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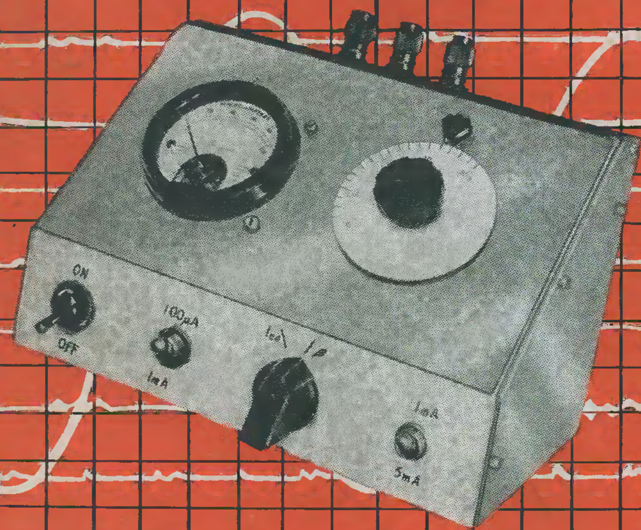
"LITON" TRANSISTOR PARKING LIGHT SWITCH

VOLUME 13
NUMBER 9
APRIL
1960

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS



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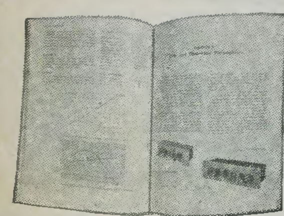

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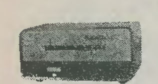

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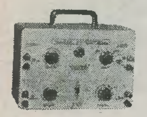

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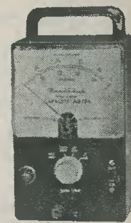

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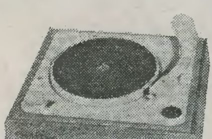

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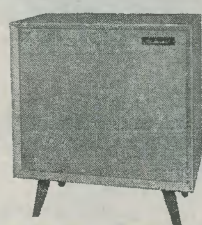

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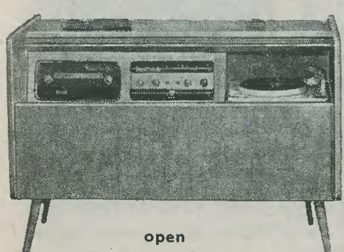

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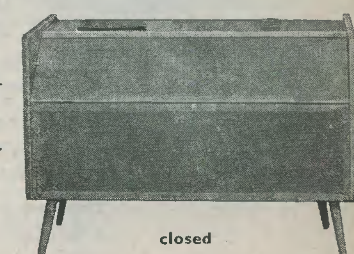

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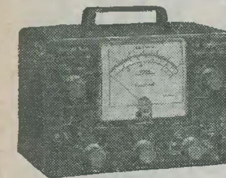
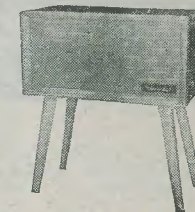


AG-9U



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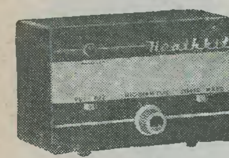
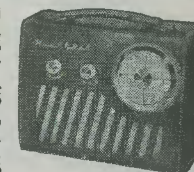


USP-1



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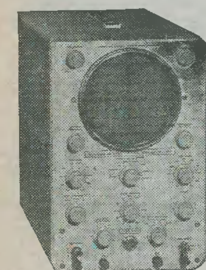
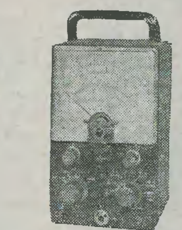
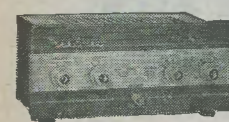


O-12U



V-7A



S-33

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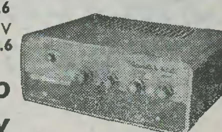

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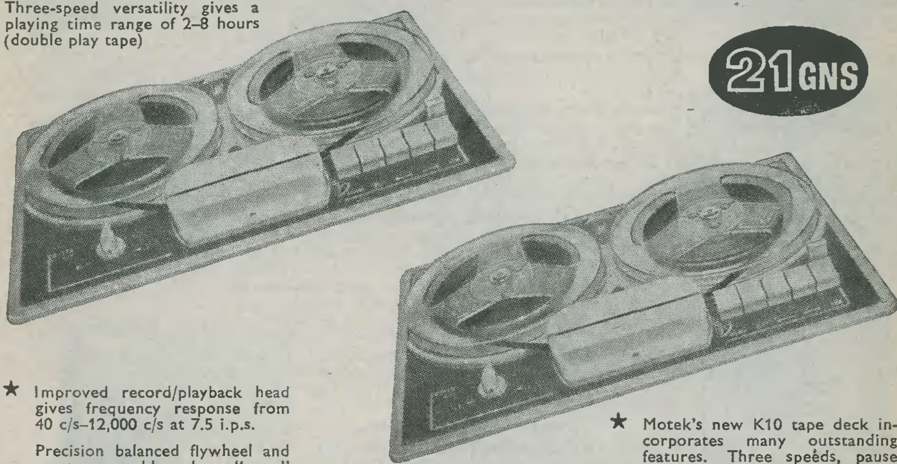

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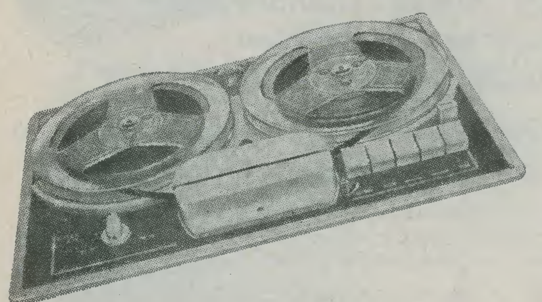

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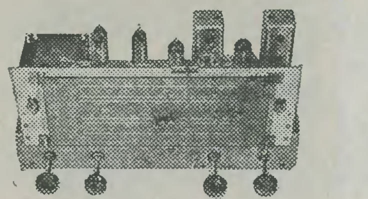

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5Y3	7/6	6V6G	6/6	ECF80	9/6	PCF80	9/6
5Z4	9/6	6X4	7/6	ECH42	10/6	PCF82	9/6
6AM6	5/–	6X5	6/6	ECL80	10/6	PCL82	11/6
6B8	5/–	12A6	7/6	ECL82	10/6	PEN25	6/6
6BE6	7/6	12AT7	8/–	EF39	5/6	PL82	10/6
6BH6	9/6	12AU7	8/–	EF41	9/6	PY80	7/6
6BW6	9/6	12AX7	8/–	EF50	5/6	PY81	9/6
6D6	6/–	12BE6	8/6	EF80	8/–	PY82	7/6
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SMALL. 250-0-250V 100mA, 6.3V 3.5A	**19/6**
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Mullard "510" Osram "912" 300-0-300, 120mA, 6.3V 4A c.t., 6.3V 2A tapped 5V	**38/6**

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32/450V	5/6	8+16/500V	5/6	50+50/350V	7/–
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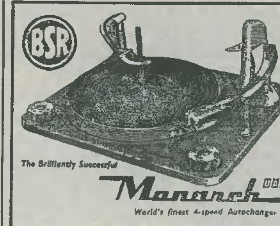

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CONTENTS

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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."

suggested circuits

No. 113 Line Timebase "Cheaters" for Television Servicing

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

Television trouble-shooting is not always a simple process, and it can be especially difficult when faults appear in the line timebase section. Line timebase servicing is usually at its most complex when flywheel synchronisation is used, as the circuits employed may give rise to particularly abstruse fault conditions. A further complicating factor is provided by the leaky-grid arrangement common to practically all line output valve input circuits, this causing excessive anode current to be drawn if grid drive fails, with the result that damage to the line output transformer and valve itself may occur. In consequence, the drive to the line output valve grid cannot be temporarily disconnected during fault diagnosis.

A servicing technique which goes a long way towards overcoming these difficulties consists of using temporary circuit stages, or "cheaters", to replace equivalent stages in the receiver. In this month's article two such replacement stages are described. One consists of a line sawtooth generator providing an output which is capable of being applied direct to the grid of the line output valve and which may be synchronised or not according to immediate requirements, whilst the other consists of a sync separator and inverter which may be coupled direct to the cathode of a cathode-modulated picture tube and which offers both positive-going and negative-going sync pulses. If desired, the two units may be employed together, with the result that they replace the complete line sync separator and sawtooth generator circuits in the receiver.

Another point brought out in the article is the principle of employing specialised test equipment units which are fed from a common heater and h.t. supply. Both the cheater units described here are intended for building into small probes which may be positioned close to the circuits into which they couple, heater and h.t. supplies being obtained via a flexible cable to a separate power unit mounted at any convenient point on the bench. Such a power unit may also be employed to feed other items of test equipment such as a.f. or i.f. oscillators, etc., the appropriate units merely being plugged into the power supply as desired. The writer has employed a technique of this nature very successfully in the past, the items of test gear being coupled to the power unit by means of octal plugs.

Replacement Line Sawtooth Generator

The circuit of the replacement line sawtooth generator is given in Fig. 1. Readers who have followed W. G. Morley's articles in this magazine will recognise the circuit as being, basically, that of a cathode coupled multivibrator.* The two triodes of an ECC82 (12AU7) appear in the multivibrator, the scan period occurring when $V_{1(b)}$ is cut off (C_3 discharging), and the flyback period when $V_{1(b)}$ is conductive (C_3 charging). The length of the scan period, and thus the frequency of oscillation, is controlled by R_6. When $V_{1(b)}$ conducts it discharges the sawtooth-forming, or shaping, condenser C_4, allowing this condenser to charge again, via R_4, when it is cut off. Thus a sawtooth appears across C_4, its flyback section being negative-going. The sawtooth waveform across C_4 is applied, via C_5, to the output lead of the unit, the latter consisting of a flexible wire some six inches long terminated in a suitable crocodile clip. A switch on the probe unit cuts C_4 out of circuit when desired, with the result that shaping is then provided by the appropriate condenser fitted in the receiver under test.

*"Understanding Television" part 24 *The Radio Constructor*, Jan. 1960.

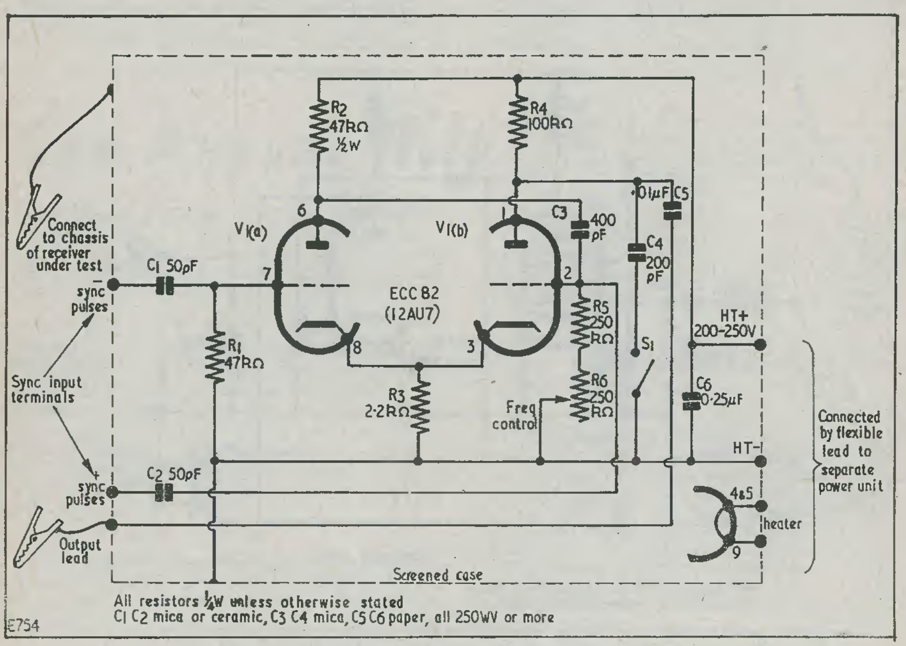


Fig. 1. The sawtooth generator replacement unit

Sockets on the test probe enable the multivibrator to be synchronised with either negative-going or positive-going sync pulses, these being applied to the grid of $V_{1(a)}$ or $V_{1(b)}$ respectively.

Replacement Sync Separator Unit

Fig. 2 illustrates the circuit of the sync separator unit. In this unit an ECF80 (or PCF80 with the appropriate 9 volt heater supply) is connected up such that its pentode section operates as a conventional sync separator whilst its triode section functions as a sync pulse inverter.

The input to the unit is provided by a flexible lead some twelve inches long terminated in a suitable crocodile clip. This lead is intended for connection to the cathode of a cathode-modulated picture tube. The video information fed to the picture tube cathode has positive-going sync pulses, with the result that leaky-grid action in C_7 and R_8 causes the positive tips of these pulses to take up a position on the grid of $V_{2(a)}$ which is approximately equivalent to chassis potential. The grid base of $V_{2(a)}$ is short, and the valve cuts off at negative grid voltages less than sync pulse height. In consequence, $V_{2(a)}$ conducts only when sync pulses are present on the picture tube cathode. Conduction in $V_{2(a)}$ causes negative-going pulses to appear on its anode. These pulses are fed, via the isolating condenser C_9, to the appropriate output socket on the unit.

The anode of $V_{2(a)}$ is coupled to the grid of $V_{2(b)}$ via C_{11}. This condenser, in company with R_{12}, causes leaky-grid action to occur once more, with the result that $V_{2(b)}$ is conductive in the absence of sync pulses, and is non-conductive when sync pulses appear.

Positive-going pulses appear, therefore, on the anode of $V_{2(b)}$. These are fed to the appropriate output socket via the isolating condenser C_{10}.

Application

A simple practical example should suffice to illustrate suitable applications for the cheater units.

Let us assume that a television receiver is received, for repair, which suffers from low e.h.t. voltage. Valve checks offer no assistance in diagnosis, and suspicion falls on the line output transformer. The sawtooth generator unit can now be brought into use. condenser in the receiver will have been disconnected.

It should be noted that most line output valves have a grid stopper of some 500Ω to 1kΩ in series with the grid, and that the replacement unit should be connected to the end of this resistor which is remote from grid. (No harm, apart from possible parasitic oscillations, should result from a temporary connection direct to the line output grid, incidentally, and the process of connecting the unit to either side of the grid stopper would test this component under working conditions.) Another point is that the grid leak of the line output valve should

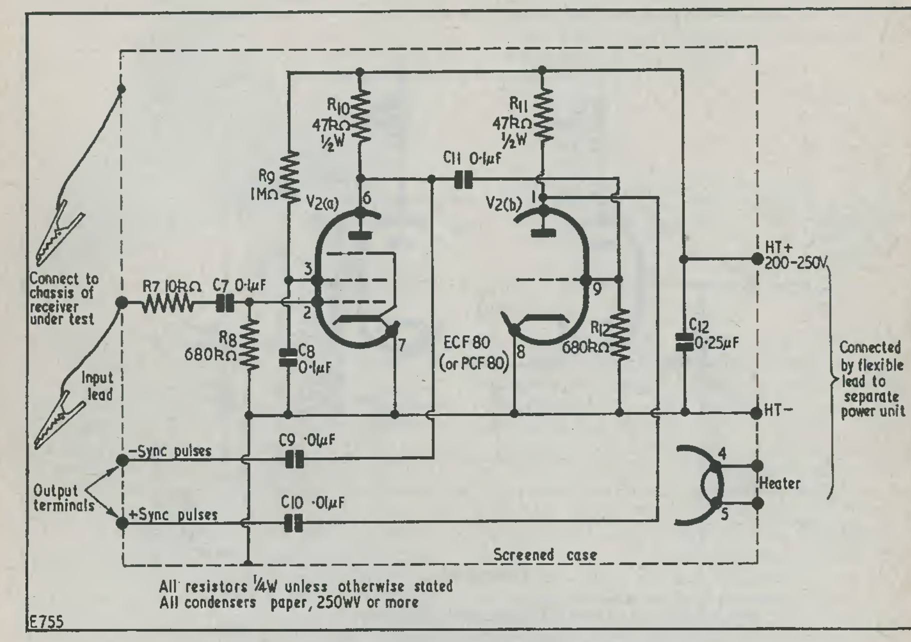


Fig. 2. The sync separator and inverter replacement unit

This unit is coupled to the grid of the line output valve, the receiver sawtooth generator having been uncoupled from this point, and the receiver is switched on. If the line output stage, including the line output transformer, is satisfactory, the output from the replacement unit will cause a raster of correct brightness to appear with unsynchronised line. The fault will then lie in the drive from the sawtooth generator in the receiver. Alternatively, if the same low e.h.t. conditions exist when the replacement unit is brought into use, the fault will lie in the line output stage. The shaping condenser, C_4, may be switched in for this test, as the shaping always be in circuit when the replacement unit is coupled to it, as the latter does not include any resistive path between its output terminal and chassis.

Should it be desired to synchronise the replacement sawtooth generator unit, the sync separator unit may be brought into use. This may be connected to the cathode of the picture tube and either of its outputs, negative-going or positive-going, coupled to the appropriate sync input terminal of the sawtooth generator unit. The two units then replace the entire line circuitry in the receiver between the tube cathode and the line output valve grid.

Other uses for the units will soon recommend themselves to the enthusiast or service engineer.

Construction

The construction of the units should not raise too many difficulties. Space requirements are not excessive and it should be possible to house both units in small metal containers. Apart from the decoupling condensers C_6, C_8 and C_{12}, condensers should be spaced slightly away from metalwork at chassis potential in order to reduce stray capacities.

After completion, the units may be tested by coupling them to any serviceable television receiver. It would prove helpful, at this stage, to provide an indication for the setting of R_6 which corresponds approximately to correct line frequency when the sawtooth generator unit is unsynchronised.

The Power Unit

The separate power unit which provides heater and h.t. supplies for the units requires little comment here. The h.t. supply should be isolated from the mains so that the probes may be bonded to "live" chassis under test. The heater supply will need to be connected to the h.t. negative line at some point, and this can be done most conveniently in the power unit itself. If, as is recommended by the writer, the probes connect to the power unit by means of suitable plugs at the end of flexible leads, it will be necessary to provide two sockets in the power unit so that both probes may be used at the same time.

Can Anyone Help?

Requests for data are inserted free of charge. Enquirers undertake to answer all correspondence and defray all expenses

Valve Tester 10S/658 and Valve Tester Sub-Panel 10S/556.—F. Vale, 103 Charles Street, Leichhardt, Sydney, Australia, would like to obtain the circuit and instruction data for these items of surplus equipment.

* * *

V.H.F. Tx/Rx Type 1520.—N. Boyle, 44 The Avenue, Whitburn, West Lothian, would like to obtain a circuit or manual of this unit.

* * *

"Sound Prince" Tape Recorder.—V. Siggery, 49 Highbury Road, Leicester, urgently requires the circuit of this recorder, willing to hire or purchase.

* * *

Collins T.C.S.12 Receiver.—M. Hampson, 48 Mosslands Drive, Wallasey, Cheshire, would like to buy or borrow a circuit or manual for this receiver.

* * *

R.F. Unit 27B.—V. E. Batchelor, 24 Woodstock Rise, Sutton, Surrey, would like information on how to convert this unit for 21 and 28 Mc/s for use with an R1155 receiver. Also modifications for the Collins T.C.S. Tx for 120 watts output.

* * *

CR100 Receiver.—B. Gill, 18 Causeway House, Abbots Langley, Herts, requires the circuit and modification details for conversion of the front end of this receiver—also any other improvement modifications.

* * *

R207 Receiving Equipment.—G2UK, "East Keal", Romany Road, Oulton Broad, Lowestoft, Suffolk, would like to receive the circuit and any other data on the above equipment.

Simple Plans or Books.—S. Moss, 110 Upminster Road, Rainham, Essex, a very young learner, requires these on the subject of crystal and one- or two-valve receivers. Willing to refund postage.

* * *

No. 19 Set Mk. II.—L. Marks, 14 Avenue Road, Kingston, Surrey, requires a circuit or manual on the above equipment.

* * *

Out of Print Books Wanted.—D. Bowers, 24 Home Park Road, Saltash, Cornwall, would like to obtain the following: "Communication Receivers Manual", "Ultra-Shortwave Handbook", both by Bernards Publishers Ltd.; "Hints and Kinks", an A.R.R.L. Publication; "Receivers", an R.S.G.B. Publication; copies of "Television and Short Wave World" 1938 until cessation of publication; also "Radio Handbook" since 1955. Also loan of CR100 manual and circuit.

* * *

Transmitter/Receiver No. 18.—J. Kelly, 27 Springwell Road, Wigtownshire, Scotland, would like to purchase instruction book or circuit diagram of the above equipment.

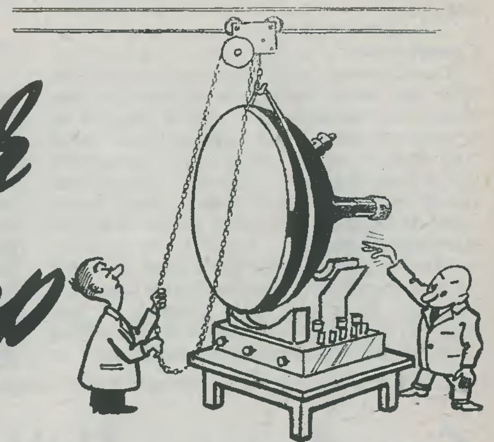
* * *

Ex-Admiralty P104 Receiver and Monitor Unit 56.—J. B. Taylor, Buxton College, Buxton, Derbyshire, has just acquired this ex-service V.H.F. receiver and monitor unit, and would like any information, circuit, manual, etc.; all expenses and postage paid.

* * *

Hallicrafters SX24 Receiver.—P. L. Ashley, 119 Sundale Avenue, Selsdon, South Croydon, Surrey, would like to receive any information on the above receiver. Would be willing to purchase manual.

In your Workshop



This month Smithy the Serviceman takes advantage of a quiet period to discuss, with his able assistant, Dick, topics ranging from intermittent connections to frame buzz

"Do *what?*"

"Polish the bench tops", repeated Smithy.

The Serviceman gazed unemotionally at his outraged assistant.

"But they've never been polished before", protested Dick. "*Ever.*"

"All the more reason", commented Smithy, "for starting now."

The Workshop was going through one of its periodic quiet spells. Whilst plenty of work had been coming in for repair, faults were of a simple order and required little diagnostic skill on the part of either Smithy or Dick. In consequence, the pair had found that they had an unusually large amount of spare time on their hands. Smithy, philosophic as ever, had taken advantage of the situation to catch up on his paperwork, and to force his rebellious assistant into spring-cleaning the Workshop.

However, even Smithy was a little taken aback at Dick's reception of his polishing suggestion. He decided to change his tactics slightly.

"You'll be amazed", he remarked mildly, "at the difference a bit of polish makes to the benches. There's something psychological about it."

"Schizophrenic is the word *I'd* use," said Dick bitterly. "And it applies to split-personality Servicemen who get Service-minded!"

Coil Formers

With much grumbling Dick set about his task; and he reluctantly rubbed polish into the linoleum-topped benches. It was his own inventiveness which, fortunately, prevented a complete rupture in Workshop relations. After having applied the polish Dick set himself to the manufacture of a buffing-wheel from old rags fitted to the hand electric drill. This turned out to be quite successful, and he was able to bring up a shine in not much more than twice the time it would have taken to do the job by hand.

"There you are, Smithy," he remarked proudly, as the overloaded hand drill finally screamed its way into silence. "Operation Bullshine is now complete!"

"Good," said Smithy approvingly. "And I think you'll agree that a bit of polish does make the place a bit more cheerful."

"I suppose it does," commented Dick, grudgingly. "At least it will be easier to spot elusive nuts and bolts against the shiny surface. But, please, Smithy, let's give this spring-cleaning a rest! Why don't we face up to the fact that things are quiet and relax for a bit? It's a long time since we had a gen session, and I'm bursting with queries."

Smithy looked at his papers. He disliked quiet periods just as much as his assistant.

"Fair enough," he said. "You get the kettle going whilst I finish off what I'm doing here. Then we can have a nice cosy rag-chew."

Dick needed no second bidding, and it wasn't long before he and Smithy were comfortably settled with cups of tea in their hands.

"The first question", said Dick, wasting no time, "has to do with coil formers. As you know, we've had quite a few television tuner units in recently with very thin-wall s.r.b.p.[1] formers. When you try to adjust the oscillator cores in these formers you sometimes push them right in. What's the cure for that?"

"Well," said Smithy. "Let's begin at the beginning. The type of tuner you're talking about has its coils mounted radially on a disc rather than in a drum. Right?" Dick nodded an assent. "Now the formers in these tuners have indentations along their length which interfere with the core threads, so that the latter can be screwed in and out. These formers also have very thin walls, and the indentations tend to be somewhat weak in consequence. Before going any further, I think I should make the point that you shouldn't, in any case, apply too much pressure to such cores."

