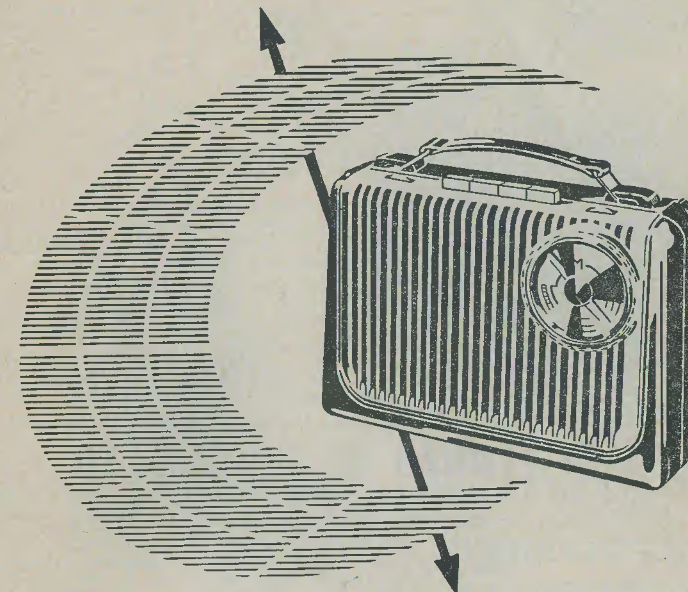

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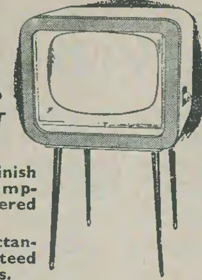

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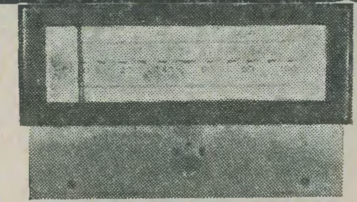

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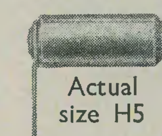


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|---|---|---|---|---|---|---|---|
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| DAF96 | 8/6 | EF92 | 5/– | Z66 | 8/– | 6SJ7M | 6/6 |
| DH63 | 8/6 | EL84 | 9/– | Z77 | 4/– | 6SN7GT | 4/9 |
| DH77 | 7/6 | EL85 | 9/6 | 1D5 | 9/6 | 6V6G | 5/11 |
| DK92 | 9/– | EL91 | 4/– | 1L4 | 3/9 | 6V6GT | 6/– |
| DK96 | 8/6 | EY86 | 10/6 | 1R5 | 7/– | 6X5GT | 4/6 |
| DL96 | 8/6 | EZ80 | 7/11 | 1T4 | 5/3 | 7B7 | 8/– |
| DF96 | 8/6 | GT1C | 7/6 | 1S5 | 6/6 | 7C5 | 7/6 |
| DM70 | 7/6 | KT33C | 8/6 | 3S4 | 7/– | 7C6 | 7/6 |
| EB34 | 1/6 | KT36 | 9/6 | 3V4 | 7/9 | 7H7 | 7/6 |
| EB91 | 4/6 | L63 | 4/– | 3Q4 | 7/6 | 7S7 | 9/6 |
| EBC41 | 9/– | KTW61 | 7/6 | 5U4G | 6/6 | 7Y4 | 7/6 |
| EBF80 | 9/– | MU14 | 8/6 | 5Z4G | 9/– | 10F1 | 9/6 |
| ECC81 | 6/– | OZ4 | 5/6 | 6AG5 | 5/– | 10F9 | 9/6 |
| ECC82 | 7/– | P61 | 2/6 | 6AT6 | 7/– | 12AT6 | 9/– |
| ECC83 | 8/– | PCC84 | 8/6 | 6AM6 | 4/– | 12AT7 | 6/– |
| ECC84 | 9/6 | PCF80 | 9/– | 6AL5 | 4/6 | 12AU7 | 7/– |
| ECC85 | 9/– | PCL82 | 12/– | 6B8G | 2/11 | 12AX7 | 7/6 |
| ECF80 | 11/6 | PEN36C | 9/6 | 6BA6 | 6/6 | 25L6GT | 9/6 |
| ECH42 | 9/– | PL33 | 9/6 | 6BJ6 | 6/6 | 25Z4G | 8/6 |
| ECL80 | 10/6 | PL81 | 13/6 | 6C4 | 4/– | 35L6GT | 9/6 |
| EF36 | 2/6 | PL83 | 9/– | 6F1 | 9/– | 35W4 | 7/6 |
| EF37 | 4/6 | PY31 | 8/6 | 6F6M | 7/6 | 80 | 8/– |
| EF40 | 13/6 | PY81 | 8/6 | 6F13 | 9/– | 90AV | 4/6 |
| EF41 | 9/– | PY82 | 8/6 | 6F33 | 5/6 | 807(B) | 3/9 |
| EF42 | 9/6 | PZ30 | 9/6 | 6H6M | 2/6 | 807 (USA) | 5/6 |
| EF50 | 2/9 | U31 | 8/6 | 6J5G | 2/6 | | |
| EF50(R) | 4/– | U35 | 9/6 | 6J5GT | 3/6 | 954 | 1/6 |
| EF55 | 3/6 | UBC41 | 8/– | 6J5M | 4/6 | 955 | 3/11 |
| EF80 | 7/6 | UCH42 | 9/– | 6K7G | 2/6 | 956 | 2/11 |
| EF85 | 7/– | UF41 | 9/– | 6K8G | 6/6 | 9001 | 4/6 |
| EF86 | 13/6 | UL41 | 8/6 | 6Q7G | 8/3 | 9003 | 4/– |
| | | | | 6SA7M | 8/6 | 9006 | 4/– |