"The indentation strength seems to vary from former to former," Dick volunteered.

"That may well be the case," confirmed Smithy, "and I have little doubt that the formers are very tricky to manufacture. Now, let's get down to the instance where you've been unlucky enough to push the core right in, whilst attempting to adjust it, and you want to get it out again. When this happens, the indentations in the former are usually sufficiently wrecked for it to be impossible to screw out the core, even with the lightest of pressures. What I always do then is to find the approximate position of the core by feeling for it with a screwdriver, and then lightly press the blade of another screwdriver on to the outside of the former at that spot. (Fig. 1 (*a*).) The second screwdriver slightly distorts the former and gives the core a purchase. I then unscrew the core until it has passed the distortion given by the second screwdriver, and re-apply the latter over the new position of the core. Three or four operations of this nature are usually enough to unwinkle the core."

"What about a pair of taper-nosed pliers instead of the second screwdriver?"

"Not so good," said Smithy. "The screwdriver blade takes up much less room on the former, and you can insert it between the turns of Band III coils, if necessary, without disturbing them."

"That seems fair enough," remarked Dick. "How about re-fitting the core again?"

"Well, you can't just re-insert it, of course, or it will slip down all over again! What I do myself is to pop a bit of cigarette paper in the former before re-inserting the core. A double thickness about an eighth of an

[1] S.R.B.P. is an abbreviation for "synthetic resin bonded paper". This material is more commonly known under trade names such as Paxolin.

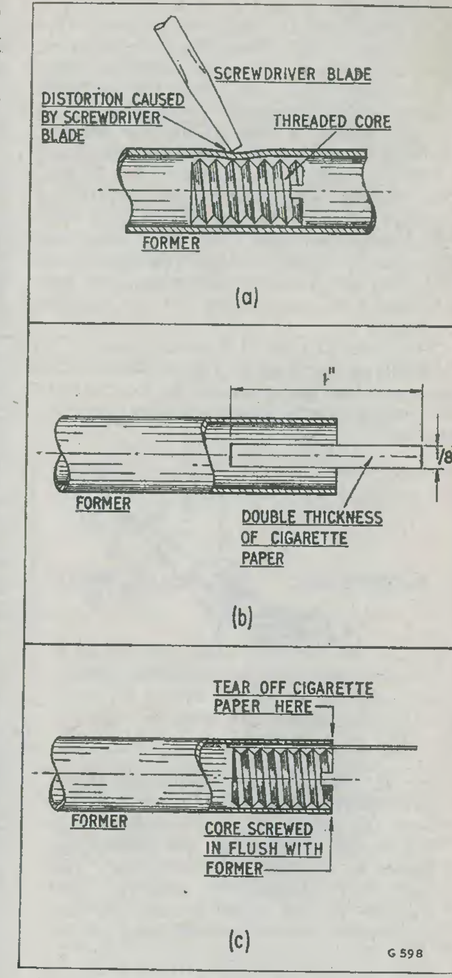


Fig. 1 (a) The cores in thin-wall television tuner formers occasionally become pushed down and cannot readily be removed. If the former is distorted by light pressure from a screwdriver, as shown in this cross-sectional view, sufficient interference is provided to enable the core to be unscrewed. (b) Before the core is re-fitted it is advisable to lay a small piece of cigarette paper inside the former. (c) The bulk of the cigarette paper provides added interference, and ensures that the core does not slip again. When the core has been screwed in flush with the end of the former, the excess paper should be torn off inch wide and an inch or so long popped in for two-thirds of its length usually does the trick. (Fig. 1 (*b*).) The extra bulk provided by the cigarette paper causes adequate interference with the core over the distance through which it normally has to travel, and you can adjust it with no further trouble. I should mention that, after you've screwed the core in flush with the end of the former, you should tear away the protruding cigarette paper. (Fig. 1 (*c*).) You may occasionally find that you only need one thickness of paper, or that you need more than two, but the first few turns of the core will soon tell you whether it's too tight or too loose."

"Any special type of cigarette paper?"

"Nothing particular. The ordinary white paper you buy in packets at the tobacconist's for rolling your own cigarettes is quite adequate."

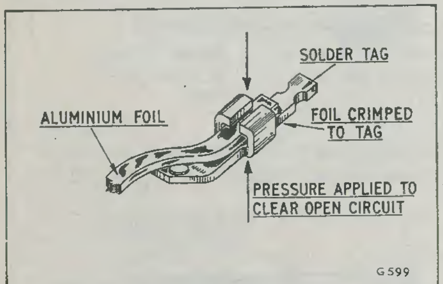


Fig. 2. The lead-out connection shown here, whereby a length of aluminium foil from the inside of an electrolytic condenser was crimped to the solder tag, caused an intermittent open-circuit. The fault was cleared by applying light pressure to the crimp in the direction indicated by the arrows with a pair of side cutters

"Hmm," said Dick. "Does this cigarette paper idea clear loose cores in the heftier sort of former you find in i.f. transformers and the like?"

"It does sometimes," said Smithy, "but you have to be careful not to use too much or you may jam the core and break it. It is worth mentioning that there are several highly viscous lubricants on the market which are ideal for application to loose cores, a well-known example being Kilopoise 0868G.[2] These lubricants are more useful to the professional service engineer, of course. Application is dead simple: you just smear the stuff on the core or on the inside of the former. The lubricant then holds the core in position without stopping you from adjusting it. Ordinary soft soap works pretty well on a job of this nature, too!"

"*You* should know about soft soap!"

Smithy ignored the interruption.

"Any other queries?"

Intermittents

"Oh yes," said Dick. "I bumped into rather a queer sort of intermittent the other day. It was a t.v. receiver and its line blocking oscillator just refused to work. I broke its h.t. supply whilst searching for the fault, and then re-connected it whilst the set was on. And, blow me, if the oscillator didn't go like a bomb! And it's never stopped since!"

"The basic fault there", remarked Smithy, "is an oldie which has plagued service engineers ever since the radio game started, well-nigh. What probably happened in your case was that you had a dicey connection somewhere in the oscillator circuit, and the pulse of current given by the sudden application of h.t. welded it over and made it good. Normally, the relatively slow rise in h.t. given by switching on the receiver wouldn't give the connection the pulse it needed. I would guess that, in your instance, the ropey joint was in the blocking oscillator transformer itself.

"The first time," continued the Serviceman, "I bumped into something like this was before the war. I had a sound receiver which gave a thin and reedy output until, with the volume turned up, it reproduced a loud burst of music. It then cleared itself and the receiver gave correct reproduction. However, if the set was switched off for a few hours the reedy reproduction would return once more, only to be cleared by another heavy burst of sound."

"Where was the snag?" asked Dick.

"So far as I could tell", said Smithy cautiously, "it was in one of those intervalve a.f. transformers that we used in those days. At any event, the trouble disappeared when I fitted a new component. The infuriating thing was that the old tranny showed perfectly good when tested with an ohmmeter. I must admit, of course, that the ohmmeters we had in those days passed a fair old current, and this may have been enough to bridge the gap, as it were."

"Have you encountered this snag recently?"

"Now and again," said Smithy. "It's like a No. 11 bus: you don't see one for ages, and then you get a lot in a rush. In a recent case I had an a.f. coupling condenser which gave the same symptoms as my old transformer set. That is, reedy reproduction until a thump of music made the set work O.K. again. I suppose that there was an internal intermittent in the condenser and that, in its faulty condition, it exhibited a low capacity only. Another recent instance concerned a cathode bypass electrolytic. In this receiver, though, the fault didn't affect frequency response. What happened, instead, was merely that the gain was rather low until a loud pulse of a.f. came along; whereupon the receiver provided full amplification. I located the fault to the cathode bypass condenser, and I assumed that this was open circuit during the low-gain periods. The particular component fitted had strips of ali foil coming out of the innards, these being crimped to the solder tags. (Fig. 2.) The bad connection was at the crimp, and I made it good again by applying light pressure to it with a pair of side cutters. Due to their small contact area the cutters applied quite a high pressure to the junction of ali foil and solder tag material, thereby breaking through any oxides that might have formed on either surface. This process cured the intermittent altogether."

Frame Buzz

"Another fault that's come my way", remarked Dick, "is frame buzz in t.v. receivers."

"Another cup of tea, please."

Dick got up and replenished Smithy's cup.

"I was saying, "he repeated, "that I've been getting quite a few cases of frame buzz recently."

"Ah, yes," said Smithy, sipping his tea appreciatively. "What you mean is the audible buzzing in a television receiver which occurs at frame frequency and which is quite distinct from mains hum. Even though the frame frequency is the same, at 50 c/s, as that of the mains."

"That's right," Dick remarked, "so what I'd like to . . ."

"Some people", continued Smithy, completely ignoring his assistant, "refer to it, fairly obviously, as frame 'tick'. The first thing to remember is that frame buzz may come either from the loudspeaker or from the frame output transformer, or both. It *could* come from the frame deflection coils as well, but I've never met such a case myself, and I don't intend to give it serious consideration at the moment."

"Yes," put in Dick. "Well, what I was about . . ."

"An important thing to bear in mind", Smithy sailed on, "is that what appears to be a trifling case of frame buzz in a service workshop may be absolutely infuriating to the viewer at home. The reason for this is that the ambient background noise level in the average workshop is surprisingly high, much higher than exists in many customers' houses. So always treat a complaint of frame buzz with respect, even if it does seem to be insignificant when you get the set on the bench. I don't know what you've done this morning, Dick, but this tea is almost acceptable for human consumption. I'm certain that the County Veterinary Officer would say that the horse was fit for work."

The Serviceman smacked his lips approvingly.

"You *always* come out with that corny old gag," remarked Dick bitterly. "Anyway, to get back to the buzz, I was first of all going to ask you about possible sources and whether low-level cases should be considered."

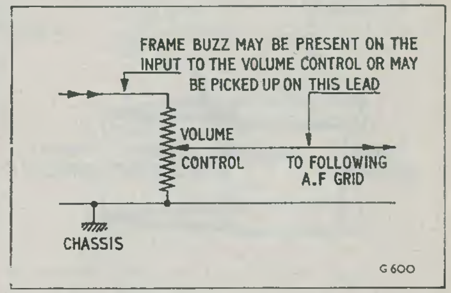


Fig. 3. If adjustment of the volume control varies frame buzz level, the buzz may be picked up in the circuitry and wiring preceding the volume control, or on the lead connecting to its slider

"But I've already answered those questions."

"Yes, I know," continued Dick patiently. "So let's get on to the next step. What's your usual procedure for curing frame buzz?"

"Ah," said Smithy. "Well, the first thing I do is to switch on the set, putting it on to a dead channel if necessary, listen for the buzz, and try to localise its source. That is, try to see whether it comes from the speaker or the frame output tranny. It's a funny thing, but frame buzz is of such a nature that it is sometimes quite difficult to determine which of these two things it comes from, particularly when the cabinet is still on the chassis. Should I feel at all doubtful I normally give the volume control a waggle. If buzz reduces to zero, or very nearly to zero, as the volume control is set to minimum, then I'm certain that the buzz is coming from the speaker and that it is being picked up either before the volume control or on the lead connected to its slider. (Fig. 3.) The possibility of pick-up before the volume control represents an obvious diagnosis. The idea of pick-up by the lead connected to the volume control slider may not be quite

[2] Kilopoise Lubricants are manufactured by Rocol Ltd., Rocol House, Swillington, Leeds.

so obvious, until you remember that the slider short-circuits this lead to chassis when it is set to minimum.

"Very often there isn't any noticeable change in buzz level as you adjust the volume control. This does not mean, though, that the buzz is not coming from the loudspeaker, as it could still be picked up in the a.f. stages after the volume control. So, if the source of buzz is still doubtful, the next step is to short-circuit the speaker. If the buzz then stops, it is obviously coming from the speaker. If it remains, it is obviously coming from the frame output tranny. You may notice, incidentally, that so far it hasn't been necessary to remove the cabinet, if the set is at all conventional."

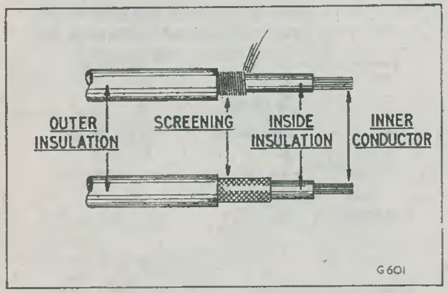


Fig. 4. The screened wire employed in many present-day receivers has an outer conductor consisting of several strands of wire wound spirally around the insulation of the inner wire. Such wire is shown in the upper diagram, conventional braided screening being illustrated below

"Suppose the buzz *does* stop when you short out the speaker?"

"You proceed", said Smithy, "to find out where the buzz is getting into the receiver a.f. stages. The buzz can be picked up from any part of the frame circuits; from the sync separator feed into the frame oscillator to the output leads to the frame deflector coils. The most common snag is poor dressing (or positioning) of leads in the frame circuits. Particularly suspect here are the usually long leads which travel to the frame hold and linearity controls, and to the frame deflector coils. The set is almost bound to have frame flyback suppression and any lead which carries the suppression pulses to the tube base also becomes suspect. Should any of these leads approach the a.f. wiring, the a.f. components, or the a.f. amplifying valve or valves, then you may well get sufficient cross-coupling to cause frame buzz from the speaker. In practice, it's usually pretty easy to sort out bad dressing, as all you have to do is to move the appropriate leads around gently with an insulated rod and listen to the buzz. When you move a lead which is causing trouble, the consequent change in buzz level normally sticks out a mile. I might add, incidentally, that I've been able to cure quite a few cases of bad dressing without having to take the cabinet off at all."

"What about the earlier instance where buzz level changed as you adjusted the volume control?"

"More or less the same rules apply. With the exception that you know that the buzz is being picked up in the volume control circuit or in the circuits immediately before it. It's fairly usual to have long screened leads running to the volume control, and these may quite possibly run close to frame circuits. You should check that the screening on these leads is reliably earthed. Also that all the metalwork of the volume control *and* the metal bracket on which it is mounted, if any, is also correctly connected to chassis in the manner intended by the manufacturer. In tough cases I've once or twice had to earth the screening of screened leads to the volume control at both ends, the manufacturer having earthed it at one end only. And don't raise your eyebrows and mutter about 'hum loops', Dick my boy! There isn't usually enough gain in a t.v. a.f. amplifier to give trouble on *that* score. Another point is that you shouldn't rely too much on the screening of the screened leads, either! Very often, the outer conductor of the screened leads used by manufacturers these days consists of a spiral of wire around the centre conductor instead of the braided arrangement you get in coaxial cable. (Fig. 4.) The spiral outer conductor may occasionally 'let in' a bit of frame buzz if it is *very* close to high amplitude frame points.

"If the buzz is being picked up before the volume control you may have to look at quite an extensive bit of receiver a.f. circuitry to find the pick-up point. Starting at the sound detector you may, for instance, have to pass through an interference limiter diode as well as a choke or two before the volume control even hovers into view. Plenty of high-impedance points there to pick up buzz!"

"Hmm," grunted Dick. "Not so easy. Any other route via which frame buzz can get into the a.f. stages?"

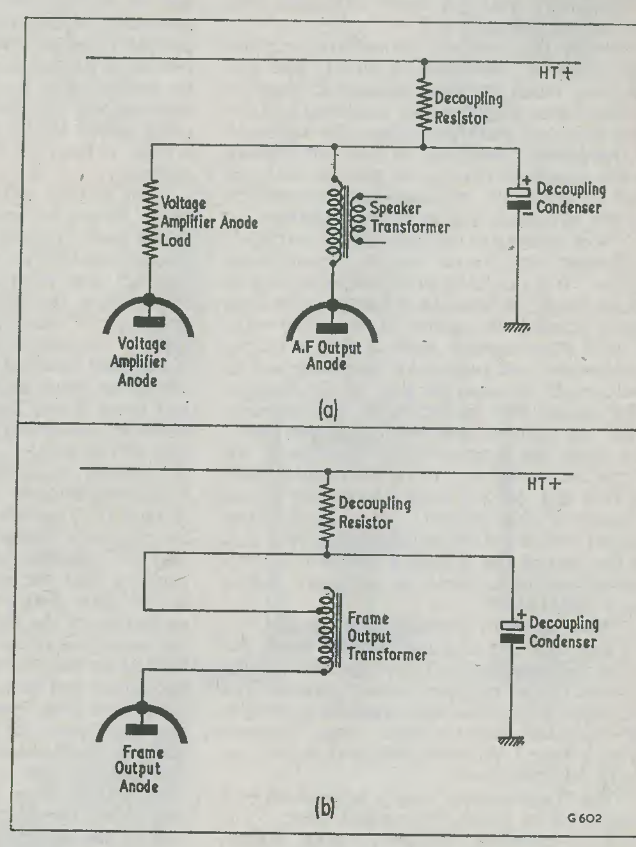
"Very occasionally", replied Smithy, "it gets in along the h.t. line. Some sets decouple either the sound stages (Fig. 5 (*a*)) or the frame output stage (Fig. 5 (*b*)) to overcome this risk. If such decoupling exists you can, of course, always check it by popping another condenser across that already in circuit. If both the frame output and the a.f. stages are run direct from the h.t. line you *could* decouple the latter from h.t. with the aid of

an additional resistor and condenser. Something like 500Ω and 32μF should meet the bill there. However, this is a real Custer's Last Stand remedy."

he could quite possibly wreck the transformer."

"The inexperienced types have got to start somewhere," said Dick, reasonably.

Fig. 5. In order to prevent frame buzz being passed via the h.t. positive rail, some receivers provide additional decoupling for the a.f. stages, as in (a), or for the frame output stage, as in (b)



Lamination Buzz

"What's the remedy if the buzz comes from the frame output tranny?"

Smithy looked a little cautious.

"Well", he replied eventually, "the obvious answer to a frame output transformer which buzzes too much is to swop it for a new one."

"You don't sound very sure," commented Dick.

"That's because I'm in a bit of a quandary," confessed Smithy. "You see, there is very often a simple basic fault in a buzzing frame output transformer which can be cured by any knowledgeable sort of geyser with very little fuss at all. The trouble is that if an inexperienced chap attempts the same repair

"That's true enough, I suppose," conceded Smithy. "So I might as well pass on the necessary information. But I'm going to make the point here and now that anyone who attempts some of the more difficult repairs I mention must take upon himself the full responsibility for any accidental damage he does to the transformer."

Smithy walked over to the spares cupboard and rummaged around.

"O.K. then!" he remarked briskly, returning to his seat. "Now the frame output transformers you're liable to meet in the average t.v. receiver will be simple butt-laminated jobs like one of these two." As he spoke, Smithy showed Dick the two transformers he had taken from the cupboard. (Fig. 6 (*a*)). "By butt-laminated I mean that the E and I laminations with which the tranny is made, (Fig. 6 (*b*)), are not interleaved, but are all put in one way round with a piece of gapping paper between them."

"Wouldn't you get more efficiency with interleaved laminations?"

"Not in this instance. Interleaved laminations—that is, alternate Es and Is like you get in a mains transformer—would saturate at the higher frame output currents, and the iron wouldn't truthfully follow the sawtooth in the primary winding. If you put a break in the magnetic circuit—as you do with the butt-lamination arrangement—saturation occurs at a much higher primary current.

"Now, the gap at the butt-joint is extremely important in frame output transformer design. It is normally provided by a piece of tough paper of selected thickness, the lams being pressed up against it on either side. If you play around with a frame output transformer you must take great care not to accidentally increase the gap, or you may get what might well be incurable non-linearity. Also, the reduced primary inductance resulting from the increased gap may cause the frame output valve to draw increased current at the end of the scanning stroke at the bottom of the picture. Since most frame output valves are already straining their guts at the end of the scanning stroke this extra current is quite liable to seriously reduce their useful life."

"What happens if you reduce the gap?"

"You may run into non-linearity again due to the increased inductance, together with the possible risk of incipient lam saturation. The increased inductance may also, in a marginally-designed frame output stage, increase flyback time. With the result that you get frame foldover."

"The frame output tranny appears to be a touchy bit of goods," remarked Dick.

"It is certainly touchier," said Smithy, "than most people imagine. Right! Now that I've delivered my Awful Warning about the gap, let's get down to the buzz.

"If the frame output transformer causes buzz, this can come either from the gap, because the Es and Is are not held securely against each other, or, more frequently, by vibration from the Is or the limbs of the Es. The first cause of buzz is obvious enough, and is usually the result of previous maltreatment of the transformer. Someone has probably bashed it around a bit and loosened the lams. If such is *obviously* the case it may be worth while trying to tighten things up mechanically by bolting the shroud down more tightly to the chassis, or by attempting a cure of the type I'm going to discuss in a moment.

"The second and more prevalent cause of buzz, where the individual lams vibrate, is pretty easy to understand. All the lams are magnetised in the same way so, as the current through the primary increases during the frame cycle, the mutual repulsion they suffer goes up. It may happen that, with certain types of shroud, part of an outside lamination is not held down at all, and that it is free to vibrate as much as it likes. If this is the case just bend it out and cut it off. There's no point in attempting to clamp down just one part of one lam.

"Usually, however, the lams are loose within the shroud. And now we come to the dicey bit! You can often clear such trannys by primarily fitting a clamp to keep the Es and Is together and then putting small dimples into the shroud with the aid of a fairly blunt centre-punch and hammer, the underside of the shroud being supported by the open jaws of the vice. (Fig. 6 (*c*)). Don't tighten up the clamp too much; just give it enough to feel that pressure is being exerted. And there must always be a supporting vice jaw underneath the particular dimples you're making. Half-a-dozen dimples spaced around the shroud are all you need normally. (Fig. 6 (*d*)). Then you turn the tranny over and repeat the dimpling process on the other side of the shroud."

"What happens if tag-boards or terminals get in the way of the clamp or the vice jaws?"

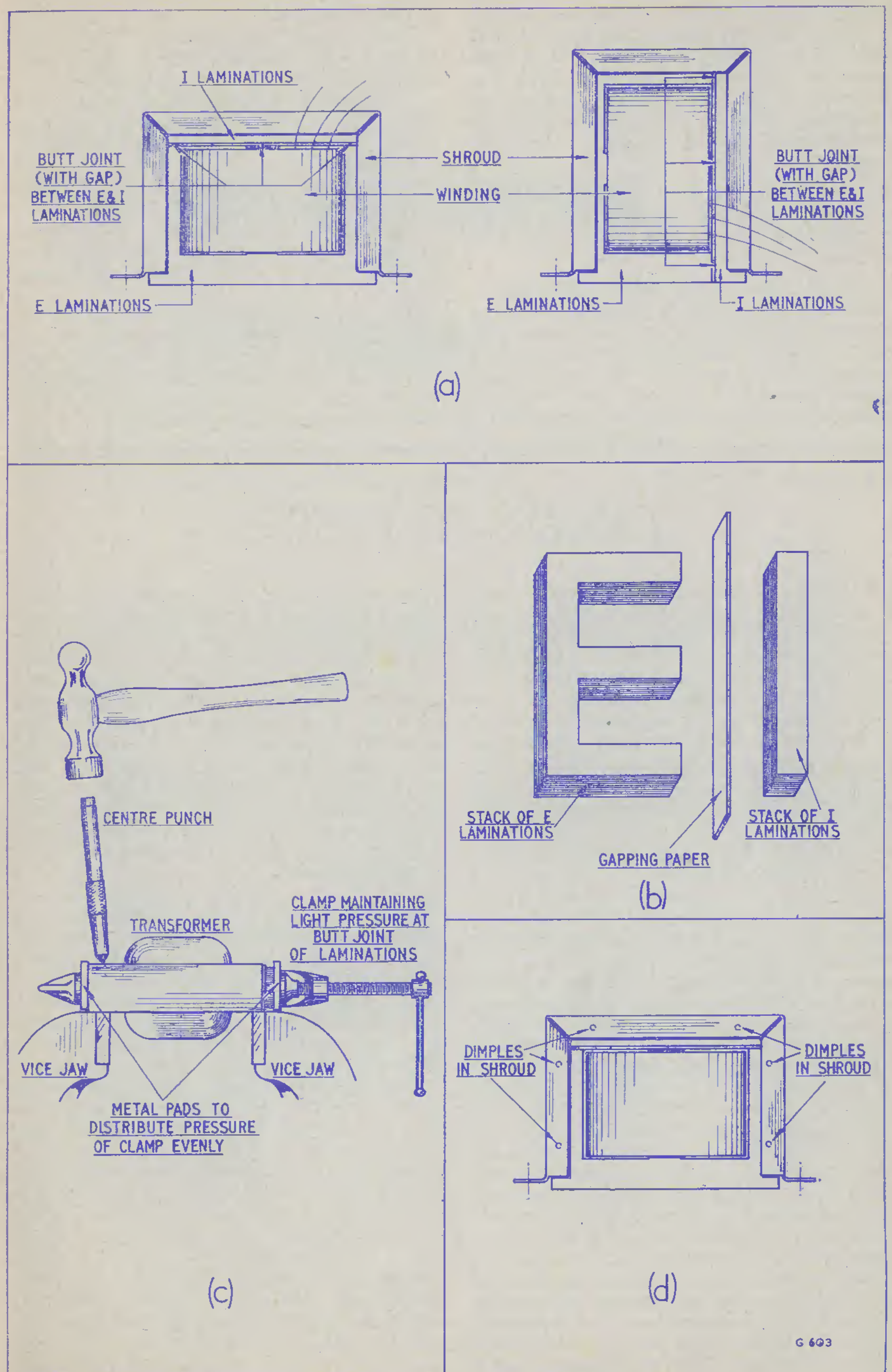


Fig. 6 (a) Two conventional frame output transformer assemblies. It should be noted that, whereas bolting the left-hand assembly to a heavy chassis ensures that pressure at the gap between the E and I laminations is maintained, the right-hand assembly does not provide this facility. (b) Showing graphically the manner in which the laminations are brought together in a butt-laminated transformer. When the transformer is assembled the two stacks of laminations are pressed together, the only separation being provided by the gapping paper. The latter, shown rather thick here for purposes of illustration, normally has a thickness lying between 0.01 *and* 0.001 *inches. (c) Tightening up laminations. The E and I laminations are held together securely with the aid of a clamp, whilst dimples are put into the shroud with the aid of a centre-punch and hammer. The underside of the shroud is supported on the open jaws of a vice. (d) Six dimples on either side of the shroud, spaced as shown here, should be sufficient to clear most cases of lamination buzz*

"You have to dream up suitable spacers to prevent damage to them", replied Smithy. "But these should not be beyond normal ingenuity. As I said before, the process is a piece of cake for those who've had plenty of experience, but it may have disastrous consequences in the hands of the unpractical."

"That's fair enough," commented Dick. "Are *all* frame output transformers laminated in the same way as the ones we've just discussed?"

"Nearly all of them are," said Smithy. "Although there are a few filtering on to the market now with C-cores, and things like that. However, these tend to be semi-potted in encapsulating material. If any of *those* should buzz, and I think it's extremely unlikely, I think you'd be forced to swop it."

A Clear Outlook

"Well," said Dick reluctantly, "that seems to be it. The teapot's empty, the kettle's empty, and I've run out of questions!"

"You could", said Smithy, rising from his chair, "do a little more cleaning up, you know. The windows are getting a bit murky, for instance."

One glance at his assistant's horrified expression was sufficient for Smithy.

"O.K., O.K.", he chuckled. "I'll forget it for now. The only other practical idea I have to offer is that you take the rest of the day off."

This particular suggestion was by far the most popular mooted by Smithy that day; and it was put into immediate effect with such a flurry of coat-changing and such a slamming of the door that even that imperturbable gentleman was mildly surprised.

TRADE REVIEWS

CHASSIS. We have received from **Messrs. P. J. Products** (see advertisement this issue), a sample of their chassis. These are of 14 gauge aluminium, very strongly constructed, with each corner flanged and riveted—this making for an extremely rigid job. A complete chassis service for the home constructor is provided by the company; chassis in various sizes and shapes, complete with drillings to individual requirements, can be supplied. Prices are reasonable, and readers interested may obtain a data sheet, with details of the products, by forwarding direct to the company an S.A.E.

TELEPHONE JACKS AND PLUG. A. F. Bulgin & Co. Ltd., Bye Pass Road, Barking, Essex, have produced a new screened telephone plug in two forms, these being P.538/Chrome and P.539/Gold-plated. The dimensions of these types are overall length $2\frac{41}{64}$in, handle barrel width $\frac{35}{64}$in. With the standard $\frac{1}{4}$in. electrode size, designed for tape recorder or telephone work, this jack-plug is specifically for use where screened concentric or co-axial cable is involved. The electrodes, tube and ball tip, are finished in bright nickel plating, while the insulating spacer between them is a top quality Bakelite moulding. Internally, care has been taken to provide the easiest possible connections—a screw terminal block for the central live lead and a clench terminal for the outer screening lead, which also provides mechanical strain relief. The new all-moulded jacks are of two types; the J.35 closed circuit and the J.36 open jack. Both have P.O. spring-grade nickel silver blades and tags riveted to a black Bakelite body. The self-capacity measurements of these jacks were 0.8pF average and, tested under dry conditions, they showed infinitely large insulation resistance and, after being immersed in water for 60 minutes, gave the same result as soon as the surplus water had been blown off. Life tests carried out under operating conditions, the jack being opened and closed 22,959 times—and continued far in excess of this figure—show that these jacks are extremely robust and provide a high degree of insulation (100%) from the panel.

"DAFILE FLEXI-FILE." Dafiles Ltd., 37 Sheen Road, Richmond, Surrey, have forwarded samples of their new "Flexi-File". Unlike conventional piercing saw-blades, the "Flexi-File" is circular with teeth all round, and therefore there is no necessity to twist the frame of the adjustable piercing saw to coincide with the direction of cut. Gentle application of pressure simply guides the direction of cut. The blade is sold in lengths (buy it by the yard!). The small pack retails at 2s. and the large pack at 5s., these being a 12in and a 36in length respectively. Two grades are available, No. 1 approx. 0.019in cut and No. 2 approx. 0.030in cut. Used in standard piercing saw frames, the "Flexi-File", both grades, will cut aluminium, ebonite, acrilic plastics, hardboard, plywood, plaster of paris, foam rubber, cork, etc. No. 1 grade will also cut mild steel, duralumin, copper, gold and silver, etc.

continued on page 683

UNDERSTANDING TELEVISION

PART 27

By W. G. MORLEY

The twenty-seventh in a series of articles which, starting from first principles, describes the basic theory and practice of television

In last month's issue we discussed the basic line output stage employed in modern television receivers, pointing out the fact that the line output valve functions more as a "switch" than as a conventional amplifier. The sawtooth current flowing in the line deflector coils is, then, produced by the inductive "sawtooth-forming circuit" given by the combined inductances of the line output transformer winding and the line deflector coils. We also saw the means whereby the line output transformer may be employed to provide extra high tension for the final anode of the cathode ray tube.

We shall now continue with an examination of line output transformer manufacture.

Line Output Transformer Assembly

The manner in which the line output transformer is assembled is of interest in even a theoretical discussion of the line output stage. This is because the manufacture of the transformer involves techniques which qualify its design and operation.

Early line output transformers employed iron laminations in order to obtain the requisite inductance from their windings. However, such laminations introduced excessive losses, particularly during the flyback period, and their use was discontinued in favour of alternative magnetic core materials which, being relatively non-conductive, could be fitted to the windings as single piece-parts instead of in laminated form. Notable, in the U.K., amongst these materials were Caslam (manufactured by Plessey), consisting of iron particles in a bonding medium, and Ferroxcube (manufactured by Mullard), a ceramic-like, non-metallic, ferromagnetic material. More recently introduced by Plessey has been another material, Ferramic, this having an appearance and properties similar to those of Ferroxcube. These materials are now used almost universally in line output transformer manufacture.

Fig. 153 (*a*) and (*b*) shows two representative methods of line output transformer assembly, and illustrates what has become, over the last six years or so, a more or less standardised method of manufacture. Two U-cores (i.e. shaped like the letter U) of either Ferroxcube or Ferramic are employed in the construction of the transformers, their limbs meeting inside the coil formers. Pieces of gapping paper are normally inserted between the junctions of the limbs to prevent the formation of a complete magnetic circuit with the consequent onset of early saturation, and it is usual to apply an adhesive to the joints to ensure that neither core may become dislodged. Fig. 153 (*c*) illustrates the cores in more detail and shows the manner in which they come together inside the coils.

In Fig. 153 (*a*) we see a transformer whose e.h.t. winding is wound on top of the main anode winding, whilst in Fig. 153 (*b*) the e.h.t. winding is fitted on the opposite pair of limbs to that occupied by the anode

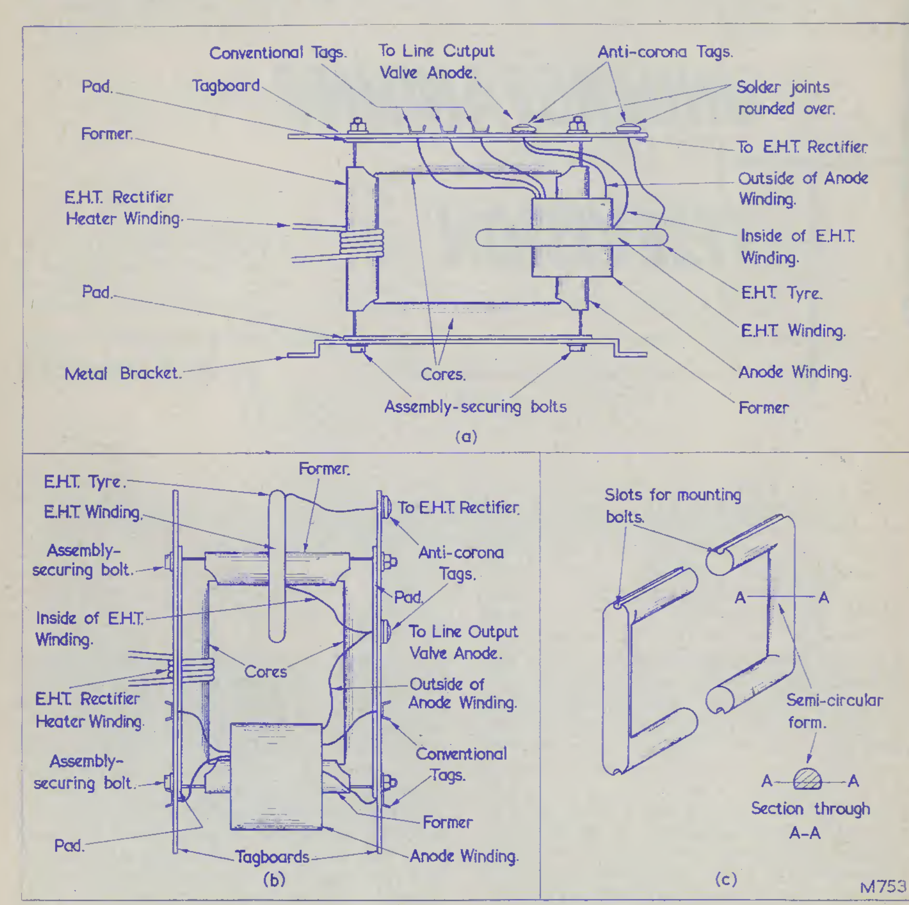


Fig. 153 (a) A typical method of line output transformer assembly, employing one tagboard and a metal bracket. The e.h.t. winding is wound on top of the anode winding and in the same direction, thereby enabling its inside connection to be conveniently joined to the outside connection of the anode winding at the line output valve anode tag. A leakage path from the cores to chassis is automatically provided via the assembly-securing bolts and the metal bracket. It should be noted that rounded solder tags are employed for high potential points such as those which connect to the e.h.t. rectifier and line output valve anodes. (b) Illustrating alternative methods of line output transformer assembly. Firstly, two tagboards are used; and, secondly, the e.h.t. winding is fitted to the opposite pair of core limbs to that occupied by the anode winding. Again, direction of winding is such that the inside of the e.h.t. coil may be conveniently joined to the outside of the anode coil at the appropriate tag. In this assembly, the cores are not automatically connected to chassis. (c) A pair of typical line output transformer cores. The circular-section limbs meet inside the formers of (a) and (b), separated by pieces of gapping paper

windings. The e.h.t. rectifier heater winding may be fitted in any convenient position around the loop provided by the cores, two typical examples being shown in the diagrams. Transformers of this type are normally assembled by passing threaded rods or long bolts through slots in the ends of the cores, these passing under the coil formers in the manner illustrated. This method of assembly also enables a tagboard, or boards, to be conveniently mounted.

Although cores made of Ferroxcube or Ferramic are relatively non-conductive they are by no means perfect insulators. Because of this, it is possible for line output transformer cores made of these materials to acquire a high potential above chassis due to the capacity existing between them and the windings. Such high potentials may be maintained by the small capacity between the cores and surrounding metalwork, and are undesirable due to the consequent risk of breakdown between the cores and chassis or windings. This difficulty may be cleared by connecting the cores to chassis, and thereby preventing the initial formation of the high potential. Such a connection to chassis may have a resistance as high as 10MΩ in many cases and still provide adequate leakage path for the charge on the cores. A common method of providing this leakage path consists of connecting one or both of the mounting bolts to chassis, this process being carried out automatically when the transformer is mounted on a metal plate, as it is in Fig. 153 (*a*). Occasionally, a more positive chassis connection is provided, a typical instance consisting of the fitting of brass or copper foil strips between the pads and the backs of the cores, these strips being connected direct to chassis. An alternative solution, occasionally employed, consists of painting a line of Aquadag between the cores and any adjacent metalwork connected to chassis. (Aquadag is a colloidal solution of graphite. When, after application, the Aquadag solvent has evaporated, a film of conductive graphite remains.)

Shown in both Figs. 153 (*a*) and (*b*) are flat pads fitted between the backs of the cores and the mounting plates. Due mainly to magnetostrictive effects[1] the cores of line output transformers tend to radiate an audible whistle at line frequency, and the pads prevent direct mechanical coupling to the mounting panels, which might themselves further radiate the whistle. Pads are fitted to most line output transformers, and are normally made of a spongy material or soft p.v.c. It should be pointed out that precautions against audible whistle from line output transformer cores are mainly required when the associated receiver operates in the British 405 line system, because the line frequency of this system, 10,125 c/s, is within the range of human audibility. Less precautions, if any, are taken for line output transformers intended for operation on the American 525 and "C.C.I.R. 625" line systems because the associated line frequencies, 15,750 c/s and 15,625 c/s respectively, are beyond the range of audibility for most people.

Due to the presence of high voltages in the line output transformer it is necessary to provide protection against the effects of *corona*. Corona occurs when the electrostatic stress around a high potential conductor in air is sufficiently high for the air to ionise. Such ionisation results in the formation of ozone (O_3), having a characteristic odour, from the oxygen (O_2) of the air, and it produces a blue glow. Corona is undesirable in line output transformers because it may be the forerunner of a spark via the ionised air, and because it causes r.f. radiation which may be picked up by the aerial or early stages of the receiver and be reproduced as interference on the cathode ray tube screen. Also, the ozone released can have a long-term deleterious effect on some insulating materials, in particular natural rubber. Corona is avoided by ensuring that conductors in contact with the air are free of "spikes" which would cause a concentration of electrostatic field at a single point. In consequence, specially-rounded solder tags are employed for e.h.t. connectors and care is taken to ensure that "spikes" are not formed elsewhere in the construction and wiring of high potential points. Corona may also be prevented by providing thick insulation over any conductor carrying high potentials, thereby excluding the air from immediate contact with the conductor. Thus, the e.h.t. windings of Fig. 153 (*a*) and (*b*) (and, also, Fig. 154) are provided with anti-corona "tyres" of insulating material on the outside. Anti-corona precautions are usually necessary for potentials above 4kV or so.

Winding Design

The design of the windings employed in line output transformers has tended to change over recent years. An early technique is to have both the anode and e.h.t. coils wave-wound (i.e. in the "criss-cross" manner familiar in such components as 465 kc/s i.f. transformers), the e.h.t. winding being wound in a narrow single "pie", as in Fig. 154 (*a*). The winding wire employed for wave-wound coils is fibre (i.e. cotton, silk or rayon) covered enamelled wire, the function of the fibre covering being that of providing a spacing factor between adjacent conductors, the space being later filled by the wax or

[1] Magnetostriction defines the change in physical dimensions of a material caused by change of magnetic flux in it.

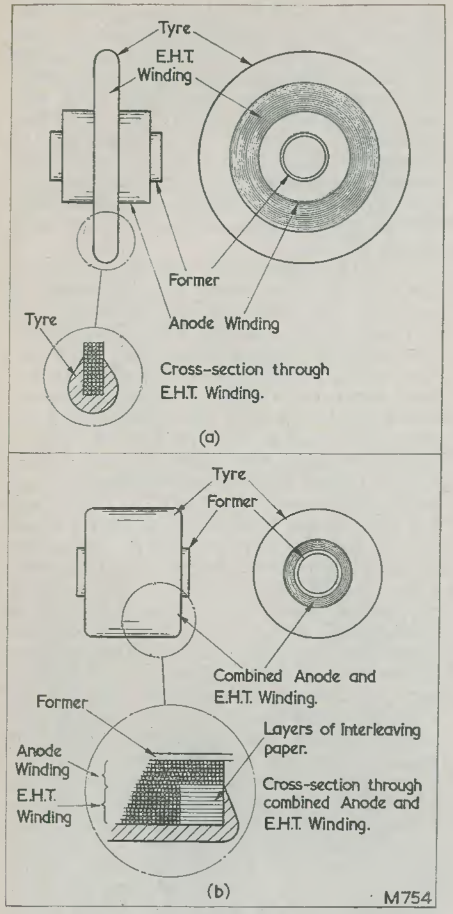


Fig. 154 (a) Illustrating the construction of a wave-wound anode and e.h.t. coil assembly, showing also how the tyre is fitted on the outside of the e.h.t. coil. The tyre is usually formed by rotating the coil with its rim immersed in a bath of hot wax or bitumen, thereby picking up some of this material on each revolution. In some designs the tyre may completely envelop the e.h.t. coil. Due to the method of application the tyre normally has a somewhat irregular outline. (b) By layer-winding the anode and e.h.t. coils, a considerable saving in space, as well as a tighter coupling, may be achieved. The tyre is applied in the same manner as for wave-wound coils

varnish impregnant.[2] Such a high degree of insulation between adjacent conductors in a wave-winding is desirable because conventional line output transformers develop some 6 to 10 volts per turn during the flyback period.

Later winding designs employ layer-wound, instead of wave-wound, coils, each layer being separated from the next by interleaving paper. With the layer-wound technique each turn of the winding is in contact with its two immediate neighbours only, with the result that turn-to-turn insulation requirements can be reduced, and a simple enamel covering on the winding wire becomes adequate. A typical example of a layer-wound coil, with e.h.t. winding on top of the main anode winding, is shown in Fig. 154 (*b*). Since the layer-wound coils dispense with the fibre covering, their overall bulk is considerably smaller. As a result, cores of smaller dimensions may be employed, with a consequent reduction in costs.

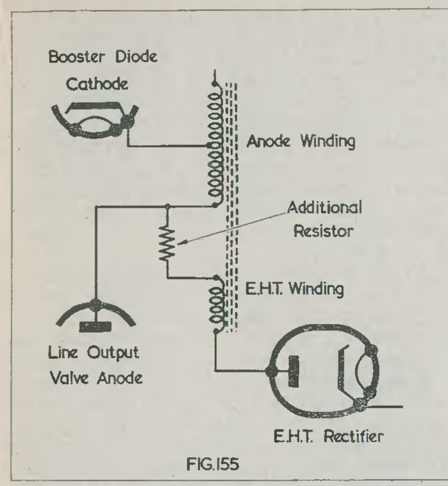
There is, in every line output transformer, an inevitable *leakage reactance* between the main anode and e.h.t. windings.[3] This leakage reactance, in company with winding capacities, may cause a subsidiary ringing effect to be produced in the transformer, the result of which is to superimpose an alternating current at the ringing frequency on the sawtooth waveform appearing in the main anode winding. The ringing current has highest amplitude immediately after the shock-excitation of the flyback period, this amplitude reducing as the scan period advances. The ringing current is liable to have visible effects on the picture reproduced by the cathode ray tube (in a manner which will be discussed later) unless steps are taken to keep it to a low level. An early method of reducing the ringing effect consisted of winding the e.h.t. coil with resistance wire. The damping introduced by the resistance decreased the amplitude of the ringing current without seriously affecting e.h.t. voltage regulation.[4] Another version of this technique consists of using copper wire for the e.h.t. winding and of inserting a fixed resistor between the junction of this winding and the main anode winding, as in Fig. 155.

A different approach towards the ringing problem consists of ensuring that minimum ringing current flows in the line deflector coils themselves. It is, normally, possible to

[2] The fibre covering also assists in the wave-winding operation, since stray filaments on the outside of the wire provide a "key" which enables the wire to lay in position during winding.

[3] All transformers exhibit a "leakage flux" about each winding, this term defining the field which does not cut the turns of other windings and which does not, therefore, contribute to transformer operation. The effect of leakage flux is the same as that given by an imaginary inductance inserted in series with each winding, such inductance being described as the "leakage inductance" or "leakage reactance".

[4] Voltage regulation defines the stability of the voltage offered by a power supply for different current demands.



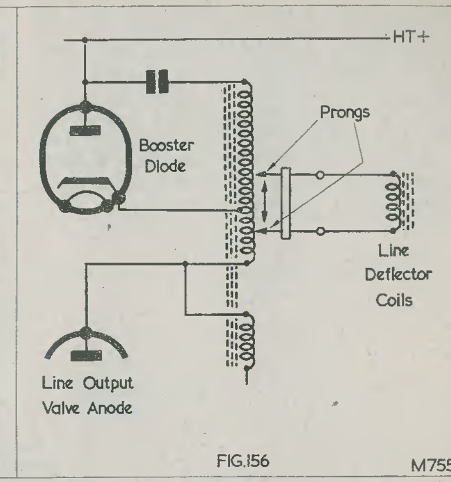


Fig. 155. Ringing currents in the anode winding due to leakage reactance between anode and e.h.t. coils may be reduced by inserting a resistor at the junction of the two windings. Fig. 156. Showing graphically that, if it were possible to move two "prongs" up and down the anode winding of a conventional line output transformer a setting may be found which corresponds to minimum ringing current in the line deflector coils

tap the line deflector coils into the main anode winding at two points which cause minimum ringing current flow. As a rough illustration Fig. 156 illustrates an anode winding to which two "prongs" from the line deflector coils are applied, the spacing between the "prongs" being that which gives correct matching into the winding. If the two prongs are now moved up and down the winding, a position will be found which corresponds to minimum ringing current in the deflector coils.

In modern line output transformers it is usual practice to tap the line deflector coils into the anode winding at points corresponding to minimum ringing current, and to dispense with such things as e.h.t. windings wound with resistance wire or fitted with series fixed resistors. Also, the e.h.t. winding is often layer-wound on top of a layer-wound anode winding, with the result that the consequently tighter coupling between the windings reduces leakage reactance and ringing amplitude.

A technique frequently employed with currently-manufactured transformers consists of designing winding self-capacities such that the ringing frequency resulting from leakage reactance is nearly three times the frequency of the flyback pulse. This causes the voltage on the line output anode to be in a trough at the same time as the pulse applied to the e.h.t. rectifier is at a peak (see Fig. 157) and results in an improvement in e.h.t. regulation. Such a transformer is described as having a "tuned leakage reactance".

It is possible to reduce the leakage reactance between anode and e.h.t. windings very considerably by dispensing with conven-

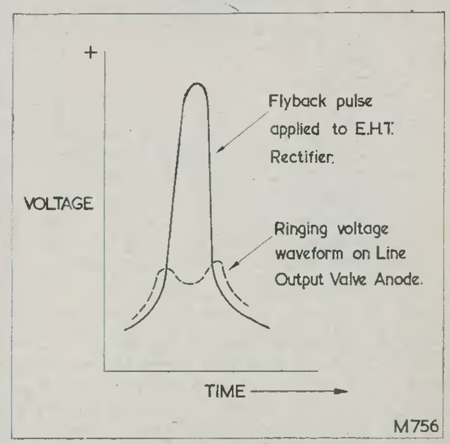


Fig. 157. In a tuned leakage reactance transformer, winding capacities are arranged such that the peak of the e.h.t. pulse appears at the same time as a trough in the ringing voltage waveform on the line output valve anode

tional U-core assembly methods, and by fitting anode and e.h.t. windings into a pot-core of magnetic material which completely encircles them, as in Fig. 158. Line output transformers of this type are beginning to appear in domestic receivers. Due to the very tight coupling between windings, they should give rise to markedly less ringing currents than are given in the more open construction provided by U-cores.

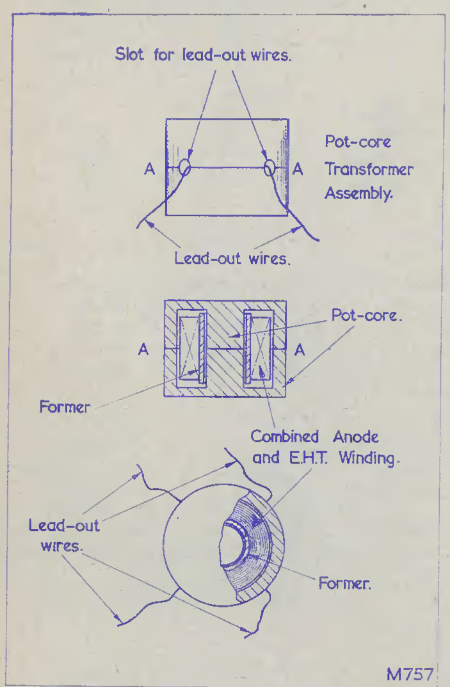


Fig. 158. The upper diagram illustrates a pot-core assembly, whilst the cross-sectional view in the centre diagram shows how the magnetic material of the pot-core completely encircles the windings. The pot-core is made in two halves which meet along the line AA. The lower diagram gives a top view of the assembly

Other Line Output Stage Circuits

A number of line output stage designs have been successfully introduced to domestic receivers which, whilst retaining basic booster diode principles, have differed considerably from the circuit arrangements we have examined up to now. These alternative circuits will now be briefly considered.