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Circuit diagram with instructions available from most advertisers in this magazine, 1/– post free

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*Sole Distributors to the Trade*



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*See page 116 for full details*

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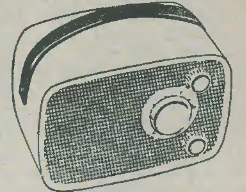

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45/– *P. & P. 1/6*

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**.... and now 12 months guarantee!**

**All tubes rebuilt with new heater, cathode and gun assembly-reconditioned virtually as new:**

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**180 Mc/s-205 Mc/s (Channels 6—13)**
Suitable London, Birmingham, Northern, Scottish, Welsh and I.O.W. ITA transmissions.
**Mk. 2 Model.** Latest cascode circuit using ECC84 and EF80 valves giving improved sensitivity (18 dB) over standard circuits, built-in power supply a.c. 200-250V. Dimensions only 6½" x 3", ht. 4". Simple and easy to fit—only external plug-in connections. Wired, aligned and tested ready for use. State channel required. Guaranteed. Bargain offer—good results or full refund. **ONLY £3.19.6** Carr. and pkg. 2/6
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*BARGAIN OFFER MANUFACTURERS SURPLUS*
Latest type ECC85 series valves with 3 watt EL84 Output Med., Long and V.H.F. Wavebands with Switched Gram Position. Magic Eye Tuning. Illuminated glass dial 11½" x 3½". 4 controls Chassis size 13½" x 6½" x 7½"ht. A.C. 200/250V. *Aligned and tested ready for use. Carr. and ins.* 5/-. *Complete with 4 knobs–Walnut or Ivory to choice.* **£13.10.0**
P.M. Speakers only required, 8" **20/–**, 10" **25/–**.

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*Low Loss Semi-Air Spaced AERAXIAL, polythene ins.*
*SPECIAL REDUCED PRICES*
20 yds **12/6**, P. & P. 1/6; 40 yds **22/6**, P. & P. 2/–; 60 yds **32/6**, P. & P. 3/–. All other lengths **8d.** yd.
**Coax Plugs 1/–, Coax Sockets 1/–, Couplers 1/3, Cable End Sockets 1/6, Outlet Boxes 4/6.**

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**New improved types—mains prim. 200/250V tapped**
All isolation transformers now supplied with alternative no boost, plus 25%, and plus **50%** boost taps, at no extra charge. All standard individual voltages available: 2V 2A-13V 0.3A (as previously advertised).
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*Small size and tag terminated for easy fitting.*

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Log. or lin. ratios, **10,000** ohms-2 Megohms. Long spindles. 1 year guarantee. Midget Ediswan type, 1⅛" dia. No sw. **3/–**, d.p. sw. **4/6.**
TWIN GANGED CONTROLS. ¼ Meg. ½ Meg. **1** Meg less sw., each **8/9.**

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2 W/band Midget Portable. Printed circuit, 6 transistors and one xtal diode and stage by stage instruction manual. *Complete Kit incl. Cabinet and 2½" Speaker.* **ONLY £9.19.6** *P. & P. 2/6*

**CAR RADIO KIT.** This popular Hybrid printed circuit 12V Car Radio as recently featured in *The Radio Constructor* is now available. *Complete Kit incl. Speaker* **ONLY £12.19.6** P. & P. 3/6
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**SPECIAL** 1R5, 1T4, 1S5, 3S4 or 3V4 per set, **27/6**, DK96, DF96, DAF96, DL96, **35/–**. 6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5, **35/–**.

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**MODEL A10: 500 Micro-amp Movement.**

★ AC/DC voltages, 2000 ohms per volt; 10, 50, 250, 500 and 1000 volts. ★ Resistance 10k ohms and 1 Megohm. ★ D.C. current 0.5 mA; 25 mA; 250 mA. ★ Decibel range. ★ DC ± 2% accuracy; AC ± 3%.

*INCLUSIVE OF TEST PRODS, ILLUSTRATION BOOK AND BATTERIES* **£4·17·6**

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The ideal f.m. conversion unit as described in P.W., April/May 1957. Complete with 6 valves, three EF91s, two EF92s and one EB91. I.F.T.s, etc., in absolutely new condition. With circuit and conversion data.

**12/6** (less valves) **37/6** (with valves)

*Postage and packing 2/6 (either type)*

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**For No. 19 Set**

10 kc/s, 100 kc/s and 1 mc/s xtal controlled osc. on/off modulator: 5-12SC7 valves: quartz crystal.