Fig. 159 illustrates the *direct-drive* line output circuit. In the direct-drive arrangement the line deflection coils are wound with a large number of turns, with the result that they have a much higher inductance than do the more conventional coils which tap into the anode winding of a normal line output transformer. At the same time, the anode winding of the direct-drive line output transformer has fewer turns than does a conventional transformer. The anode winding of the transformer of Fig. 159 would normally present roughly the same inductance as is present between the line output anode and booster diode cathode taps of a conventional component.

The direct-drive circuit functions in much the same manner as the booster diode circuits we have already discussed. During the second part of the scan period the conductive line output valve draws a continually increasing current through the deflector coils and through the transformer anode winding. At the initiation of the flyback period, the fields in the deflector coils and the anode winding collapse and the potentials across them reverse, causing the anode of the line output valve to go violently positive and allowing an e.h.t. voltage to appear at the bottom end of the e.h.t. winding. The potential across the deflector coils reverses again, and it becomes equal to that held by the boosted h.t. reservoir condenser. After this the potential across the deflector coils becomes stable and there is a current decay as energy is fed to the reservoir condenser. As the decaying current approaches zero the line output valve becomes conductive once more and another cycle commences.

The anode winding of the line output transformer does not enter into the exchange of energy to and from the reservoir condenser (apart from the fact that current is drawn *through* it by the line output valve during the second half of the scan period) and its main function is that of providing an e.h.t. voltage.

The direct-drive line output circuit has the advantage that the line output transformer can be of very inexpensive design. The two simple windings required can, for instance, be mounted on a cylindrical rod of magnetic material, as in Fig. 160, thereby reducing costs considerably. On the other hand, deflection coil design becomes complicated, as it is necessary to provide many more turns of what must be, for space reasons, finer wire than is required in conventional line deflector coils, and to provide these with insulation capable of handling the higher voltages which appear across them during the flyback period. There is a further disadvantage to the direct-drive system insofar that e.h.t. voltage regulation tends to be worse than that provided by the more conventional line output stage; this being due to the fact that the field whose collapse induces the e.h.t. voltage is provided by an anode winding having a much smaller inductance.

Direct-drive systems were popular when 70 degree (scanning angle) cathode ray tubes were introduced, as the internally castellated cores[5] employed for 70 degree deflector coil construction were particularly suitable for the line coils required. Direct-drive systems are not used in currently-manufactured British receivers.

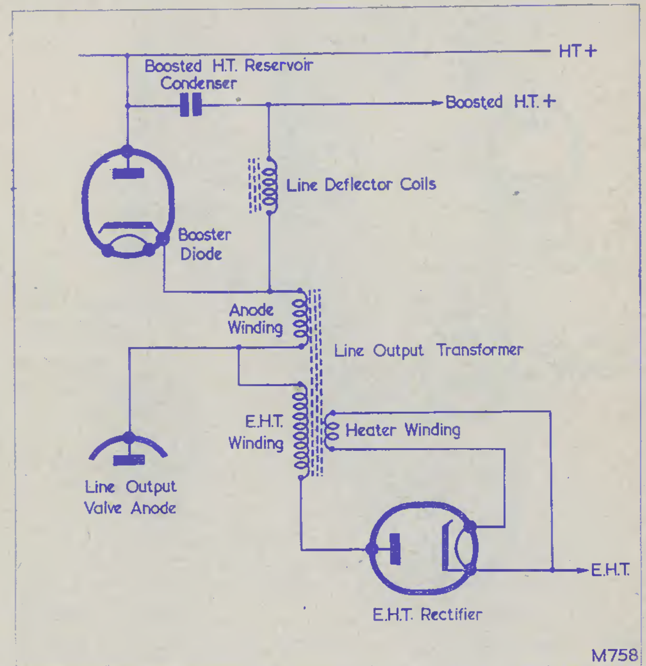


Fig. 159. The basic circuit of the direct-drive line output stage

Another variation on the basic booster diode circuit is the *self-running* line output stage. A typical example is illustrated in Fig. 161. The transformer shown in this diagram is similar to the conventional types we have considered already, with the exception that there is an extension of the anode winding above the boosted h.t. reservoir condenser tap. This extension, the "feedback winding", is connected via suitable resistors and a condenser to the grid of the line output valve.

Operation of the circuit resembles that of the blocking oscillator, insofar that feedback to the grid of the line output valve is positive. During the scan period, the feedback winding causes a positive voltage to be fed to the grid of the line output valve which becomes, in consequence, conductive. At the end of the scan period either the valve or the transformer core saturates, with the result that the transformer magnetic field becomes stationary. Because of this, the positive voltage fed back to the grid drops, making it go slightly negative. The consequent drop in anode current causes a further drop in feedback potential, and a cumulative effect takes place

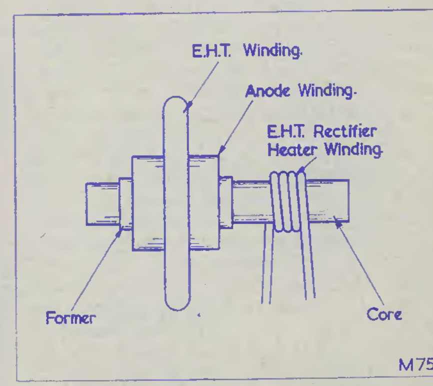


Fig. 160. The direct-drive line output transformer can be assembled on a simple cylindrical core in the manner shown here

[5] To be described next month.

which results finally in the collapse of the line output transformer field and the application of a high negative potential to the grid. The anode of the line output valve swings violently positive in normal manner, after which the potentials across the winding return to their original polarity, and another scanning period commences. The frequency at which the circuit operates may be controlled by careful choice of component values in the feedback circuit. It is usual to insert a variable resistor in this circuit, this functioning as a frequency, hence line hold, control. Negative-going sync pulses applied to the line output valve grid cause the flyback period to be initiated before it would naturally occur.

Self-running line output stages have been used in commercial receivers to quite a large extent, and they have the considerable advantage of eliminating the components and valves needed in a separate sawtooth generator. On the other hand, they have the disadvantage that, when free-running, flyback is initiated due to saturation of either valve or transformer core, saturation in neither of these being a desirable design feature in the line output stage or one that is easy to control. In one particular British receiver, a self-running line output stage has been provided with a fixed feedback circuit which causes it to run at a frequency considerably lower than nominal line frequency. This stage has then been controlled by an oscillator which provides large sync pulses at the correct frequency. Thus, the self-running circuit is used without the risk of saturation.

Fig. 162 illustrates another type of line output stage. In this case a tap into the anode winding connects via a coupling condenser to the grid of a triode preceding the line output valve. As may be seen, this triode forms, with the line output valve, a multivibrator. At the end of the scanning period the triode, previously cut off due to the charge on the coupling condenser, commences to conduct. This causes a negative voltage to be passed to the grid of the line output valve. The anode, in consequence, draws less current through the anode winding of the line output transformer, causing a positive-going voltage to be passed to the triode grid. The mutual amplifying action of a multivibrator now takes place, ending with the line output valve cut-off, and the triode fully conductive.

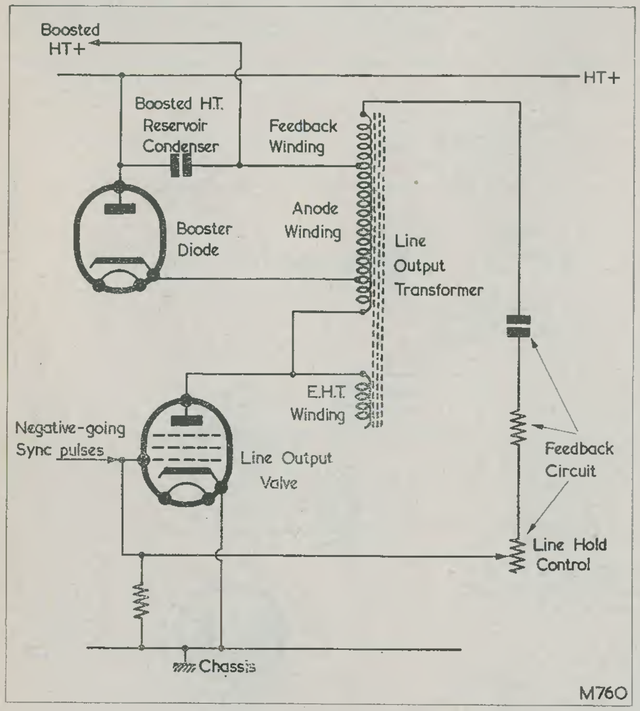


Fig. 161. The self-running line output stage. Typical values for components in the feedback circuit are 200pF and a total resistance (at correct running frequency) of 200kΩ

A relatively high positive potential is applied, during the flyback period, to the right-hand plate of the coupling condenser. At the same time, the left-hand plate of this condenser is kept approximately at chassis potential due to the effective diode formed by the cathode and grid of the triode. In consequence, the condenser acquires a charge, the right-hand plate being positive. At the end of the flyback period the right-hand plate of the coupling condenser returns to approximately the same potential it previously held, whereupon the charge it holds causes the grid of the triode to go well beyond cut-off. During the scan period the coupling condenser discharges via the resistors in the grid circuit of the triode until this grid rises just above cut-off potential, whereupon the next flyback period is initiated. Since the length of the scan period is controlled by discharge in the coupling condenser, it is possible to make one of the resistors in the triode grid circuit a frequency, or line hold, control.

The circuit of Fig. 162 has the advantage of eliminating several sawtooth generator components, and has been used in a number of receivers.

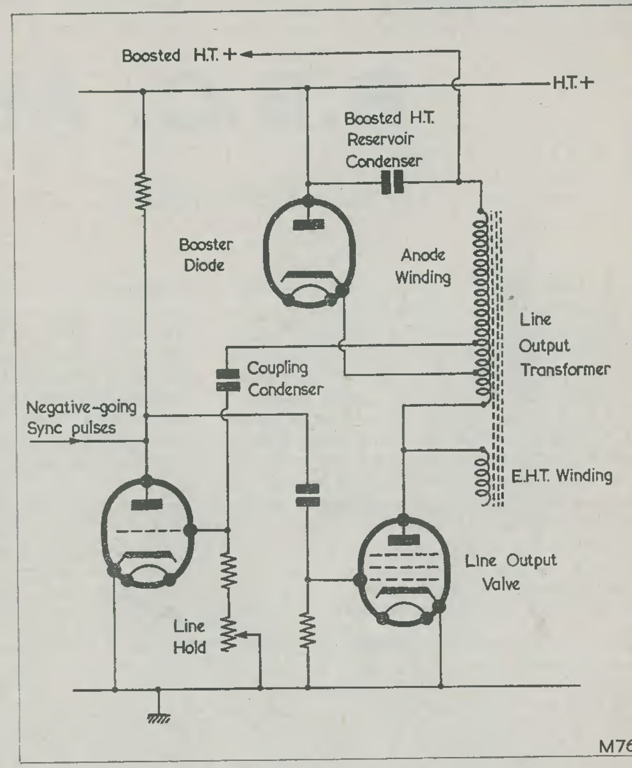


Fig. 162. A circuit in which the line output stage forms half of a multivibrator. In a practical circuit the coupling condenser would have a value of some 50pF and the total resistance in the triode grid circuit (at correct running frequency) of approximately 400kΩ

Next Month

In next month's issue we shall discuss the circuits employed for e.h.t. voltage stabilisation, interference from the line timebase, and line width and linearity controls. We shall, also, carry on to deflector coil assemblies.

HEATHKIT EXHIBITION

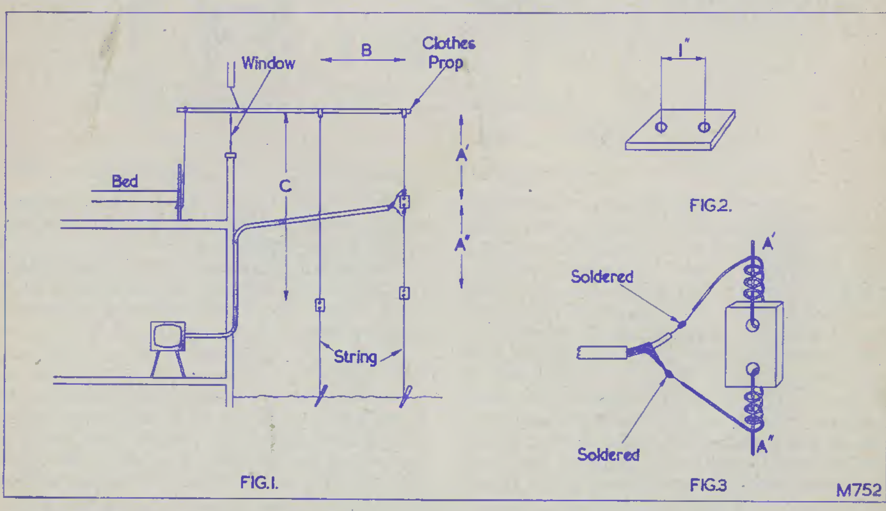
Daystrom Ltd., Gloucester, England, announce that they will be showing and demonstrating the full range of British Heathkit equipment at the Grand Hotel, Southampton Row, London, W.C.1 (opposite Russell Square), during the period of the Audio Fair, 21st-24th April.

A copy of the latest Heathkit catalogue has also been received. This provides much useful information, and is available to readers free of obligation (see advertisement in this issue).

An Emergency B.B.C. AERIAL

By R. J. STEPHENSON

HAVING RECENTLY TAKEN DELIVERY OF A new television receiver, I was rather taken aback when the family expected a picture the same evening. Perhaps I should explain that a short time ago we were living in Birmingham, where we could receive a good picture on the proverbial "piece of wet string"; and now we are living in an area of weak signal strength, approximately 90–100 miles away from Holme Moss. Briefly, the position was that I had to provide a picture that evening or else my reputation would be lost!



In my wanderings round the locality I had observed the various arrays on the chimney pots, the least ambitious of which consisted of an "H" or "X" for B.B.C. and a nine-element array for I.T.V., mounted as high as possible.

With some misgivings I looked through the spares box, and all I had in the way of aerial equipment was a long piece of co-axial cable, enough to reach from the aerial (which was yet unsited) to the receiver. I.T.V. reception was ruled out because of the complicated array which would be needed. However, it was thought something might be done about a B.B.C. picture, and the solution may help others who suddenly find their main aerial out of use.

First, a piece of ordinary lighting flex was split and two lengths "A^{1}", "A^{11}" cut off. (Fig. 1.) One end of each piece was tied to a small piece of insulating material with ¼in holes bored 1in apart. (Figs. 2 and 3.) The ends were bared and soldered to the co-axial cable as shown. The top end of A^1 was tied to a similar piece of insulating material, which was, in turn, screwed to the end of a clothes prop. The other end of the prop was passed through the top of a spare bedroom window and lashed to the foot of a spare bed, so that the prop was horizontal. It was hoped to use the aerial in this state, but two snags became immediately apparent. Firstly, the weight of the co-axial cable, where fastened to the wall, dragged the aerial out of position; and secondly, the bottom of the aerial wafted about in the slightest breeze. This was overcome by tying the bottom of the aerial to another insulating block and tying the whole to a stake in the ground, immediately below.

The next step was to connect a suitable co-axial plug to the other end of the cable and try it out. Dismay! Although the picture could be seen on the screen, there was not enough signal to synchronise either the line or frame timebases and the sound was weak and noisy. It may well be that in an area of higher signal strength the aerial will work as described.

However, it was noticed that the prop was pointing almost directly to the transmitter, so it was decided to fit a reflector. This was fitted in the same way as before, again using a single piece of "split" twin flex, but it is in one piece and no connections are made to it. This was a considerable improvement. Although the position of the line and frame hold controls are rather critical, a steady picture can be obtained. As a matter of fact, the aerial has been in use for a week and, apart from the initial "settling up", the line and frame hold controls have not been touched since. The picture is a little "noisy", but it is better than no picture at all, and there is sufficient contrast and volume for comfort.

Finally, I must stress that this is only meant to be a temporary aerial. It is no substitute for a high, properly erected array, but it will most likely get a picture in an emergency. A table of suggested sizes is given below:

Channel		*A*	*B*	*C*
1	..	5ft 3½in	5ft 7in	11ft 1in
2*	..	4ft 7½in	4ft 10in	9ft 9in
3	..	4ft 2½in	4ft 5in	8ft 11in
4	..	3ft 10in	4ft 1in	8ft 1in
5	..	3ft 6½in	3ft 9in	7ft 6in

* These were the sizes actually used to receive Holme Moss (Channel 2).

From our Mailbag

SIR,—News that Crown Prince Moulay Hassan of Morocco had flown into Agadir with amateur radio emergency equipment, to help with disaster relief in that town, once again highlighted the service to the community which this aspect of amateur radio can provide. The day previous to this announcement, I received urgent 'phone calls from Red Cross Headquarters in London, enquiring whether any amateur radio links could be arranged with that organisation's relief unit in Mauritius. There is no need for me to stress the difficulties, both legal and technical, of providing such an emergency link; your readers will be well aware of them. I suggested that the Red Cross should try to make contact with radio amateurs in Nairobi and ask them to establish contact with the emergency amateur radio station which was reported to have been heard in action in Mauritius. This leads me to the point of this letter. I am endeavouring to compile a world-wide list of National Amateur Radio Emergency Organisations and their H.Q. addresses, to which the Red Cross could appeal locally in such disasters as have just occurred. Amateurs in this country may not yet be able to handle relief messages direct from such scenes of disaster to Red Cross H.Q. in London, but the provision and linking up of local networks in the vicinity of such disasters with Red Cross Relief Units would help tremendously in improving communications in circumstances which always tax every form of message handling to its utmost.

I should much appreciate any help in this matter which your overseas readers could give me.

Yours faithfully,
DR. ARTHUR C. GEE, G2UK,
Chairman, Radio Amateur Emergency Network Committee

Electrical Fair

The rapid expansion in the use of domestic electrical equipment during recent years has created an urgent need for an exhibition devoted exclusively to all aspects of electrical equipment for the home.

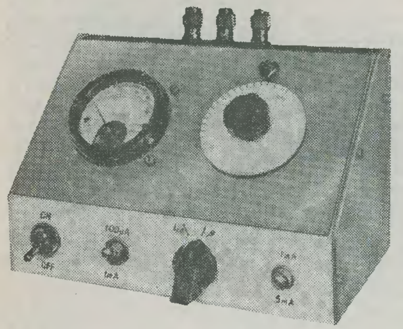
Such an exhibition is now being organised by a newly formed company, Electrical Fairs Ltd., which is a subsidiary of Electrical Engineers (A.S.E.E.) Exhibition Ltd., and the first show will be held at Alexandra Palace, London, from 23rd September to 1st October, 1960. Two Saturdays have been included to ensure large public attendance.

Apart from the obvious need of such an exhibition, the new company has been encouraged to embark on this venture by requests from many manufacturers of domestic electrical equipment to stage a show of this nature. Many organisations, including the Electrical Association for Women (who will be arranging a kitchen planning display) and the National Inspection Council for Electrical Installation Contracting, have already promised their support.

It is anticipated that the products on show will include electric washing machines and dryers, fans, electric blankets and bedwarmers, thermostats, vacuum cleaners and polishing machines, cookers, refrigerators, domestic lighting equipment including lamps and shades, kitchen equipment, heaters of all types, portable electric tools, etc.

It is the intention of the organisers and the exhibitors to promote the safe and correct use of electrical equipment in the home.

Electrical Fairs Ltd. registered office is at 6 Museum House, 25 Museum Street, London, W.C.1.



A TRANSISTOR TESTER

by Leslie Krause

An Instrument for Measuring α, β & I'_{co}

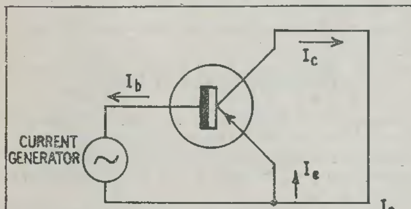


FIG. 1.
(A.C. CONNECTIONS ONLY SHOWN)

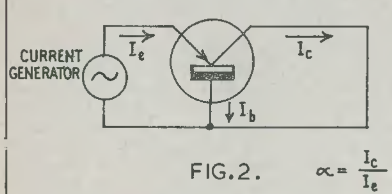


FIG. 2.
(A C CONNECTIONS ONLY SHOWN)

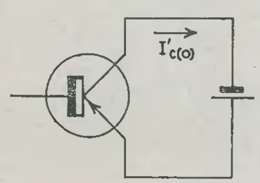


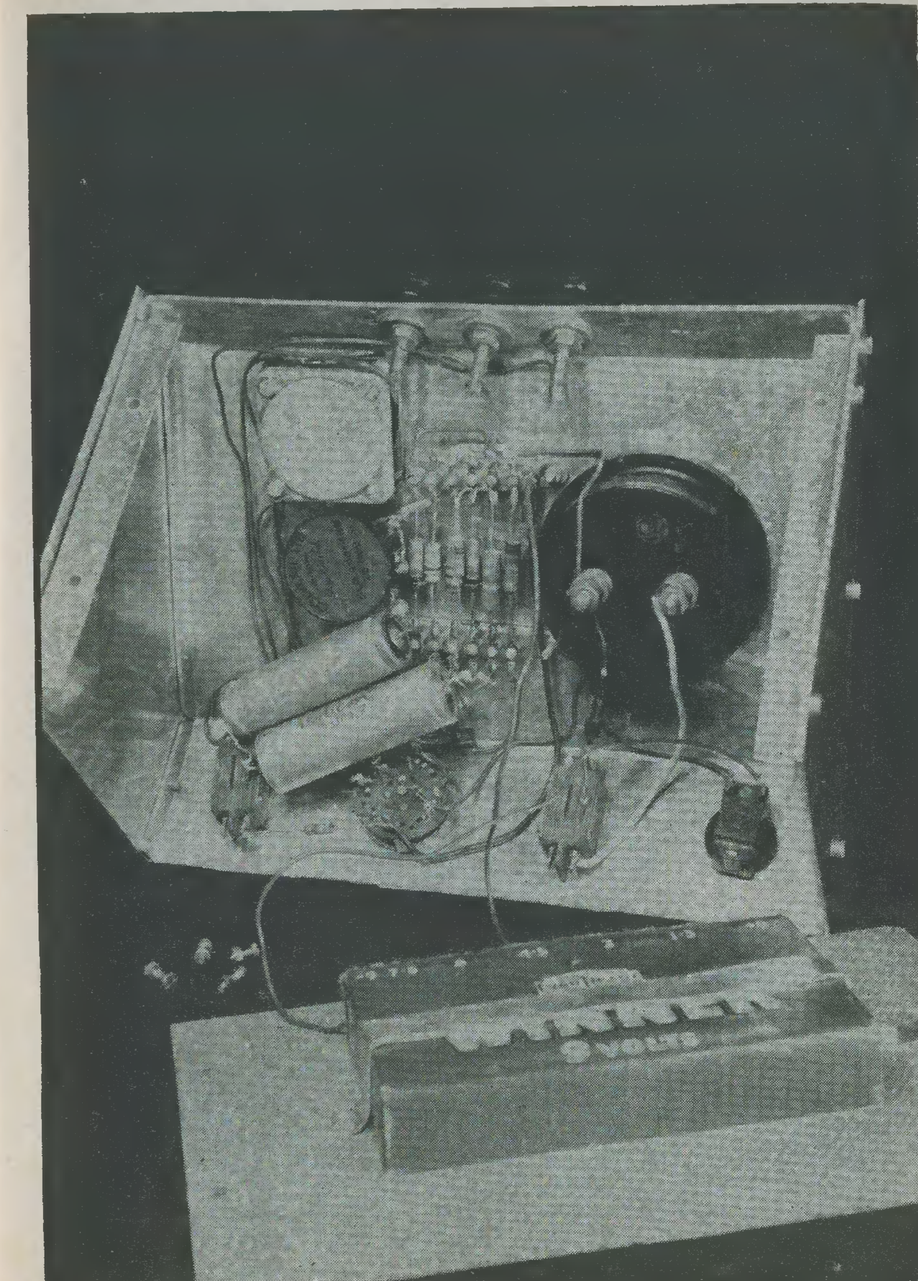
FIG. 3

Uses of the Instrument

THE INSTRUMENT DESCRIBED WILL MEASURE three important transistor parameters, namely β, α and $I'c$ (o). β is the ratio of the a.c. collector current to the a.c. base current and is measured with the emitter of the transistor connected to earth (see Fig. 1). α is the ratio of the a.c. collector current to the a.c. emitter current and is measured with the base of the transistor connected to earth (see Fig. 2). Both the above definitions only hold for very small a.c. currents. $I'c$(o) is the collector d.c. current with the base open-circuited and the emitter connected to earth (see Fig. 3). By comparing the values of the above measured parameters with those published by the manufacturers, an estimate of the transistor's condition can easily be made. Where it is necessary to match a pair of transistors the instrument will also prove useful.

Circuit Explanation

To describe the circuit used reference is made to Fig. 4. With S_2 in the β position, the circuit is connected as a transformer coupled oscillator. The collector current is shared between R_4 and the primary winding of the phase reversing transformer T_1 via RV_1 and R_3. The secondary current is fed to the base of the transistor and supplies the positive feedback to maintain oscillatory conditions. The amount of the a.c. collector current fed back to the base can be controlled by RV_1. It follows that RV_1 can be adjusted so that the oscillator is just on the point of oscillation and the values of the a.c. currents flowing are very small. As stated previously, it is under small a.c. current



Interior view of the transistor tester showing method of construction of the case and disposition of components. The way in which the battery is fitted is also shown conditions that β and α are measured. The presence of oscillation is indicated by detecting the waveform at the emitter terminal by means of C_2, R_7, diode D_1 and the meter. The d.c. current flowing in the transistor is determined by R_1, R_2 and the emitter resistor R_5 or R_6. With R_5 in circuit approximately 5mA of d.c. emitter current flows and 1mA with R_6 connected.

With S_2 in the $I'c(o)$ position the base of the transistor is open-circuited and the meter connected across the collector and negative side of the battery. The emitter is connected to the positive side of the battery through R_5 or R_6; the value of the emitter resistance does not alter the collector current in the $I'c(o)$ connection. The range of current the meter can measure is varied by S_4; with R_8 in, the full-scale reading is 1mA, and 100μA with R_8 open-circuit.

Function Explanation

If the transistor to be tested is connected in the circuit of Fig. 4 and RV_1 is adjusted so that the transistor is just at the point of oscillation, it can be shown that:—

$$\beta = \frac{N(1+RV_1)}{R_4} \quad (1)$$

where N = turns ratio of T_1. The point of oscillation is found by reducing RV_1 until the meter reads approximately half full-scale and

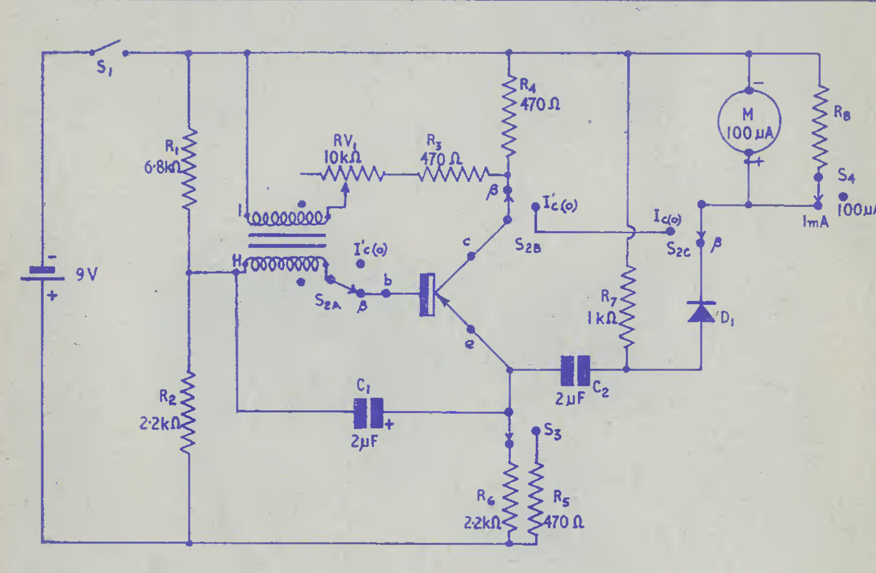


FIG.4. CIRCUIT DIAGRAM OF TRANSISTOR TESTER

G 518

Components List

Resistors

- R_1 6.8kΩ 20% $\frac{1}{8}$W
- R_2 2.2kΩ 20% $\frac{1}{8}$W
- R_3 470Ω 20% $\frac{1}{8}$W
- R_4 470Ω 2% $\frac{1}{8}$W
- R_5 470Ω 20% $\frac{1}{8}$W
- R_6 2.2kΩ 20% $\frac{1}{8}$W
- R_7 1kΩ 20% $\frac{1}{8}$W
- R_8 Adjust on test
- RV_1 10kΩ variable

Capacitors

- C_1 2μF 10V
- C_2 2μF 10V

Switches

- S_1 On/Off
- S_2 3-pole 2-way
- S_3 1-pole 2-way
- S_4 On/Off

Miscellaneous

Transformer T_1 turns ratio (N)=6:1 (see text)
D_1 Germanium diode
Battery 9V grid bias
Meter 100μA F.S.D.

slowly increasing RV_1 until the meter reading is just perceptible. The value of β can be deduced if the scale attached to RV_1 is calibrated in accordance with equation (1).

$I'c(o)$ is measured by switching S_2 to $I'c(o)$ and noting the meter reading.

α can be obtained from the value of β as they are related by the following equation:

$$\alpha = \frac{\beta}{1+\beta} \quad (2)$$

The scale can be made to be double reading and calibrated in accordance with equation (2) as well as equation (1), if required.

As the values of α and β vary with the standing d.c. current, S_3 is switched to the position giving the nearest conditions to those which will be used in the intended circuit.

Method of Measurement

(1) Switch S_2 to $I'c(o)$.
(2) Switch S_4 to 1mA.
(3) Note the reading on the meter. If the value is below 100μA, switch S_4 to 100μA. This reading is the value of $I'c(o)$.
(4) Adjust RV_1 fully anti-clockwise.
(5) Switch S_4 to 100μA.
(6) Switch S_3 to the desired value of standing current.
(7) Switch S_2 to β.
(8) Turn RV_1 clockwise until the meter reads approximately 50μA.
(9) Gradually reduce the meter reading by turning RV_1 slowly anti-clockwise until it reads 0.5μA.
(10) Read the value of α and β from the dial.

Method of Calibration and Meter Shunt Adjustment

Connect an ohmmeter as shown in Fig. 5, and calibrate the dial in accordance with equation (1).
As N=6, R_4=0.47kΩ.

$$\beta = 6\,\frac{(1+RV_1)}{0.47} \quad (3)$$

RV_1 in equation (3) is in kΩ. For values of $\frac{RV_1}{0.47}$ much greater than 1 the scale calibration will be linear. When this has been completed the β scale can be used to calibrate a second scale in accordance with equation (2) to give the value of α.

To obtain the correct value of R_8, a meter M_2, that reads 1mA and two potentiometers are required. Connect the two meters and the two potentiometers in the circuit shown in Fig. 6, ensuring that RV_1 shorts out the 100μA meter before connecting the battery. RV_2 is then adjusted until the meter reads 1mA and RV_1 is increased until the 100μA meter reads full scale deflection. It will be necessary to re-adjust RV_2 and RV_1 until finally the meter reads 1mA and the 100μA meter reads full scale, when the required value of R_8 can be measured between the slider and the battery end of RV_1.

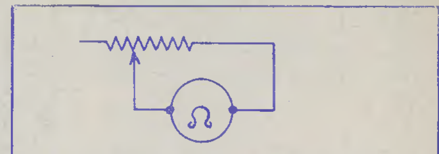


FIG.5. DIAL CALIBRATION

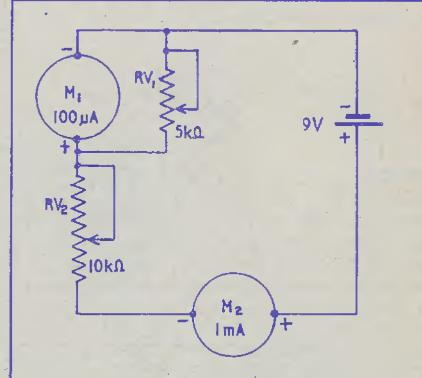


FIG.6. METER SHUNT MEASUREMENT

G 519

Constructional Details

The materials required to make the tester are as follows:

(1) 12in x 21in approximately of 16 gauge aluminium.
(2) 18 6BA and 2 4BA nuts and screws.
(3) Components as listed.
(4) Two tag strips.
(5) Three terminals suitable for connecting the transistor to the tester.
(6) Scale and pointer.

The first operation is to mark out the front panel, as detailed in Fig. 7, on the aluminium. Cut out and drill the panel, and bend the shaded lines as shown in Fig. 8. It will be found easier to bend the outside edge flaps first, next the two 45° angles and finally the top edge flap. The two side and end plates can now be cut out, drilled and bent to shape as shown in Figs. 8 and 9. Before bolting together, fix the two tag strips astride the hole C at a convenient distance apart to mount the components.

All the components are standard types apart from the transformer and meter. The

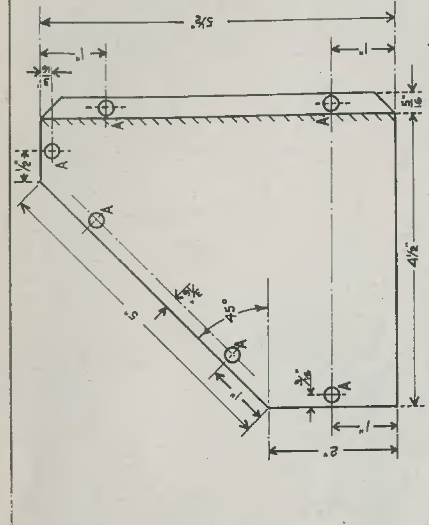


FIG.8. SIDE PANELS (16 SWG ALUMINIUM)

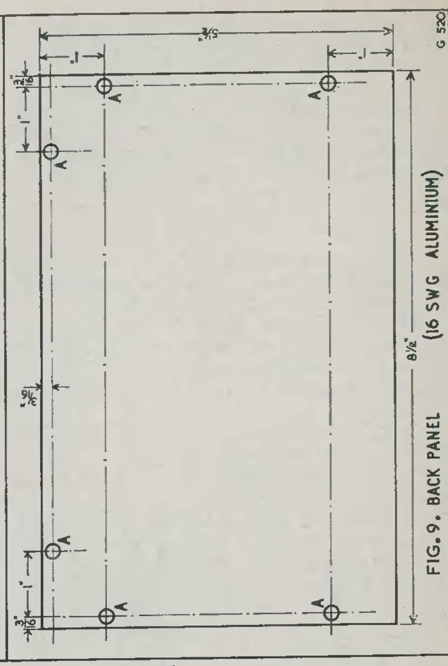


FIG.9. BACK PANEL (16 SWG ALUMINIUM)

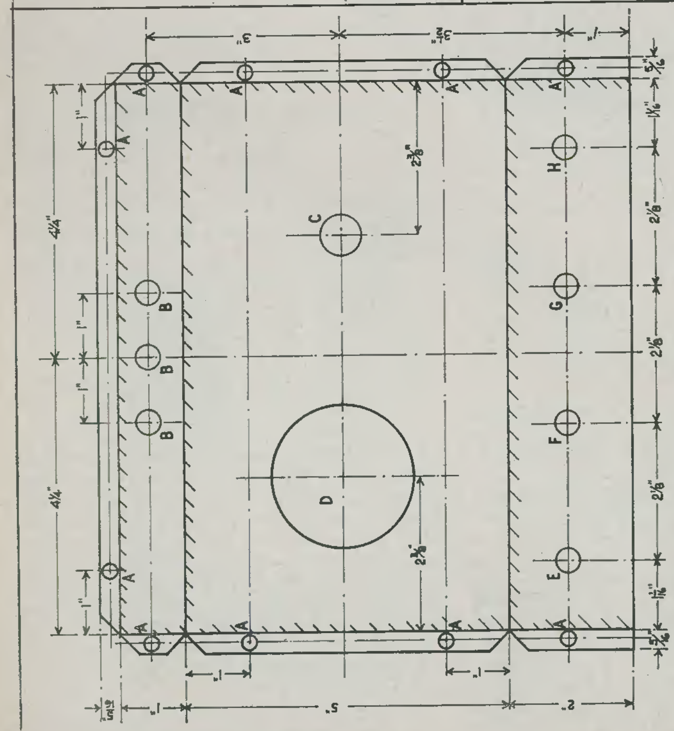


FIG.7. FRONT PANEL

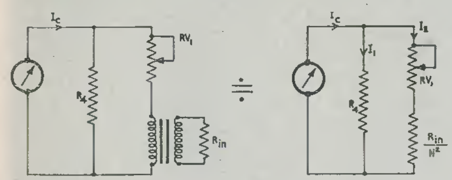
transformer is best constructed by stripping down an old loudspeaker matching transformer and re-winding it. The turns should be counted on carefully as the accuracy of the instrument depends upon the turns ratio. Mounting the former in the chuck of a hand-drill clamped in a vice will make winding less laborious. It is important to get as many turns on the windings as possible, but the actual number is not critical as long as the turns ratio is correct. Wire gauge around 40 s.w.g. will be suitable. Any 100µA full scale reading meter of about 2½in diameter will be satisfactory. The only high stability resistor is R_4; as this resistance appears in the equation for β, the tolerance should be 2%.

Wiring Details

All that remains to do now is to wire up the components as shown in the circuit diagram. The switch positions are shown in Fig. 7, and an idea of the component layout can be obtained from the underside photograph. The battery is mounted with the aid of a simple U-shaped aluminium clamp bolted to the back panel.

Appendix

The equivalent circuit of Fig. 4 on β connection is as shown:



where I_c = collector current.
R_{in} = input resistance of transistor.
N = turns ratio of transformer.

Now $\frac{R_{in}}{N^2} \ll RV_1$

$$I_2 = \frac{I_1 R_4}{RV_1},\ I_c = I_1 + I_2,\ I_1 = I_c - I_2$$

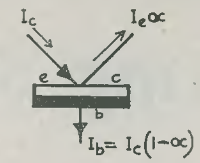
$$I_2 = \frac{(I_c - I_2)R_4}{RV_1} = \frac{I_c R_4}{RV_1\left(1 + \frac{R_4}{RV_1}\right)} = \frac{I_c}{\frac{RV_1}{R_4} + 1}$$

and $$I_b = \frac{I_2}{N} = \frac{I_c}{\left(\frac{RV_1}{R_4} + 1\right) N}$$

as $$\beta = \frac{I_c}{I_b}$$

$$\therefore \quad \beta = N\left(1 + \frac{RV_1}{R_4}\right) \text{ which is equation (1)}$$

Equation (2) is deduced as follows:
The transistor currents are as shown:



Now $$\beta = \frac{I_e \alpha}{I_e(1-\alpha)} = \frac{\alpha}{1-\alpha}$$

or $$\alpha = \frac{\beta}{1+\beta} \text{ which is equation (2).}$$

Trade Reviews

continued from page 666

CUTTING AND CLINCHING PLIERS. Home Radio (Mitcham) Ltd., 187 London Road, Mitcham, Surrey, are currently marketing a most interesting and unusual pair of pliers. These pliers, type No. 11009, have an overall dimension of 5¼in and have been specially designed for use when working on printed circuit boards and components. This special purpose tool, designed to cut off the excess wire of the components, leaves about $\frac{1}{16}$in projecting above the copper circuit board. By exerting further pressure, the wire is clinched to retain the component prior to soldering the wire ends to the copper striations. One of the most useful radio tools that we have recently encountered, it is available direct from Home Radio (Mitcham) Ltd. at 16s. 6d. plus 6d. postage.

A.F. POWER METER KIT. Home Radio (Mitcham) Ltd. are currently supplying the Labgear E5115 A.F. Power Meter in kit form at the attractive price of £3 15s. 0d., or ready built at £4 10s. 0d., plus 1s. postage in each case. This is a kit of components which, together with clear step-by-step instructions, will enable an accurate and low cost meter to be constructed. The use of printed circuits eliminates a large proportion of wiring and assembly time and reduces the possibility of wiring errors. Specification of the watt-meter is as follows: Range: power: 25mW to 10W in two switched ranges. F.S.D.: 1W and 10W. Input impedances: 3 ohm, 15 ohm and 600 ohm unbalanced. Accuracy: 5% scale reading, 5% impedance. Dimensions: panel size 4¼in x 6½in, depth 3⅜in. Finish: silver hammertone enamel with matt aluminium panel. A very useful test instrument at a very reasonable price.

Getting Started on RTTY

by Arthur C. Gee, G2UK

Hon. Sec., British Amateur Radio Teleprinter Group

Part 6

We have now described in this series of articles all the extra equipment needed to convert an amateur radio station for RTTY operation. There are one or two points which need attention in the assembling of the various units, which will help in successful operation, and the writer proposes to deal with these in this article.

A photograph of the writer's station is reproduced herewith. As can be seen, the teleprinter is located alongside the transmitter—a Heathkit DX40, with the Heathkit VFO modified for FSK beneath and, below that, the two-tone audio filter terminal unit. It is as well to have these units located as close as possible to the T/P so that the keying leads from T/P to VFO/FSK unit, and from terminal unit relay to T/P are kept reasonably short. The receiver in the writer's station is just out of sight, on the top of the shelves shown to the left of the photo. Power supply to the T/P motor and electromagnet supply are on the floor beneath these shelves and stow away nicely in spite of their rather large size. A mains switch to control current to the T/P motor power supply should be located conveniently near the T/P, as much switching on and off will be needed at times.

In the writer's opinion it is worth while taking some considerable trouble installing the gear and getting a neat, convenient layout. In the writer's case, too, all wiring has been done in screened cable. It helps a great deal in keeping down the "hash" level in the receiver, if this is done. Use screened cable from mains plug to motor switch; from switch to motor power supply unit and from power supply unit to the T/P motor terminals. Bond all the screening together and earth to a good earth system. The wiring of the T.U. relay, T/P electromagnet and its associated power supply should be similarly treated. Much thinner screened cable can be used for this as the current is only a matter of milliamps, not amps as it is in the motor supply system. Screened microphone cable suits the purpose well. Finally, use co-axial cable or screened lead for the receiver aerial lead-in, from outside the shack to the receiver. See that the receiver itself is well screened, i.e. is in an earthed metal cabinet. All this is, no doubt, a policy of perfection, but in the writer's opinion it is worth the trouble. There are enough snags in copying some teleprinter signals, without having to cope with one's own man-made interference within the shack from the T/P motor, transmitting and relay contacts. If you start off from scratch having thoroughly eradicated these, subsequent difficulties will be easier to sort out.

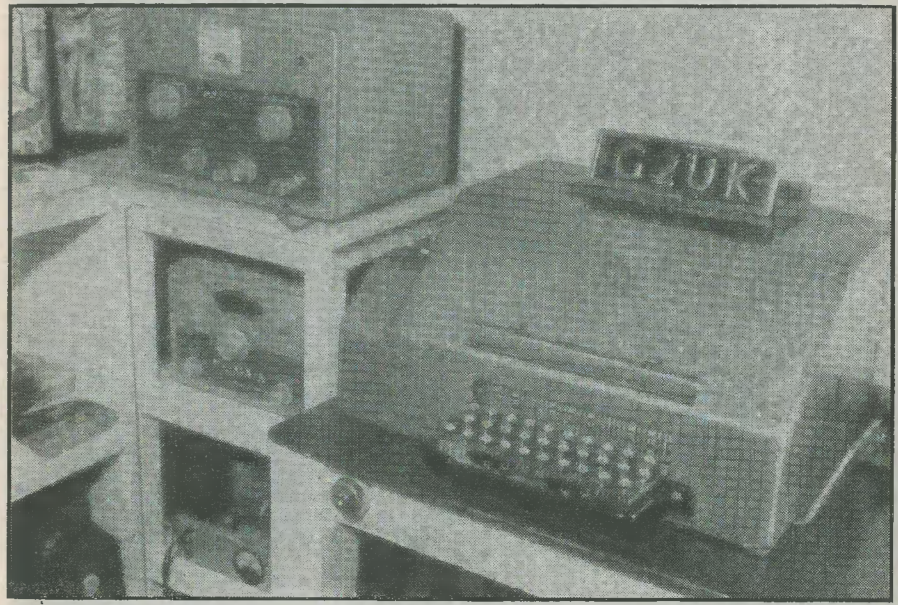
As has been said in an earlier article, the receiver must have good frequency stability and freedom from drift. Some of the war surplus receivers are excellent in this respect and are well screened into the bargain. The writer uses a BC.348. This does suffer from the fact that neither the 21 Mc/s nor the 28 Mc/s Amateur bands are covered and much of the DX RTTY activity does take place on the former of these two bands. However, some of the most consistent and powerful commercial teleprinter signals are to be found on the lower frequencies, for which this receiver is eminently suitable.

A few hints on tuning-in teleprinter signals may be helpful. Having got everything assembled and working, switch on the receiver and allow adequate time to warm up and become stable. Set the BFO control knob to its centre position and tune round on the receiver tuning control until a loud teleprinter signal is heard—the characteristic "jingle-bells". These will soon be recognised, but to start with be careful to distinguish them from the high speed morse code signals sounding like sawmills, high speed FSK, facsimile, etc., etc., which are also to be found and may deceive the unwary searcher for the type of FSK teleprinter signal we are looking for. Once you have found what you think is what you're looking for, tune it so that you get a "zero beat" signal with the BFO. Now turn the BFO control one way slightly until the two tones are audible. The relay in the T.U. should now start to function and the milliammeter pointer should flick around either side of zero. The neons, too, should flash equally and consistently. Switch on the teleprinter, take a deep breath—and watch the outcoming tape! If you are lucky, intelligible printing will appear and you'll get as big a thrill as you've had out of amateur radio for a very long time! More likely than not, however, nothing but "gibberish" will appear on the tape. In which case, first try retuning the BFO so that the two tones are transposed, i.e. turn the BFO control knob back to its centre—"no-tone"—position and continue turning it until the tones reappear. This alters your "Mark" and "Space" sequence. Switch on the T/P and see what happens this time. If still no luck, you're probably tuned into a station which is not transmitting at the International speed but on the American speed. Tune around and try again. Sooner or later you will come across one which will give you sensible printing. The chances are the first signals you'll print will be "THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK 1234567890", etc., or one of the other test phrases which commercials use.

This concludes this series of articles. In them the author has endeavoured to give the essentials for "getting started on RTTY", with equipment which is reasonably available. The author continues to receive letters asking where teleprinters can be obtained.

Whilst he cannot undertake to produce another batch at the price which those referred to at the beginning of this series were obtained for, he would point out that quite frequently advertisements appear in the radio magazines of machines which are offered at a very reasonable price, and seekers after machines are recommended to watch the "Small Ads" in the journals. Several of the "surplus" firms also offer machines at what

continued on page 687



Part of the transmitting station at G2UK. The Creed type 3 Teleprinter is on the right. To the left, at top, is the Heathkit DX-40U transmitter, below that the Heathkit type VF-1U VFO, and at bottom the FSK receiving converter

RADIO Topics

By Commentator

Correspondence

Apropos our remarks re using a tape recorder for Morse flashing, Mr. Luetchford of Streatham writes in with an even more original idea. He says: "I should like to say that I put an ex-W.D. 3,000 ohm relay across the secondary of the loudspeaker transformer on the tape recorder. Then I recorded a continuous signal on tape from a signal generator. After recording, I erased the signal at different places on the tape. Then I connected the relay contacts to my son's OO gauge railway via a 12 volt transformer. Then I started the tape on playback. When the signal came on, the train started going round; when it stopped, the train stopped. I should like to say this relay could be used to operate points, signals, crossing gates, etc." So a tape recorder has a host of uses other than that for which it was originally intended! A low-frequency tone was found to be best for keeping the relay closed—25 to 40 c/s.

Yes, one can imagine all sorts of elaborations in this sphere. The RTTY boys, for instance, could use their "know-how" on audio filters to make a bank of them, each tuned to a different frequency and each working a separate relay. These relays could then be used to switch all manner of operations on the model railway so that a whole "train movement programme" could be recorded and used over and over again.

From Mr. R. Hicklin, G3LWA, a letter saying that VK3AXU's stereophonic transmissions are definitely not the first to be put out by an amateur radio station. He claims this "first" for the British amateur radio station G3JHL. He, apparently, carried out stereo transmissions about six or seven months ago in co-operation with G2BCX on Top Band. He writes: "Both stations are in East London. I believe tape recordings of these transmissions are still available today to prove this; also special permission had to be obtained from the G.P.O. for these tests as two transmitters were on the air from G3JHL at the same time."

From Mike Matthews, G3JFF, we have a letter saying he is trying to compile a list of calls of all R.N. and ex-R.N. amateur radio enthusiasts, with a view to forming a Society similar to RAFARS. He has already over two hundred names, but it is known that there are far more amateurs eligible who have not so far heard of the scheme. Any serving or ex-members of the Royal Navy are eligible for membership of the proposed Society, provided they hold, have held, or aspire to, an amateur radio licence. Those interested should write to: G3JFF, c/o P.O.'s Mess, H.M.S. *Ganges*, Shotley, Suffolk.