*FULL HANDBOOK* **79/6** P.P. 2/6

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★ GC2 Turnover Crystal Head.
★ Brand New. **£6·19·6** P.P. 2/6

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★ Turnover Crystal Head.
★ Plays Mixed Sizes.
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★ Turnover Crystal Head
★ **Wired fer Stereo**
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★ Turnover Crystal Pickup
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## Portable Gram Amplifier

★ For use with crystal pickups. ★ Mounted on baffle board 12½ × 4¾. ★ Includes 7 × 4 inch LAC Speaker. ★ 2 Mullard valves: Output 2 watts. ★ Full volume and tone control.

*JUST PLUG INTO MAINS AND CONNECT PICKUP.* **67/6** P.P. 2/6

**PACKARD-BELL PRE-AMP.** Complete in screened case with 6SL7GT; 28D7 relay; leads, jack plug, etc. Handbook. Sealed in carton. ONLY **12/6** P.P. 2/–

## CRYSTAL CALIBRATOR NO. 10

Crystal controlled, coverage 500 kc/s to 10 mc/s: 1 c/s mod.: battery valves 2-IT4; IR5.

*FULL HANDBOOK.* **59/6** P.P. 3/6

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**Army Type 17 Mk. II.** Complete with Valves, High Resistance Headphones, Handmike and Instruction Book and circuit. Frequency Range 44.0 to 61 Mc/s. Range approximately 3 to 8 miles. Power requirements: Standard 120V h.t. and 2V l.t. Ideal for Civil Defence and communications.

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44–61 Mc/s calibrated wavemeter for same, 10/– extra

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**Type 38 Transmitter/Receiver.** Complete with 5 valves. In new condition. These sets are sold without guarantee, but are serviceable. **22/6** P.P. 2/6

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# MAJOR-3 (See page 112 this issue)

★ 3 Ediswan Transistors. ★ 5-Stage Reflex Circuit. ★ Medium Wave Tuning. ★ No Aerial or Earth. ★ Size 4½ × 3 × 1½ in. ★ Min. Volume Control.

*Complete set of components including* **Ediswan Transistors** *and all items required. All parts available separately.* **90/–** post free

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FROM **5/–** EACH

**Ediswan** and **Mullard** Standard Range Transistor Prices Almost Halved.—*SEND FOR NEW LISTS AND DATA*

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**Combined Portable/Car Radio Push-Pull Portable Superhet**

★ Tunable over medium and long wavebands
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★ Internal Ferrite aerial
★ Highly sensitive and selective
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★ Easy-to-follow layout diagrams

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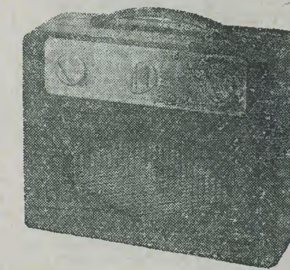

**Car radio components 8/–; A.V.C. 4/3; 325mW version now £11.11.6.** P. & P. 2/6.

Size 9″ × 7″ × 3½″. Weight 4 lb.

## NEW! SUPER-6 *Six Transistor Medium & Long Wave Superhet*

★ **Plessey Printed Circuit** ★ Size 7 × 4½ × 2 in.
★ **Mullard Transistors**
★ **3-inch Speaker**
★ **Full Medium and Long Waves**

*Recommended by us as being the easiest to build 6-Transistor printed circuit superhet receiver ever offered.*

FREE LIST ON REQUEST

Complete set of parts including Rexine Covered Cabinet and all Components. ONLY **£9.19.6** P.P. 2/6. All parts sold separately

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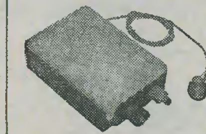

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★ Over 6 months on one battery
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★ Layout diagrams

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| ★ Miniature 2½″ 3 ohm speaker ... | 21/6 |
| ★ 20:1 output transformer to match ... | 10/– |
| ★ 5-transistor printed circuit ... | 5/6 |
| ★ 5-transistor circuit diagram ... | 1/– |
| ★ Cabinet size 5½″ × 3½″ × 1¼″ | |

**SPECIAL INCLUSIVE PRICE 55/–** P.P. 2/–

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A permanent power transistor stage complete with 7″ × 4″ speaker. May be used with any battery portable using a 3 ohm speaker. Use it with the "8"

Complete set of parts ... ... **65/–** P.P. 2/6
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★ Ideal Modulator ★ Size 2¼″ × 1⅜″ × 1″

Ideal for morse practice unit (See August Issue) P.P. 1/–

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*continued on page 151*

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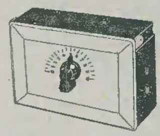

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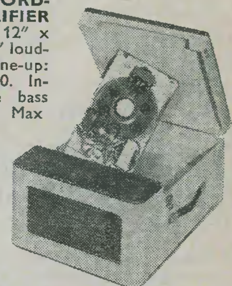

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*continued from page 149*

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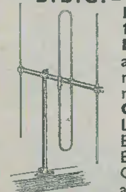

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