Electronics in Medicine

It may come as a surprise to some readers to learn that the principal use of electronics today is not in the field of communications —in which sphere electronics was born and nurtured—but in its many other applications to industry, commerce and scientific research.

Possibly one of the newer fields in which it is gaining ground is in that of medicine. Two International Conferences on Medical Electronics have so far been held; the third has been arranged to take place at Olympia in July next.

Different electronic techniques can be used to measure the variable factors in almost any system of the body.

In the respiratory system, one of the things the physician may need to know is the velocity with which air flows through the windpipe, and the volume of air respired at each breath. This may be measured by a device called a pneumotachometer. In this the airstream passes through a piece of metal gauze. This causes a change in pressure which is related to the rate of flow. The change in pressure is minute, but it can be measured by an electronic pressure-gauge. The electric signal obtained is passed through a "black box" which instantaneously computes the volume of air breathed in a given time, and records it as a line on moving paper.

Or the physician may need to know the amount of carbon dioxide which is being excreted as a waste product into the expired air. This information can be obtained by chemical analysis, but a single determination would take a skilled technician half-an-hour or more. The modern method uses infra-red rays which are passed through a sample of the breath. The carbon dioxide present abstracts some of the energy from the rays. The lost energy can be measured, and because of the terrific speed of electronic techniques the breath can be analysed in this way in a few hundredths of a second. Thus not only can the amount of carbon dioxide be measured, but also the concentration in each fraction of the expired air, and this can be very helpful in the diagnosis of respiratory disease.

In poliomyelitis the breathing muscles may be partly paralysed, and the patient's respiration may then have to be assisted by a machine. Electronic devices can now measure the patient's disability, and control the degree of assistance provided by the machine. In this way the volume of breathing is automatically adjusted to suit the need of the individual patient.

During anaesthesia, drugs may be used which produce a temporary paralysis of the breathing muscles, and here again an electronically-controlled machine may take over the patient's breathing, and keep its volume at the right level.

Servo systems are common in electronics, and a "servo-anaesthetizer" has been devised at the Mayo Clinic. This is worked by the activity of the patient's brain, the activity being measured electronically. An increase in this measurement indicates that anaesthesia is becoming lighter. This increase sets off a relay which raises the rate at which the anaesthetic is being delivered. Conversely, deeping anaesthesia results in a decrease in the rate of delivery. In this way the depth of anaesthesia is automatically held at any desired level.

These are but a few examples of the impact of electronics on two aspects of medicine. New uses are continually being found; and so rapid is the progress, in a dozen different countries, that international conferences to exchange ideas and to tell of new techniques are now needed every year.

The International Ham-Hop Club

This is the time of the year when many folk begin to plan their holidays. The glossy, nostalgia-producing brochures and booklets from the travel agencies turn up in our mail and many a dark, cold evening can be lightened browsing over them.

The International Ham-Hop Club might almost be called a "travel agency with a difference". Several attempts have been made in the past to establish an organisation for exchange holidays between radio amateurs, but none has been so successful as I.H.H.C. Those interested should write to the Hon. Gen. Secy.: Mr. G. R. Partridge, G3CED, 17 Ethel Road, Broadstairs, Kent.

QRU es 73

This article will be the last in the series which will be contributed by your "Commentator". I took over the feature from "Centre Tap" when his health unfortunately broke down to such an extent that he was unable to carry on. Although "Centre Tap" is making progress, he is not yet well enough to start contributing regularly again, and it has therefore been arranged for another of our regular writers to take over.

May I thank all of you who have sent in such stimulating letters and who have followed the series with so much interest —it is quite evident that our new contributor will have no lack of support. He, too, will not mind in the least if you disagree at times with his views; after all, argument adds spice to any hobby.

GETTING STARTED ON RTTY

continued from page 685

are really very reasonable prices.

This series has of necessity been very simple and has covered only the bare essentials of RTTY. From them the reader will have been able to gather enough information to make a start and get some gear going. We are pleased to announce that a new series on RTTY will start shortly, contributed by John B. Tuke, G3BST, and entitled *RTTY —In Theory and Practice*, which will cover the subject in considerably more detail than the first series and will carry the reader on to some of the refinements of the subject.

CALLING SHORT WAVE LISTENERS

World Radio Handbook for Listeners, 1960 edition, published by O. Lund Johansen, price 15s. 6d. We have received a copy of this excellent annual from The Modern Book Co., 19 Praed Street, London, W.2. Of 198 pages, printed on good quality paper, with heavy paper cover, this latest edition is literally packed with information of great use to the broadcast band listener and others interested in the broadcast and television stations of the world. Apart from the wealth of station information contained within its covers, the broadcast station lists are probably the most comprehensive published today. The short wave list covers some 15 pages, whilst that for the long and medium waves covers three pages in three columns per page. Altogether the best edition yet.—J.L.K.

MISCELLANEOUS

The LITON

A PHOTO-ELECTRIC PARKING LIGHT SWITCH

Described by J. Ankers

Part 1

MANY READERS OF *The Radio Constructor* are known to be motorists, and it is to them that this article should appeal—although the unit to be described here has several uses other than those normally associated with cars. Many accidents are caused every year by cars being parked at night without any warning light, and many motorists are prosecuted in the courts for leaving their vehicles without lights on public roads. Readers who are forced, by circumstances, to "garage" their cars in the street can easily forget either to place the inevitable hurricane lamp in position, or to switch on the parking light. It is for this class of motorist that the "Liton" photo-electric switch has been designed.

The automatic switch consists of three main parts: (1) a photo-electric cell, (2) a transistor amplifier, and (3) a sensitive relay. The unit, which is housed in a metal case sized $1\frac{1}{4}$in x $2\frac{1}{2}$in x 4in, can be conveniently mounted under the dashboard. The light sensitive photocell should be fixed near the windscreen or a side window. The action of the switch is controlled by the amount of light falling on the photocell and this will, therefore, switch the light or lights on in a fog or during a cloudburst, etc. A manual switch is provided so that the unit may be isolated from the car battery supply during such periods when the automatic action is not required. The unit is very robust and, once installed, will work for many years without any attention. The current consumption is negligible—only some 0.005A. The built-in relay will switch up to 0.5A, thus the parking light may be comfortably operated from this unit. A secondary relay may be added to the "Liton" unit described here that will control currents up to 5A, this being suitable for switching on all the car lights should this be desired.

Design Considerations

Within the last few years, silicon cells—also sometimes termed "solar batteries"—have become available. Their efficiency and current output are so high that they can be used as a source of electrical energy in Earth satellites. The switching of artificial lights was one of the first applications of photocells, photo-electric switches being used to control street lights nearly 30 years ago. Many excellent designs appeared even before the last war. Although perfectly suitable for certain purposes, they could not be used to control the lights of a vehicle owing to their size, weight, and excessive power requirements.

A photocell has such a small current output that an amplifier is necessary to operate a switching relay. A thermionic valve amplifier, fed from a vibrator type h.t. supply, would probably use more current than the lamp it is to control! The invention of the transistor made it possible, for the first time, to construct a small, light, and efficient device which could be put to service within a vehicle. The transistor needs no heater current and can be supplied from a very low voltage source, this making an extremely economical current amplifier which may be used within a vehicle from its 6V or 12V battery supply. Moreover, the low input impedance of the transistor matches well the output impedance of the photovoltaic cell, thus ensuring a good energy transfer so that only one stage of amplification is sufficient for our purpose. Because transistors are able to operate at very low power levels, their own consumption is negligible. The "Liton", for example, takes only some 5 milliamps at 12 volts—which represents only 1% of the current it is capable of controlling—0.5A. From the circuits shown in Figs. 1 and 2 (12V and 6V respectively), the reader will

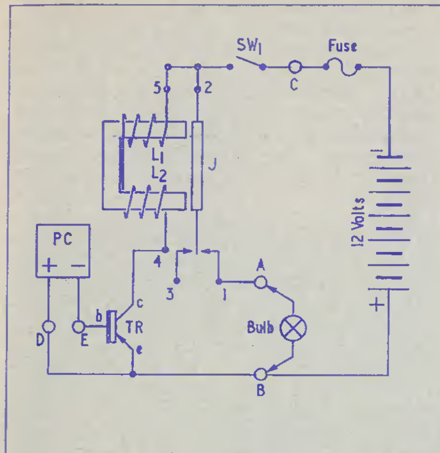


FIG. 1

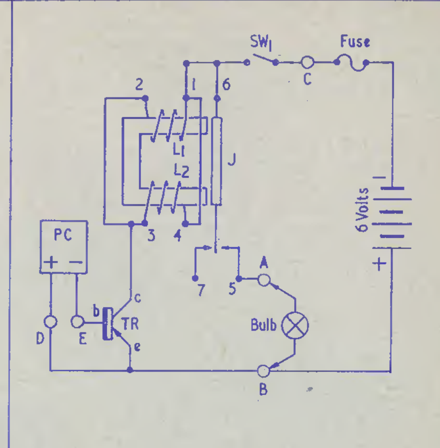


FIG. 2

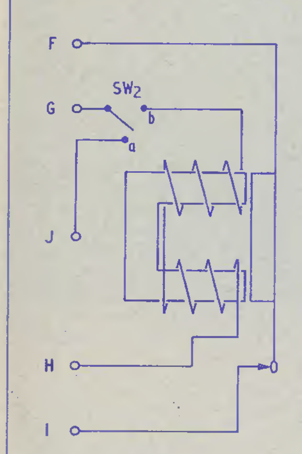


FIG. 3

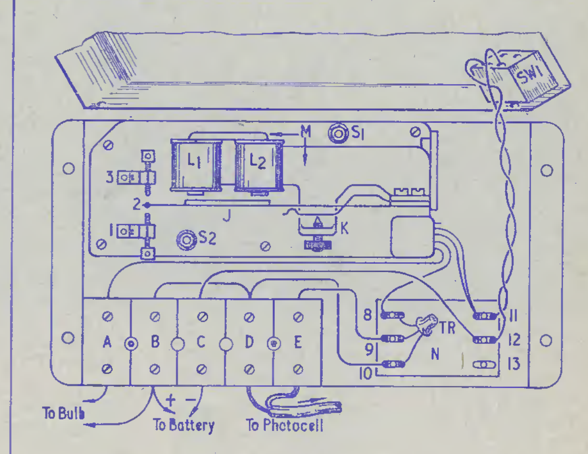


FIG. 4

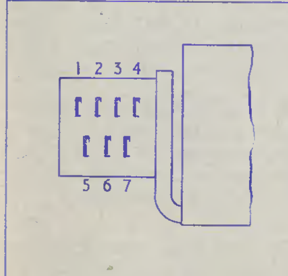


FIG. 5

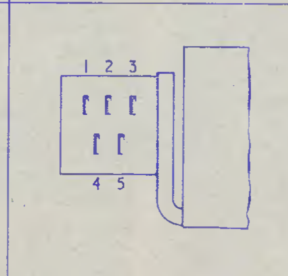


FIG. 6

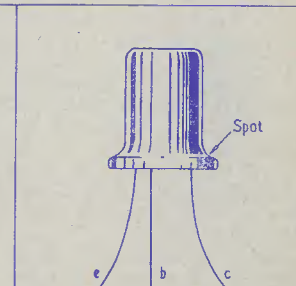


FIG. 7

note that it offers the highest degree of protection for the vehicle in which it is installed—should a fault develop either in the transistor itself or the photocell or the relay, the parking light will remain switched on.

Principle of Operation

A photocell has the property of producing a very weak electric current when exposed to light. The transistor is used as an amplifying device by means of which a weak current can be made to control a much greater current. An electromagnetic relay can also be used as an amplifying device, it being capable of switching a heavy current in an external circuit by means of a much weaker current flowing through the coils of the relay.

The actual working of the circuit may best be explained by reference to Fig. 1—this being suitable for a 12V installation, now almost universally adopted in car manufacture. PC represents the photocell connected between the base and emitter of the transistor TR. The relay coils L_1 and L_2 are contained in the collector circuit. The current for the parking light is supplied via the moving armature of the relay (J) and the fixed contact (1). When a sufficiently strong light falls on the photocell, a weak current commences to flow in the base-emitter circuit of the transistor, this causing, in turn, an increase of current in the collector circuit. By virtue of the amplification properties of the transistor, this collector current is much greater than that obtained from the photocell. At about 4 to 5 mA, the armature is attracted towards the electro-magnet, away from the fixed contact (1). This, therefore, breaks the parking light circuit, thus extinguishing the light. When the source of illumination is removed from the photocell, the armature is then released and the parking bulb will light.

The built-in relay shown here can switch up to 0.5A directly, this being the approximate current used by an ordinary parking light. A secondary relay must be employed if larger currents are to be controlled. Fig. 3 shows this secondary relay in circuit form, and this may be used to control both the side and tail lights of a vehicle. If this is used, the following connections must be made between the units. To the live battery terminal (i.e. that not connected to car chassis) connect (F). (See Fig. 3.) Connect (G) to (A) of Fig. 4, and (H) to (B) of Fig. 4. Connect (I) to a side light and (J) to the free parking light lead that was connected to (A) previously.

For those with a 6V supply, the appropriate circuit is Fig. 2, and Fig. 5 shows the relay connections for this voltage. The 12V supply details are shown in Fig. 1 and Fig. 6 shows the relay connections in this case.

Assembling the Unit

Place the paxolin panel on the bottom plate and secure to this the relay, the connecting block and the tagboard as shown in Fig. 4. Do not forget to use the shakeproof washers when screwing these components into position. Make the following connections, using the insulated wire supplied. Connect (1) of the relay to (A) of the terminal block. Join (4) of the relay to tag 8 of the tagstrip. Join 2 and 5 of the relay together and connect a wire from the junction to tag 11 of the tagboard. Connect together tag 10 of the tagboard to (D) of the terminal block, and tag 9 to (E) of the same block. Join together tag 12 of the tagboard to (C) of the terminal block. Solder the ends of two lengths of wire, about 4 inches long, to tags 11 and 12 of the tagboard, then connect the other ends of these wires to the on/off switch fixed to the metal cover. Cut the transistor leads to about $\frac{1}{2}$in in length, place systoflex over these leads, and solder them into circuit as follows. Emitter to tag 10, base to tag 9 and collector (marked with a colour spot) to tag 8 of the tagboard.

Checking the Unit

Connect the photocell to (D) and (E) of the terminal block as shown in Fig. 4. Connect the parking light between (A) and (B), and connect the battery between (B) and (C). If necessary, three 4.5V torch batteries may be used for testing purposes. Should the amount of light in the room be small, the parking light should illuminate itself; provided, of course, that the unit is switched on. Bring the photocell within 4 to 5 feet of a 100 watt bulb—this action should extinguish the light. Removing the unit from the light to a distance of some 6 to 8 feet should result in the bulb lighting up again.

Car Installation

The photocell may be affixed to the windscreen by means of the two rubber suction pads, these being reversible so that the cell may also be fixed to the facia top, thus allowing the cell to "look" at the sky. This latter method is preferable where possible. The main unit may be best mounted in a position somewhere under the dashboard.

As a final test, once the unit is secured into position cover the photocell with a piece of cardboard, thus preventing the daylight from causing the cell current to flow—this will now cause the parking light to switch on.

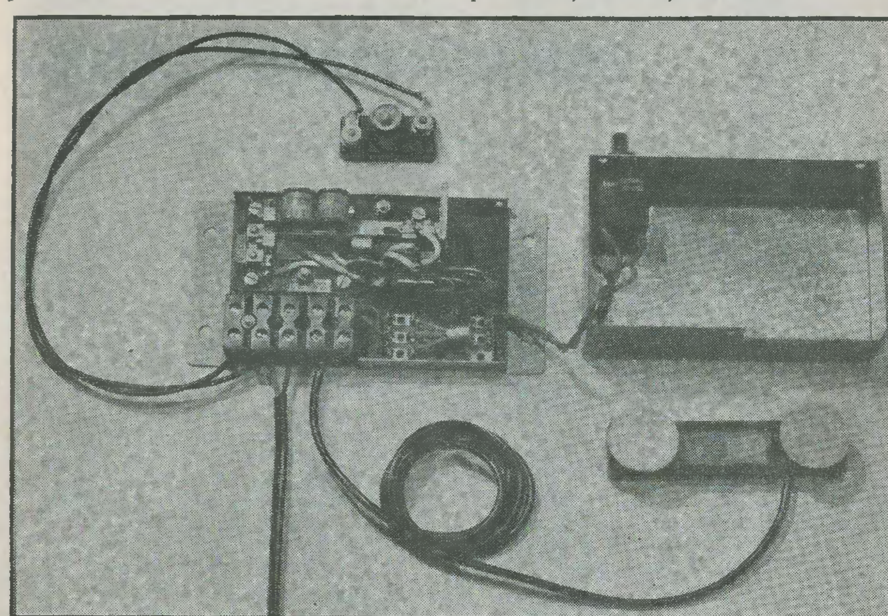
Other Uses

Although this unit has been developed primarily to control a light switch, there are other uses which have been successfully tried and tested over a period of time—all with complete success.

Anyone wishing to receive either an aural and visual warning, or both, when a person or vehicle, etc., enters their premises, may do so by installing a "Liton" unit on one side of the door and a spotlight on the other. Every time the light beam is interrupted, the unit will operate both a warning light and a bell. Such a device is of considerable assistance to garages and other business premises.

circuit of the alarm bell closed until it is manually reset.

Used with a secondary relay, the "Liton" unit may be used as a light saving device in shops, etc. Illuminated windows and signs may be switched on and off, at the right time, according to the time of the year and the prevailing weather. A small mains power pack must, however, be used here.



The component units of the Liton equipment

As a burglar alarm, it could be used in a room illuminated by ordinary electric light in the normal manner. It is always possible to find a place in the room which will provide sufficient illumination for the photocell and on which, should an intruder appear, a shadow will fall, thus actuating the alarm. If, of course, the alarm were to be installed on a permanent basis, then a latching secondary relay must be used to retain the

Components List

Photocell with leads (St. John's Radio)
Relay, drilled and adjusted (St. John's Radio)
Metal case (St. John's Radio)
Connecting block (St. John's Radio)
L.F. transistor, Red Spot or similar
Paxolin panel
Tagboard
On/Off switch
Wire, solder, screws, etc.

Literature Received

We have received from **Henry's Radio Ltd., 5 Harrow Road London, W.2,** a copy of their duplicated publication "Practical Transistor Circuits". Of 22 quarto pages, with stiff card cover, this extremely handy booklet describes in some detail no fewer than 14 do-it-yourself, easy-to-construct transistor circuits. In addition to these items, transistor data and information, hints on soldering, transistor equivalents and diagrams and other useful information is included within the covers. The constructional data includes such items as: Multi-Channel Radio Control Receiver; Crystal Controlled Transmitter; R.F. and I.F. Signal Generator; 250mW Push-Pull Amplifier Stage; R.F., I.F. and Audio Signal Tracers; 2 Watt Car Radio Power Stage; 3 to 12 Mc/s Crystal Marker; Top Band Transmitter; Light Operated Switch; 3-Channel Audio Mixer Unit; Square Wave Generator; Audio Generator; 3-Transistor Hearing Aid and 4-Transistor Baby Alarm. Compiled by D. J. French, GRAD.I.E.E., this publication is available direct from Henry's Radio Ltd. at 2s. post free.

TRANSISTORISED *Quality* MATCHING UNIT

by M. D. Roberts

Introduction

The unit about to be described was designed primarily to match a guitar pick-up to a conventional valve audio-frequency amplifier. Reasonable results can be expected from an ordinary amplifier such as may be found in radio and television receivers, but it must be remembered that power and the quality of reproduction will depend upon the valve amplifier. To save cost in building the matching unit, the coupling capacitors C_1, C_2, C_8, C_{10} can be reduced to any value as low as 8μF to 12μF. C_3 can also be reduced to 50μF to save cost, and C_9 to 25μF. This will affect the quality of reproduction to a minor degree. If the unit is not mounted on the valve amplifier chassis, and the output is isolated by a capacitor, the hum level will be reduced.

The two transistors used were "V10/30A" manufactured by Newmarket Transistors. These are p.n.p. high gain transistors, and the basic circuits used are grounded emitter circuits. The circuit consists of a low impedance input matching circuit feeding a comprehensive tone control circuit, followed by a voltage amplifier stage feeding on to the valve amplifier.

The Circuit

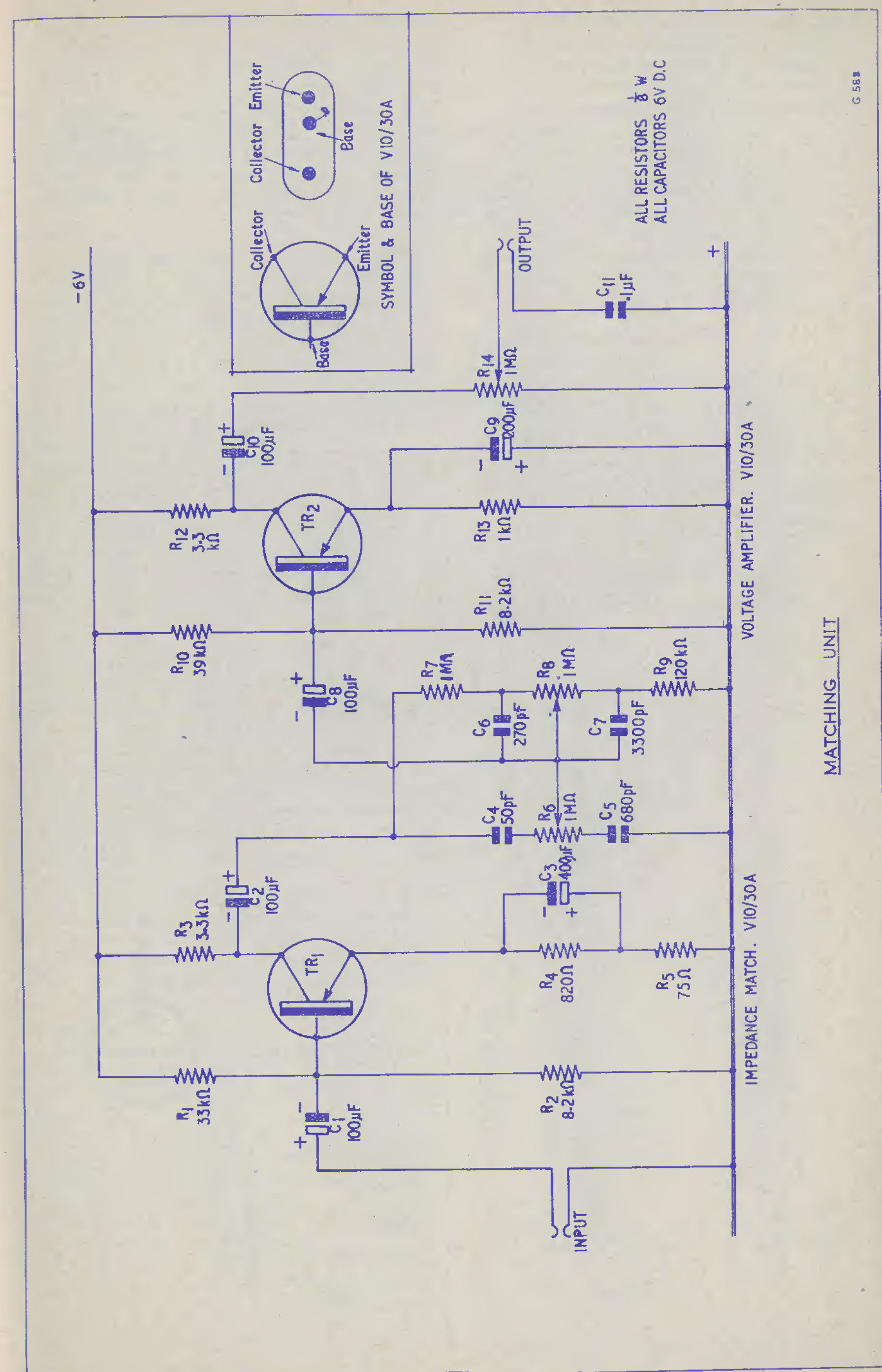
The low impedance output from the guitar pick-up is fed via C_1 to the base of TR_1, which is the impedance matching transistor. The base is biased off by the potential divider formed by the resistor network R_1 and R_2. R_4 and R_5 bias off the emitter, C_3 giving efficient decoupling across R_4. R_5 is not decoupled in order to give bass compensation. Audio frequencies are developed across R_3 and fed to the tone control network via the d.c. blocking capacitor C_2.

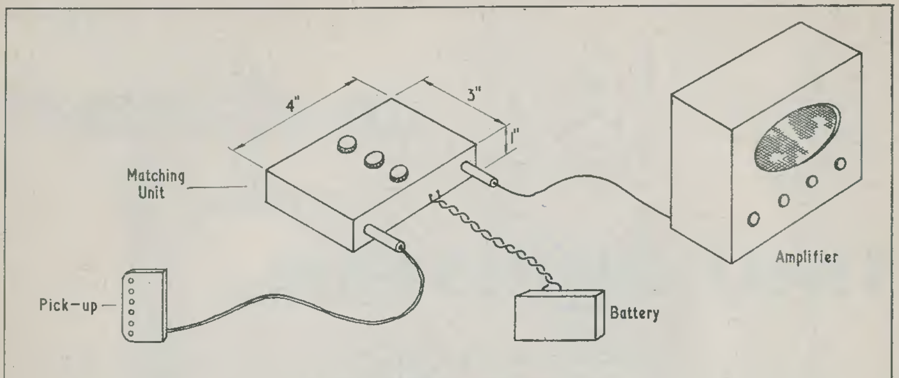
The tone control circuit is a combination of bass boost and top cut circuits. C_4 allows a fixed amount of top to reach R_6, and C_5 tends to form a low capacitance path at top frequencies. The slider on R_6 taps off the amount of top required for compensation and feeds it on to the base of TR_2. For the bass compensation, the top is allowed to go almost direct to the base of TR_2 via C_6, while the bass has to go through R_8 where the required amount of bass compensation is taken off by the slider and applied to C_8, which is the isolator capacitor between the tone control circuit and the voltage amplifier stage. It must be pointed out that the tone control potentiometers are independently set, and are not ganged together on the same spindle.

The amplification stage formed by TR_2 has its base biased off by the potential divider R_{10} and R_{11}. Its emitter is biased off by R_{13}, and decoupled by C_9. The audio output produced across R_{12} is fed via C_{10} to the volume control, and then on to the output jack socket. C_{11} isolates the unit from the valve amplifier in order to reduce hum. The unit operates quite satisfactorily on a 6V supply from a conventional dry battery.

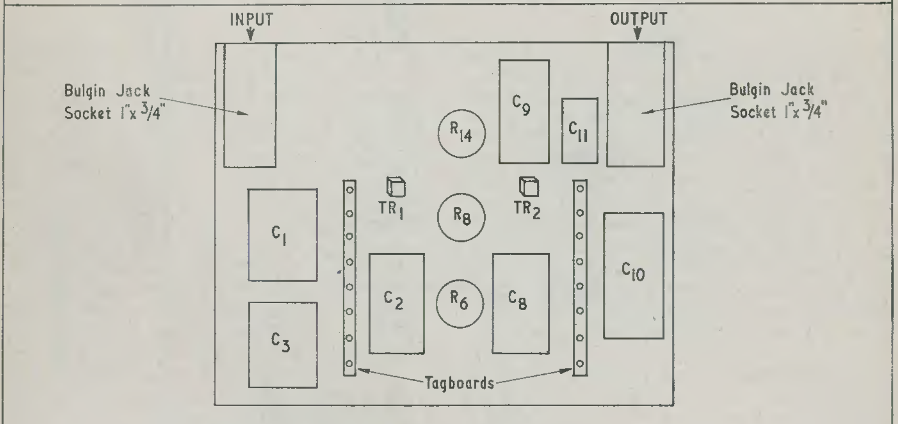
Construction

The writer's particular unit was built in a small Bakelite case 4in x 3in x 1in, which has sufficient space to accommodate all the components if they are miniatures and are carefully set out. If the reader wishes to fit a battery inside the unit a larger case must be used, with facilities for switching on and off. The potentiometers used were miniature "Radio-Spares" types, and the jack sockets were Bulgin miniatures. A reasonable layout can be seen in the diagram where the jack sockets are placed on the same side of the box, but at opposite ends of the box. The potentiometers were spaced down the middle, and in the remaining space the writer put in two tagstrips and positioned the components around them as shown.

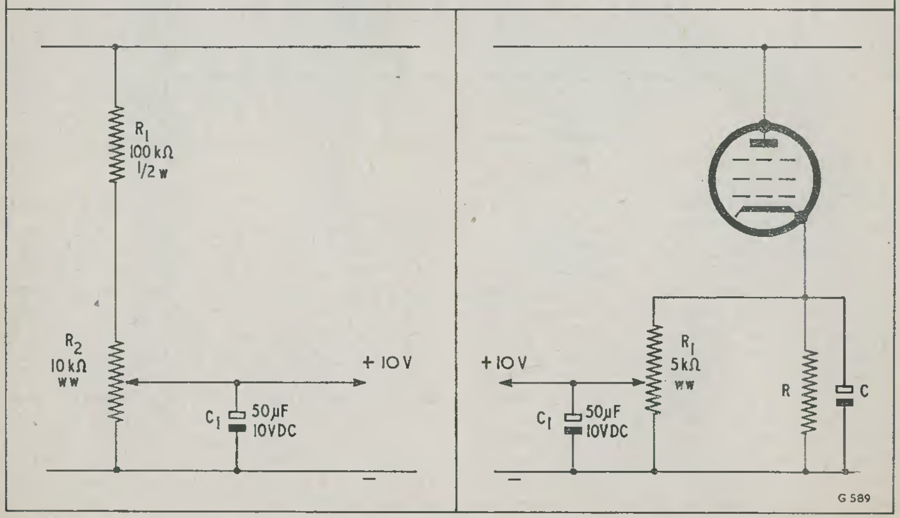




QUALITY MATCHING UNIT



LAYOUT



The transistors were wired as shown in the circuit diagram. Great care must be taken to see that no heat reaches the transistor when it is being wired in. The best thing to do is to wire the transistors in after everything else has been connected, and using a heat shunt. The easiest thing to use for a heat shunt is a pair of long-nosed pliers placed between the transistor joint and the transistor itself.

Power Supplies

The easiest way is to use a 6V battery but, if the constructor wishes, he can run the unit off the valve amplifier. It must be stressed that to do this a reliable high resistance meter must be used to set up the correct voltage.

One method is to place a potential divider across h.t.+ to h.t.– on the valve amplifier. In the circuit shown the required 6V is taken off by the slider of R_2. It must be noted that R_1 is a half-watt resistor.

Another method is to use a cathode follower circuit. This simply means taking a voltage off one of the cathodes in the audio valve amplifier and feeding it through a potentiometer adjustment to give the correct voltage output. If the cathodes in the audio valve amplifier are not decoupled or are used in a negative feedback circuit, this method cannot be used.

Switch-on Instructions

When the unit has been assembled, the output must be coupled to the valve amplifier via a jack plug, and a 6V supply attached which must be placed across the circuit with the correct polarity. If this voltage is taken out of a valve amplifier as described earlier, the voltage must be set to zero, and then attached to the matching unit. The potentiometer should then be adjusted to give the required 6V.

If an audio generator is available, a minute amount of audio can be fed into the matching unit input to test it. Once it has been established that it is working, the guitar pick-up can be assembled on to the guitar, and plugged into the matching unit.

"Alignment"

Reasonable results can be expected from the unit as it stands, but if the best results are required the transistor circuit can be "aligned".

Below is tabulated a set of step-by-step instructions which must be carried out with tone and volume controls set at top of slider.

(1) Replace R_{10} with 47kΩ.
(2) Replace R_1 with a 50kΩ potentiometer and adjust for best results.
(3) Find value of resistance required in place of R_1 and replace it with a fixed resistor, or connect the potentiometer permanently into the circuit.
(4) Insert 50kΩ potentiometer in place of R_{10} and adjust for best results. The main thing to consider at this stage is maximum reduction of distortion.
(5) Find value of resistance required for R_{10} and replace by a fixed resistor, or fix the potentiometer in permanently.

Tone Control

The operation of this has been explained earlier. After each alteration as above the tone controls should be varied to see results.

It must be pointed out that the position of the pick-up on the actual guitar is very important as having it too close to the strings will produce severe distortion, and having it too far away will give weak output.

Suggested Modifications

(1) *Insufficient bass.*
Increase C_6, decrease C_7 (in capacitance); or both.
(2) *Too much bass.*
Decrease C_6, increase C_7; or both.
(3) *Insufficient top.*
Increase C_4, decrease C_5; or both.
(4) *Too much top.*
Decrease C_4, increase C_5; or both.

Components List

All resistors $\frac{1}{8}$W. All capacitors 6V electrolytics.

Resistors

R_1	33kΩ
R_2	8.2kΩ
R_3	3.3kΩ
R_4	820Ω
R_5	75Ω
R_6	1MΩ potentiometer
R_7	1MΩ
R_8	1MΩ potentiometer
R_9	120kΩ
R_{10}	39kΩ
R_{11}	8.2kΩ
R_{12}	3.3kΩ
R_{13}	1kΩ
R_{14}	1MΩ potentiometer

Capacitors

C_1	100μF
C_2	100μF
C_3	400μF
C_4	50pF mica
C_5	680pF mica
C_6	270pF mica
C_7	3,300pF mica
C_8	100μF
C_9	200μF
C_{10}	100μF
C_{11}	0.1μF paper

Miscellaneous

TR_1 V10/30A
TR_2 V10/30A
2 Bulgin jack sockets
1 6V battery

A Simple E.H.T. VOLTAGE TESTER

by A. Youngman

THE NEED FOR A CHEAP, SAFE MEANS OF testing the e.h.t. voltage on a television receiver is, at some time or other, a necessity for most viewers who service their own sets.

The simplest form of testing is to employ the method requiring a certain voltage discharge across a spark gap. This is nothing new, and graphs giving the relationship of voltage to spark gap distance are readily available in a number of textbooks. Such a graph is shown in Fig. 1. It must be pointed out that this graph is based on a spark gap using ball contacts.

graph is almost linear. It will also be noted that the voltage required to discharge across a spark gap of 0.1 of an inch is 10kV. These two basic facts not only provide the foundation for a simple spark gap tester, but also offer a very convenient means of calibration, as will be explained later.

Fig. 2 is a cross-sectional view illustrating the assembly of a suitable tester, but it would only be fair to state that all the component parts will not be easy to find in the junk box. In fact, two of the details (items 3 and 8) were turned on a lathe; although, if a lathe is not available for

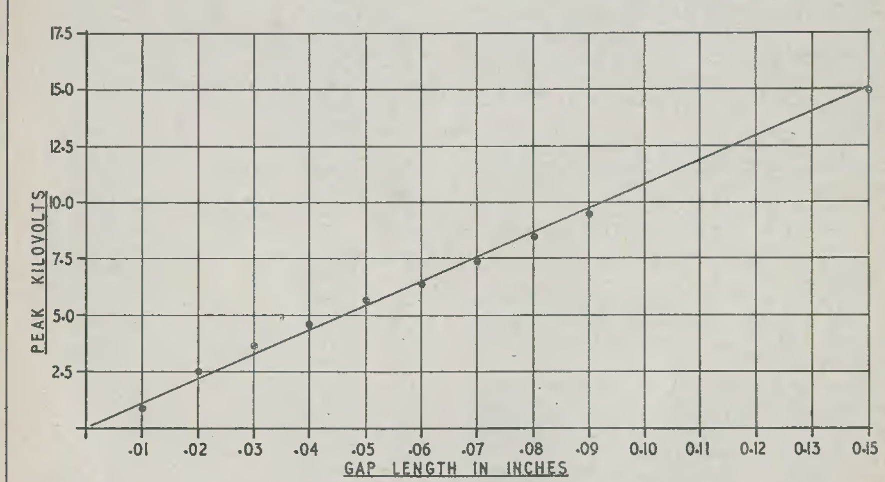
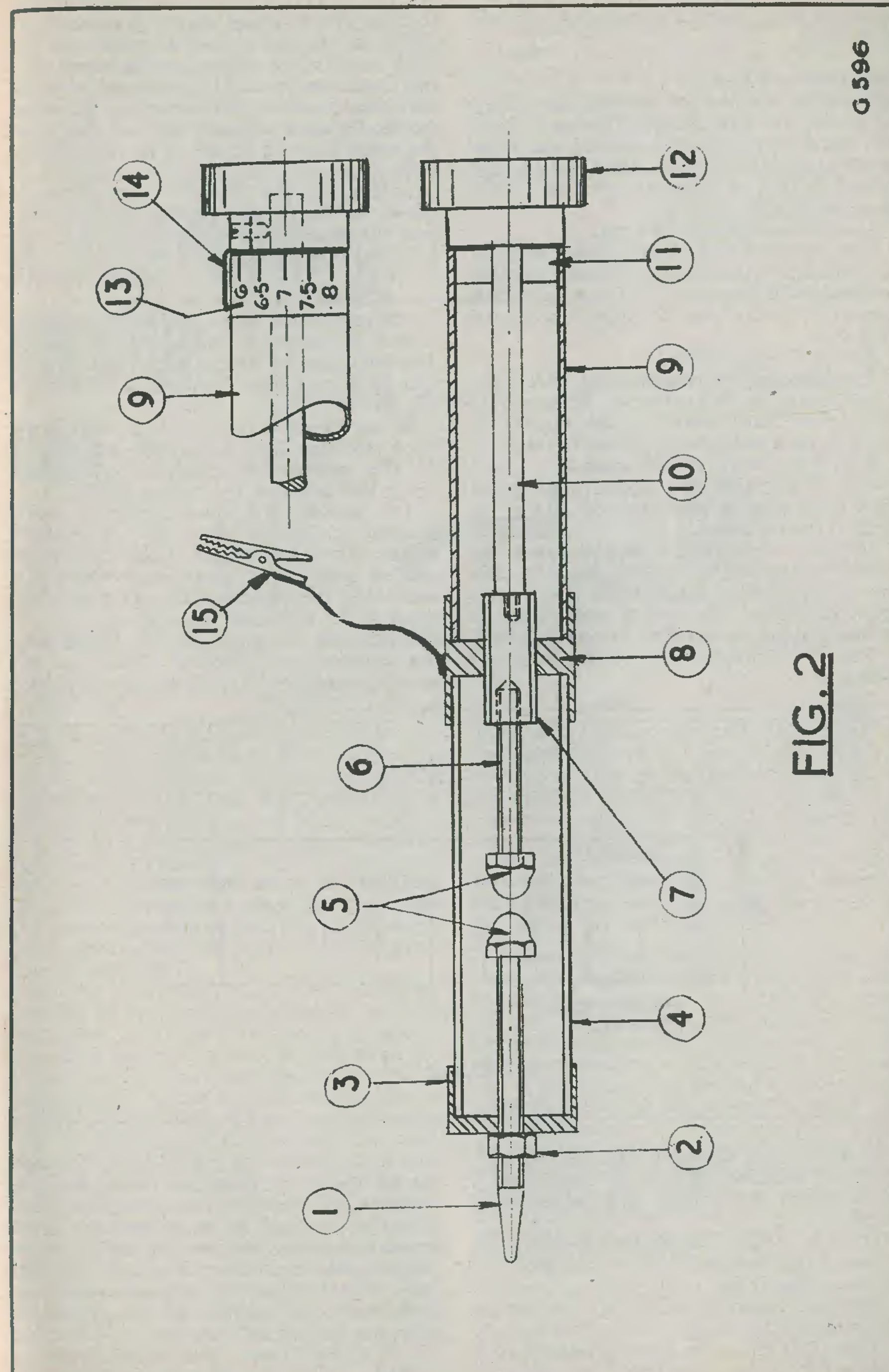


FIG. 1.

The normal working e.h.t. voltage range for most television receivers is in the region of from 8kV to 15kV, and it will be seen from Fig. 1 that over this voltage range the

making these items, it should not be too expensive to have them turned up. Alternatively, provided the principle of construction is not unduly modified, some other form of



assembly using existing parts could no doubt be devised.

Referring to Fig. 2

Item 1 is a probe for pressing against the e.h.t. contact to be tested. This, as with all the metal parts required, should use brass as the material. For this detail a 2BA stud turned, or filed, at one end to provide a taper is quite suitable.

Item 2 is a standard 2BA nut.

Item 3, being one of the turned parts, is approximately 1in outside diameter suitably recessed to fit over item 4. The hole is 2BA tapped to receive the threaded portion of Item 1.

Item 4 is a glass tube.

Item 5 consists of two standard 2BA dome nuts to form the ball contacts. These should be screwed hard home on the threads of items 1 and 6 and lightly soldered to retain.

Item 6 is a length of 2BA stud.

Item 7 ⅜in BSF stud drilled and tapped 2BA x ⅜in deep at one end, and 4BA x ¼in deep at the other end.

Item 8. This detail is approximately 1in outside diameter, suitably recessed to take one end of item 4 (glass tube) and item 9 (paxolin tube). The centre wall is to be drilled and tapped ⅜in BSF to accept item 7.

Item 9. A paxolin tube, similar in size to item 4.

thread. This has been chosen because it has 20 turns per inch. As the spark gap for 10kV is 0.1in, it will be readily noted that two complete turns of the knob will separate the ball contacts this amount. In other words, for each complete turn of the knob, the spark gap will be spaced by multiples of 5kV.

In this way, the calibration chart which is shown in Fig. 3 is quite easily calculated. For the model, the paxolin tube was ⅞in (0.875in) outside diameter.

$\therefore 0.875 \times 3.14 = 2.7475$in, approx. 2.750in.

$\therefore 2.750 \div 10 = 0.275$ each division.

The calibration chart need only consist of a piece of paper cut and marked as shown. The back can be treated with adhesive and then fixed round the diameter of item 9 (see Fig. 2).

By mounting a marker, *Item 14*, on the knob (see Fig. 2) the calibration will operate on the micrometer principle, and give a direct indication of the voltage reading.

The reason for the calibration chart starting at 5kV is that the ball contacts should not be allowed to touch each other, and, as most testing is required between 5kV and 15kV, the ball contacts are set at 0.05in apart as the minimum position.

To do this, the knob must be turned until the contacts are touching. Now set the marker against 5kV on the chart, and tighten

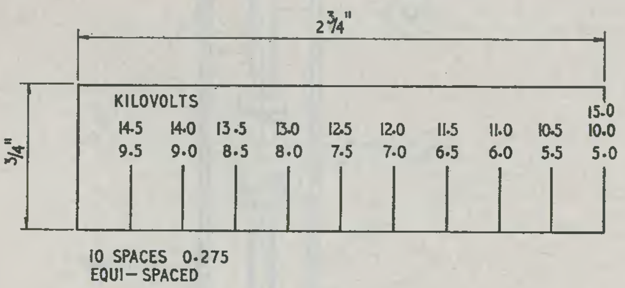


FIG. 3

o 597

Item 10. ¼in diameter paxolin rod with one end threaded 4BA to fit into item 7. Lightly coat the thread with adhesive to retain.

Item 11. This is a bearing for item 10. Material can be either brass or paxolin. Fix as shown in Fig. 2.

Item 12. Standard knob with hole for ¼in diameter shaft.

Item 13. Calibration chart. (See below.)

It will be noted that item 7 is a ⅜in BSF

the knob grubscrew. The knob is then turned back one complete turn when the contacts will be 0.05in apart. The knob grubscrew is then loosened and the knob pressed hard against item 11, at the same time keeping the marker on the 5kV indication. In this position, tighten the knob grubscrew. The readings on the calibration chart are now as follows:

5kV–10kV 1 turn; 10kV–15kV 2 turns.

With a piece of wire soldered to item 8,

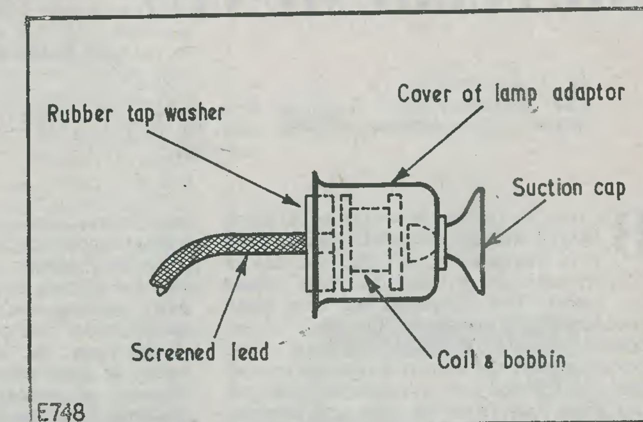
with a crocodile clip (*Item 15*) at the free end, the tester is now ready for service. Fix the crocodile clip to the chassis and press the tapered end of item 1 to the e.h.t. point to be tested. Adjust the knob until the sparking across the gap peters out. The voltage is a direct reading on the calibration chart.

One final word of warning. Item 1 when in contact with the e.h.t. point is at high potential. The hands should therefore be kept well away from items 1, 2 and 3. If the tester is operated by holding the paxolin tube in one hand, with the knob in the other, the tester is quite safe.

MISCELLANEOUS

A TELEPHONE PICK-UP COIL

by **A. H. S.**



WITH THE INCREASED POPULARITY OF tape recorders, especially of the less expensive type, a suggestion for the construction of one of the accessories—a telephone adaptor—may not be out of place.

This is a device by which a two-way telephone conversation can be recorded; there is no direct connection to the telephone as inductive coupling is employed and, since the only component necessary is an inductor, it was decided that it would be comparatively easy to construct.

In the first experiment, the secondary winding of a microphone induction coil was employed; this was mounted in a plastic container, and placed close to the rear of the telephone. It was then connected via a screened lead to the microphone input of a tape recorder, a telephone test call was made, and the recording of the two-way conversation proved to be very promising.

The finished article was now contemplated with the intention of being able to attach it to the telephone by a suction cup; this necessitated a much smaller and lighter unit. Again a ready-wound inductor was sought, and one small enough was forthcoming in the shape of a coil from an old pair of high resistance headphones. With a different coil, two or three soft iron nails could be placed in its centre to act as a core; they could be separated from each other and held in place with wax. It was not, however, essential in this case, as a soft iron sleeve existed. The current induced into the coil is due to the electro-magnetic field from within the telephone base, and since stray electrostatic pick-up was undesirable it was minimised by taking the screen of the connecting lead to the outside connection of the coil.

A pleasing finish was obtained by using the cover of a bayonet adaptor, of the type used to make connection to domestic lamp holders; it was found that the round moulded end of a small suction cup fitted very neatly into the cable entry of this. Part of the round end of the suction cup was cut away to allow more room within the cover, in which the coil was placed, with its core in line, whilst the open end was sealed with a rubber tap-washer, the hole of which served as a cable entry for the screened lead. Fortunately, all the items were obtained in black, which enhanced the appearance of the unit, and which also matches the telephone.

Maximum pick-up is obtained when the adaptor is attached to the right side of the telephone—it must be positioned towards the rear and base.

INVENTIONS *and* DEVELOPMENTS *of* 1959/1960

by **Peter Penlenham, A.M.S.D.B.**

Our contributor gives details of some of the more interesting new electronic devices with whose development over the past year he has personally been associated

BECAUSE OF THE CONTINUALLY INCREASING field of activity embraced by electronics, it is frequently stated that the day of "kitchen-table inventions" has now passed into limbo. This allegation has been given considerable prominence by leading engineers, on the grounds that the basic foundations of the electronic art are now so firmly established that all future development may stem only from the vast and complex mass of data already in existence. Such developments will require equipment and facilities far in excess of what is available to the "kitchen-table worker".

Over the past few years I have repeatedly shown that this view is completely false, and have given proof of its fallaciousness by the devices which I have successfully developed, myself, with extremely limited resources; devices, I may add, which have subsequently found wide and profitable markets. In this article I give details of several of the latest contrivances with which I have been personally associated over the last twelve months and which will be put into production in the coming year. These inventions were quite literally developed on my own kitchen table; the fact that my family cook and eat in the living room being, I submit, irrelevant.

Electronic Towel Dispenser

Anything which is done mechanically can usually be done at least as well, if not better, by electronic means. Such were my thoughts when, a year or so ago, I encountered the mechanical towel dispensers which have been introduced into many factory and insitution wash-rooms, as well as on a number of British Railway coaches. The manner in which such dispensers function will be familiar to the very many readers who have encountered them. A loop of towelling approximately eighteen inches wide hangs from the dispenser, which is mounted on the wall some seven feet or so above floor level. After washing one's hands one proceeds to the dispenser and pulls down the front part of the loop. At once some six to twelve inches of clean towelling appears, the same amount of soiled towelling being automatically taken back into the dispenser from the rear part of the loop. The amount of clean towelling dispensed is sufficient for the drying of one's hands, and no more may be pulled down until a short time has elapsed. It thus becomes possible for every person using the dispenser to obtain sufficient clean towelling for his own particular purposes without the risk of the supply being exhausted too quickly by those who attempt to extract more towelling than is required for their immediate needs.

The operation of these devices is purely mechanical. In my invention I have removed almost all the mechanics and have established the operation of the dispenser on sound electronic lines. Fig. 1 illustrates the layout of the Penlenham Towel Dispenser. A roll of clean towelling, A, is stored at the back of the machine, one end of this passing through the two Charge-Feed Rollers, B and C. After passing through these rollers the towelling emerges through slot D in the front of the machine, from which it depends in a graceful loop of convenient length. The rear of the loop returns to the dispenser through slot E and passes through Return-Feed Rollers F and G, finally being taken up on the Soiled Towel Magazine H. A train of simple gears couples the Charge-Feed Rollers to the Return-Feed Rollers with the result that, when a portion of towelling is pulled through the Charge-Feed Rollers, a similar amount is taken back by the Return-Feed Rollers.

Also shown in Fig. 1 are the Charge-Feed Generator J and the Roller Stop Solenoid K. These are the two major components in the electronic section of the dispenser, and they appear in the circuit diagram given in Fig. 2. This circuit functions in the following manner. When a length of towelling is pulled from slot D, the Charge-Feed Rollers rotate. These are coupled by step-up gears to the Charge-Feed Generator which revolves rapidly, causing a charging current to flow into condenser C via the rectifier. As soon as a sufficiently high potential appears across the plates of the condenser the Roller Stop Solenoid operates. The armature of this solenoid forces a pin between the teeth of two of the gears coupling the Charge-Feed and Return-Feed Rollers, thereby bringing the whole mechanism to a jarring stop and preventing the supply of any further towelling At once the Charge-Feed Generator ceases to rotate, with the result that it provides no further charging current to the condenser. The condenser cannot discharge into the windings of the now-stationary generator, however, because the flow of discharge current is prevented by the rectifier. In consequence the condenser can discharge only into the coil of the Roller Stop Solenoid. This coil has a relatively high resistance and some time elapses before the discharge current flowing through it is sufficiently low for the solenoid to de-energise. Immediately the solenoid de-energises the roller mechanism is freed, and a further supply of towelling may be pulled from the machine. As will be immediately gathered, the simple electronic arrangement of Fig. 2 replaces what may well be a complex and intricate mechanical assembly.

Of particular advantage in the electronic towel dispenser is the ease with which variations in performance may be obtained. Thus, should it be desired to increase the time between which successive lengths of towelling may be dispensed it is merely necessary to fit a larger value condenser. Similarly, the amount of towelling which may be pulled out at each operation can be increased by inserting series resistance between the Charge-Feed Generator and the rectifier.

An especial feature of the dispenser, omitted for reasons of clarity from the diagrams, is the Random Jamming Device. It is this feature which makes the performance of the electronic dispenser completely equivalent to that of its mechanical counterpart. The Random Jamming Device operates from a combination of temperature and barometric readings. When these readings

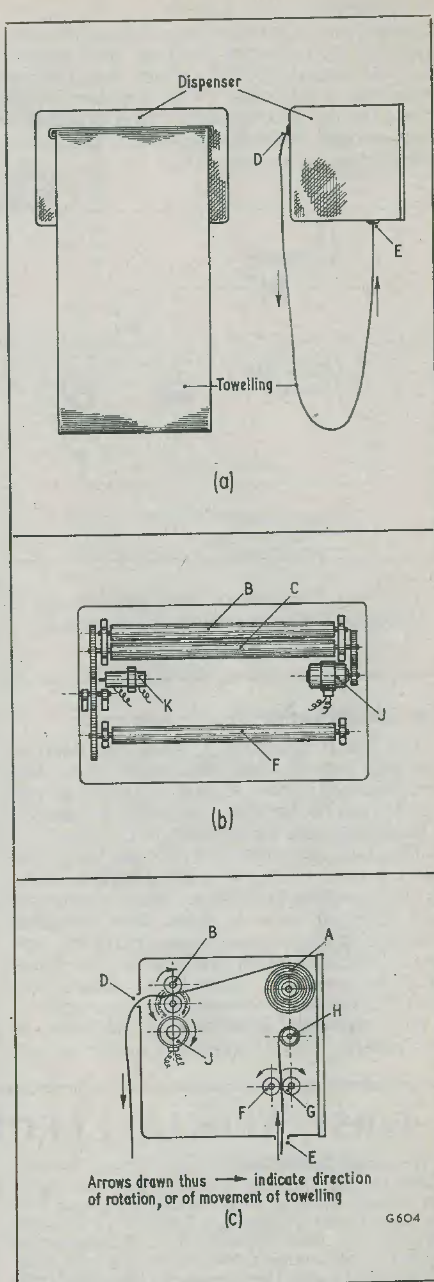


Fig. 1 (a) Front and side views of the towel dispenser. (b) Front view of the internal mechanism. (c) Side view of the internal mechanism satisfy a particular requirement built into the machine the dispenser locks up solid, and it is quite impossible to extract any further towelling whatsoever. The Random Jamming Device is completely tinker-proof and may only be freed by a qualified electronic engineer.

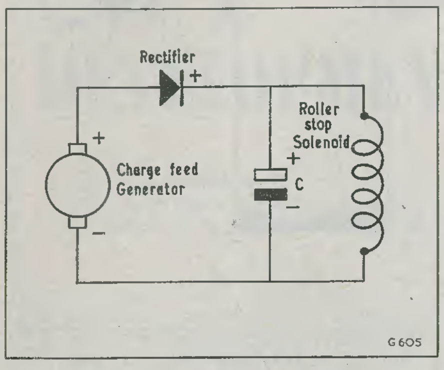


Fig. 2. The circuit employed in the dispenser. The condenser is an electrolytic component

Car Immobilisation

The final invention I wish to describe requires less detailed description than the two discussed above. Again, and this is surely a reflection on present-day moral standards, it has to do with the prevention of crime.

The theft of unattended cars has for many years been a source of considerable anxiety to the motoring fraternity. Many motorists take especial care to lock their vehicles securely; even, on occasion, carrying out simple immobilisation procedures—but none of these measures prevent the determined thief from making off with their property.

As is my usual practice with problems of this nature, I investigated the matter of car thefts from purely fundamental principles. Research into a large number of cases revealed three basic facts, two of which I will discuss immediately. The first of these two basic facts is that a stolen car is, *ipso facto*, broken into, started up, and driven away. The second is that, under normal parking conditions, a car cannot be started unless it has (*a*) a battery and (*b*) a starting handle (if applicable to the make and model). Following the rules of logic a perfectly sound conclusion may be drawn from these two premises: a car cannot be stolen if it does not have a battery and a starting handle. This is because one of the requirements for the theft (that the car be started) cannot be satisfied.

I have, in consequence of these findings, introduced the Swift-Release Car-Sentinel Accumulator. This Accumulator has the same performance, dimensions and weight as a conventional car battery, and it is available with the standard terminal potentials of six or twelve volts. When a car fitted with the Swift-Release Car-Sentinel Accumulator is parked, all the driver has to do is to open the bonnet, release the quick-action clamps and connectors, and take the accumulator away with him. The car is then rendered completely secure from theft. Available with the accumulator are a set of accessories, these consisting of tastefully finished holders which, for instance, enable the accumulator to be safely carried whilst shopping, or which allow it to be taken into the theatre or cinema where it may be conveniently stored under one's seat. The starting handle, where applicable, has also, of course, to be carried.

I referred a little earlier to two of the three basic facts which caused me to introduce the Swift-Release Car-Sentinel Accumulator. The third of these is that no car-thief will ever look for plunder whilst burdened with a spare accumulator. If he did he would be as big an

APRIL FOOL

as any other mug who walked around carrying a car battery.

FIRST WEEKLY ELECTRONICS NEWSPAPER

Heywood & Company Ltd., Drury House, Russell Street, London, W.C.2, will next September launch the first ever weekly newspaper for the electronics industry. Tabloid newspaper format has been chosen for "ELECTRONICS WEEKLY" following investigation into technical readership by the Department of Scientific and Industrial Research. Its report proved that the industry wanted news and more news, and this was confirmed by Heywood's own research team.

"ELECTRONICS WEEKLY" will provide this requirement for the industry in comprehensive and flexible form giving a wide news coverage to all aspects of the industry, including new developments in manufacture and application, components, materials, production techniques, commercial and financial news, as well as a full coverage of overseas developments.

Under the sub-head "the Newspaper of the Industry", "ELECTRONICS WEEKLY" will appeal to manufacturer and user, as well as to management and scientific staffs.

Initially, circulation will be available only to registered readers on payment of a nominal registration fee; but plans are in hand to meet a demand through bookstalls at 4d. per copy.

A UNIVERSAL TEST LEAD

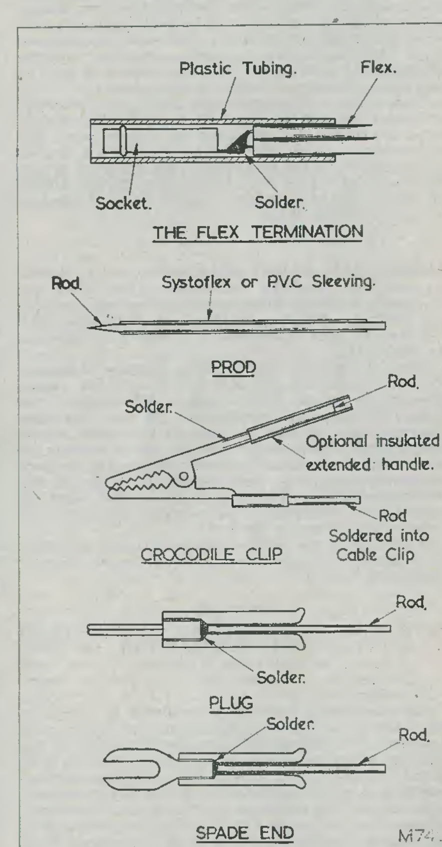
A suggestion for test leads and their terminations

by **C. J. Ashford**

MOST RADIO TEST EQUIPMENT BUILT BY constructors requires test leads. Most of these leads are pieces of wire with a prod or clip permanently attached to the end, but without much trouble some very versatile test leads can be made. The best wire to use is the unbreakable plastic-covered type as advertised for use with electric razors, though twin extruded plastic flex could be used if necessary. The actual length of the lead is in the hands of the constructor, but 12in is a good length for C.R.L. bridges, etc., and 20in–30in for multimeters, etc. There is ample insulation on these leads for 750V a.c. if properly made, and they will carry 5–7 amps comfortably.

Cut the lead at the required length and strip off the insulation for $\frac{1}{4}$in on both conductors and at both ends. Take a B4 or B5 paxolin valveholder with riveted sockets, file off the rivet heads and remove the sockets. The tags should be cut to $\frac{1}{8}$in wide and $\frac{3}{16}$in long. Obtain some plastic tubing (fuel piping can be used) that just slips over the valveholder sockets that have been removed. Cut off a $1\frac{1}{2}$in length of tubing and slide it back over the wire. Solder the stripped wire to the tag. Then generously cover the joint and socket with adhesive (Bostik or Evostik preferably) and slide the plastic tubing over the joint, using a turning motion to spread the adhesive over the wall of the tube. When the tubing is over the end of the socket, draw the tip of the socket $\frac{1}{8}$in inside the tubing so that accidental contact is almost impossible. Repeat this operation for the other end of the lead (if required) and for any other leads. Leave aside for 12 hours to allow the adhesive time to evaporate.

Into this socket can fit any one of four basic terminations, i.e. crocodile clip, prod, plug and spade end. The diagrams of these should be largely self-explanatory. The brass rod (tinned galvanised iron wire is a satisfactory substitute) should be of suitable diameter to hold nicely in the socket. Any insulation shown should be affixed by an adhesive. The prod could be of the insulation piercing type as in the September 1959 issue, suitably adapted. If two leads are going to be used for a multimeter, etc., a plug or spade



end can be used normally on the other end of the lead. Coloured insulation can be used.

The author of this article has been using these leads for 15 months now and they have been entirely satisfactory in every way.

Book Reviews

W. E. THOMPSON

SHORT WAVE RECEIVERS FOR THE BEGINNER: Compiled by Frank A. Baldwin, A.M.I.P.R.E. 72 pages, 63 diagrams and illustrations. Published by Data Publications Ltd., 57 Maida Vale, London, W.9. Price 6s., post 5d.

In preparing this latest addition, No. DB14, to the Data Book Series, the compiler has used much of his own published material and some by other authors, to present for the newcomer several good designs for simple equipment which they can readily build themselves. There are ten versions of five basic receiver designs, three of them being dealt with in such a way that progression from very simple to more complicated equipment is achieved by following the step-by-step instructions.

The introductory chapter teaches the tyro the basic principles of radio wave propagation conditions, aerials, listening on the broadcast and amateur bands, how to calibrate and operate a short wave receiver, and gives hints on c.w. and phone operation, and the all-important pastime of QSL-ing. There is also an instructive chapter on how to solder properly.

Each design is illustrated with clear circuit diagrams and constructional drawings. Many of the photographs serve admirably for guidance in construction, and perhaps are easier to follow than a drawing if a receiver is being built for the first time. This is a good primer for those who feel the desire to take up radio as a hobby, and the quality of production is up to the usual standard of the Data Book Series.

AUSTRALIAN RADIO AMATEUR CALL BOOK (1959–60 Edition). 148 pages. Compiled and published by the Publications Committee, Victorian Division, Wireless Institute of Australia, P.O. Box 36, East Melbourne, C.2, Victoria, Australia. Price A6s.

When this register of Australian amateur stations is compared with, say, the R.S.G.B. Call Book, one is immediately struck by the great difference in the density of "amateur" population. To find that there are only nine licensed stations in the whole of the Northern Territory, seven of which are in Darwin (in the north), one in Alice Springs (in the south), and one apparently operating permanently portable in the territory of South Australia, it seems that what we know as rare counties in this country are virtually overcrowded with amateur stations!

In addition to the well-compiled register of call signs, there are several pages of useful information in this handy little book.

REVIEW OF THE SERVICES OF THE LEAD DEVELOPMENT ASSOCIATION IN 1958. 24 pages. Available free of charge from the Lead Development Association, 18 Adam Street, London, W.C.2.

The Association offers this handbook to interested organisations so that they can appreciate the progress made since the Association was formed in 1953 by the principal Commonwealth producers of lead. Brief details are given of the technical and other services available to members, the research that has been done, and notes on films and lectures either given or available.

One of the Appendices tabulates the consumption in the United Kingdom of various lead products from 1949 to 1958. This represents a consumption of more than three million long tons over the period, and the figures make interesting reading. Solder, for instance, has been consumed at the rate of about 12,000 long tons per annum.

The handbook is not likely to appeal to many readers of this journal, but it does give a reader a very good appreciation of what the Association is doing to improve lead products.

R.S.G.B. AMATEUR RADIO CALL BOOK (1960 Edition). Edited by John Clarricoats, O.B.E., G6CL. 72 pages. Published by the Radio Society of Great Britain, New Ruskin House, 28–30 Little Russell Street, London, W.C.1. Price 3s. 6d., post 6d.

This latest edition of the *Call Book* is again compiled from information made available to the Society from official sources and is as near up-to-date as it is possible to make it at the time of going to press. It so happens that the writer of these notes is also kept informed of the changes in amateur station call signs that occur weekly, and he was not a little surprised to find there was an insignificant delay in presenting the true state of affairs at the time of publication.

Maintaining accuracy in such a register is no mean task, and so far as the present writer can see there are no errors to catch the eye, though it is again a source of wonder to him that the station address of GW3MQL is shown as being in the newest rare Welsh county of Inverness!

A certain feeling of loss is experienced on noticing that the two pages given over in previous editions to country prefixes are omitted, but one must concede that this has been done advisedly in order to keep down the cover price in the face of rising costs. With this thought in mind, and with due regard to the value which radio amateurs must surely attach to this essential part of their stations, the price is indeed modest for this handbook; there is, of course, no other English publication of its kind.

TUBE AND SEMICONDUCTOR SELECTION GUIDE, 1958–59. Compiled by Th. J. Kroes. 158 pages. Published by Philips Technical Library. Obtainable in England from Cleaver-Hume Press Ltd., 31 Wright's Lane, Kensington, London, W.8. Price 9s. 6d.

Designers requiring a ready means of assessing the application of valve types, or needing a quick cross-reference for interchangeability, will find this handbook of value. The eight clearly-marked sections contain an extensive index of valve and semi-conductor types, valves for receivers and amplifiers, cathode-ray tubes, transmitting valves, valves for microwave equipment, industrial valves (rectifiers, thyratrons, ignitions, etc.), miscellaneous valves (stabilisers, counter tubes, triggers, etc.) and semiconductors.

Each section comprises an interchangeability list showing near or direct equivalents, preferred types, and a replacement guide where applicable.

Although this book necessarily directs attention to Philips's valves, it should be remembered that in this country the same valve types, often with the same type-numbers, are available in the Mullard range. It should also be mentioned that the interchangeability lists include many valves in the CV range.

1960 COMPONENTS CATALOGUE. Home Radio of Mitcham Ltd., 187 London Road, Mitcham, Surrey. 127 pages, and Index. Price 2s., post 9d.

How refreshing it is to find such a fine catalogue as this in one's hands! A glance through its pages should surely dispel the plaintive belief that the home constructor is no longer catered for. Not only does one see a vast range of components and commercial equipment listed; there is, wherever possible, adequate description and prices quoted for everything the intended purchaser might need, and many of the items available from stock are illustrated.

It is many a long day since this sort of catalogue was produced, well printed on art paper and set out in legible and orderly fashion. One has the feeling that the cost of production is well in excess of the modest price asked.

MULTIVIBRATOR CIRCUITS. By A. H. Bruinsma. 76 pages, 41 diagrams. Published by Philips Technical Library. Obtainable in England from Cleaver-Hume Press Ltd., 31 Wright's Lane, Kensington, London, W.8. Price 9s. 6d.

This book is an introduction to another volume on practical robot circuits by the same author, and a full understanding of the circuits for robots requires the knowledge of multivibrators that this smaller book provides. The subject is dealt with logically from basic principles to complex circuit configurations. For its small size, the book covers a wide range of techniques and sets out to explain the several parameters and circuit states that are inherent in this particular valve application.

The treatment is essentially non-mathematical, and component values are not given, but this is merely because the text is designed to explain rather than specify. The discussions on waveforms and pulse shapes will provide many with information that will enable them to appreciate the problems of such circuit design, and the way they can be overcome.

PRACTICAL ROBOT CIRCUITS. By A. H. Bruinsma. 144 pages, 65 diagrams and illustrations. Published by Philips Technical Library. Obtainable in England from Cleaver-Hume Press Ltd., 31 Wright's Lane, Kensington, London, W.8. Price 17s. 6d.

The author of this book has had considerable experience in designing circuits for model control and robots. This present volume is full of interest, and contains many ingenious ideas. A large part of the book is devoted to the design of circuits for a robot animal and the problems of construction which were encountered. Introductory chapters explain how circuits were evolved for emulating the senses of sight, hearing and touch. The "animal" born of these conceptions is almost human—it can respond to what it sees, hears and feels, and can even be made to respond to changes of temperature. The description of the way this robot is made to walk about in different directions is of itself absorbing and interesting to read.

The latter part of the book deals with a robot "thinking" machine capable of taking on all comers, however expert they may be, at "Noughts and Crosses". Here, again, brilliant ideas in electronic circuitry are evident.

The apparatus depicted in the illustrations conveys a first impression of vast complexity, but when the basic circuits are explained and analysed the reader readily appreciates that much of the equipment is repetitive. Nevertheless these robots, interesting though they are, will not be the kind of apparatus that amateurs are likely to build, unless they possess patience in plenty and huge sacks of money.

THE TRANSISTOR ERA. Edited by C. C. Gee and Charles A. Marshall, B.SC., A.M.I.E.E. 96 pages. Published by Heywood & Co. Ltd., Drury House, Russell Street, Drury Lane, London, W.C.2. Price 5s.

There is a tremendous amount of reference data contained in the many large (11½in x 8½in) pages of this handbook. Not only does it set out details of almost every known semiconductor device available; it also gives long lists of manufacturers and their addresses. Valuable information concerning components and accessories is also given.

A small team of eminently qualified authorities contribute chapters on each device. The fields they cover consist of fundamentals of semiconductors, the state of development of diodes, the world position of semiconductors, a report of progress in British transistor manufacture, a survey of semiconductor photo-sensitive devices, etc.

Quite clearly a prodigious amount of work has gone into the compilation of material for the book, which has all the signs of becoming, if not already being, an essential book for those who are actively engaged in the development of equipment employing semiconductors. The Buyers' Guide will prove invaluable to many.

CIRCUITS FOR AUDIO AMPLIFIERS. Prepared by the Mullard Technical Services Department. 136 pages, 182 diagrams and illustrations. Published by Mullard Ltd., Mullard House, Torrington Place, London, W.C.1. Price 8s. 6d.

When the Mullard 5-valve 10-watt amplifier design appeared some five years ago, it quickly became popular as one which gave excellent reproduction yet was fairly easy to build. From time to time, further designs were produced, each one of which was described in its own handbook. This present book brings together a good selection of audio equipment designs, some of which are no longer available in their original handbooks.

Twelve designs are given: 20-watt, 10-watt and 3-watt amplifiers, a 7-watt d.c./a.c. amplifier, a two-valve and a three-valve pre-amplifier, a four-channel input mixing pre-amplifier, a 3-watt tape amplifier, a tape pre-amplifier, a 7-watt and a 3-valve stereophonic amplifier, and a stereophonic pre-amplifier. Each of these designs is described in full detail, and profusely illustrated with diagrams, constructional drawings, and photographs. Four preliminary chapters deal with amplifying systems, sources of distortion, high-quality amplification, and general notes on construction and assembly.

The book is very good value for the amount of information it contains, and is a useful reference book. Furthermore, it is particularly well produced and printed on good quality paper.

THE PRACTICAL HI-FI HANDBOOK. By Gordon J. King, ASSOC.BRIT.I.R.E., M.I.P.R.E., M.T.S. 224 pages, 158 diagrams and illustrations. Published by Odhams Press Ltd., 96 Long Acre, London, W.C.2. Price 25s.

Having had the opportunity to review some of this author's books recently, the writer of these notes has come to recognise that any new one from the same source is more than likely to be of high standard, and dealing with the subject in an original manner. This volume has much to commend it; it is very readable because the author can explain his meaning in a way which is talkative, while at the same time conveying a sense that he knows what he is talking about.

Throughout this book one sees that not only does the author have a good knowledge of theory; there are the obvious signs of practical experience being brought to bear in order to clarify his statements. Quite often, he points to troubles which might be encountered, and how they can be recognised, identified, and rectified. The drawings and diagrams are also worthy of mention, for they help considerably because they are invariably simple, well-drawn, and to the point.

The work covers high fidelity from fundamentals to stereophony, with chapters on voltage amplifiers, power amplifiers, feedback and control circuits, loudspeakers and enclosures, disc recording, pick-ups and record playing equipment, microphones, mixers, and the use of tape. One chapter is devoted to the tracing and clearing of faults in amplifiers.

BRIMAR VALVE AND TELETUBE MANUAL No. 8. 374 pages and Price List. Published by Standard Telephones & Cables Ltd., Valve Division, Footscray, Sidcup, Kent. Price 6s.

This useful handbook seems to get bigger and better as time passes. This latest edition contains data on many new valves now available, and details of components which have not appeared in previous issues. The section on circuits has been revised and enlarged, and contains some interesting designs for transistor applications.

The data on SenTerCel replacement rectifiers, contact-cooled rectifiers, cracked carbon high-stability resistors, germanium diodes and transistors provides new and useful information.

Characteristic curves for several of the newer type valves are given, and the revised system of presenting the curves for rectifier valve ratings considerably simplifies design procedure.

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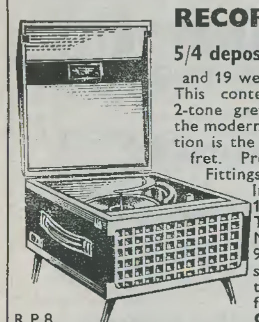

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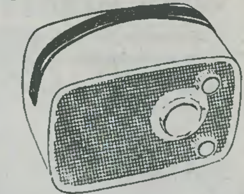

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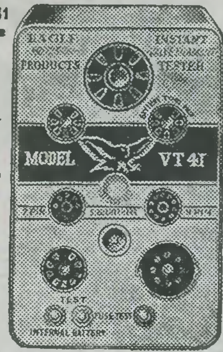

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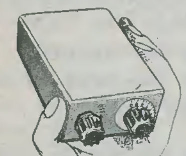

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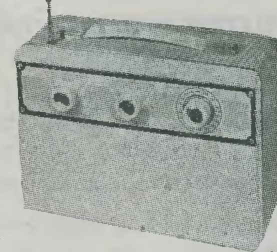

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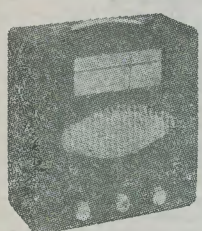

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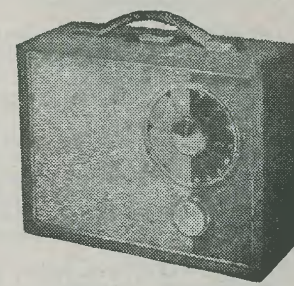

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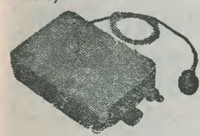

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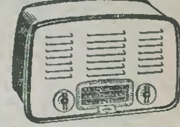

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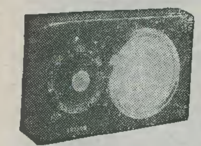

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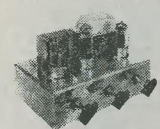

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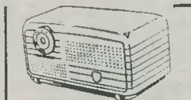

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