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THE "LUDFORD" SINGLE-VALVE RADIOGRAM, Part 3

VOLUME 13
NUMBER 1
AUGUST
1959

The RADIO Constructor

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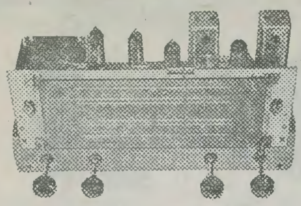

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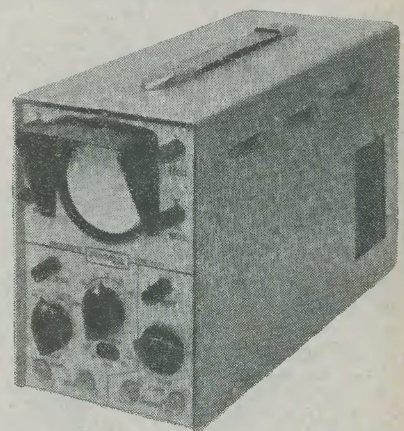

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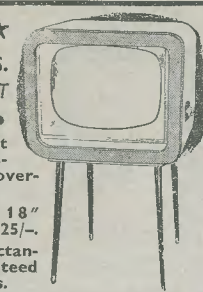

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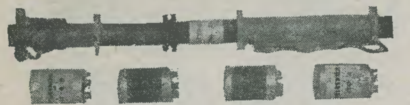

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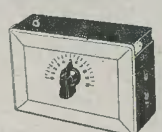

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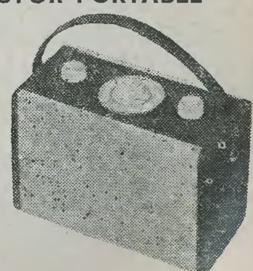

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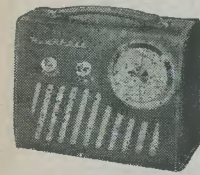

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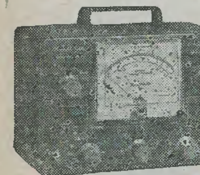

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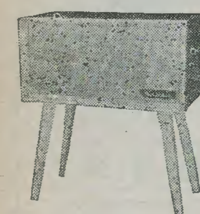

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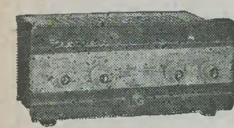

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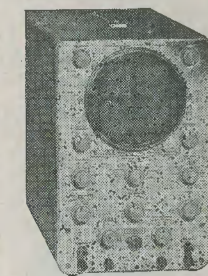

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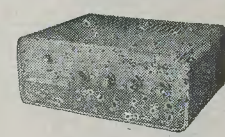
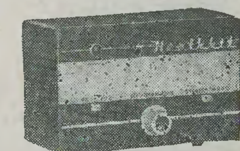


HI-FI STEREO AMPLIFIER S-88



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CONTENTS

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THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams 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.

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AUDIO

suggested circuits

No. 105 An Electronic Balance Indicator for Stereo Amplifiers

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

In a stereophonic reproducing system it is necessary for two basic requirements to be satisfied if the full stereophonic impression is to be realised. The first of these requirements is that the loudspeakers in both channels should be fed with signals having correct phasing, and the second is that volume levels at the loudspeakers should have the correct relationship to each other. Correct phasing is not difficult to achieve, as all that is normally necessary is careful attention to wiring polarities when the equipment is initially installed and set up. (Phasing switches which reverse the polarity on one channel are fitted to some amplifiers.) The question of the relationship between loudspeaker volume levels is, however, more difficult to solve because it is usually necessary to judge this relationship by simple listening tests. A "balance" control is fitted to all currently manufactured stereophonic amplifier systems, this control varying the gain ratio of the two channels and having, normally, a range of adjustment of some ±6dB. (If gain in each amplifier is equal, such a balance control enables a difference between loudspeaker levels of 6dB to be achieved at either end of its range.) Setting up a balance control is not a simple task when volume levels have to be judged subjectively, and it is especially difficult if the control cannot be adjusted from the normal listening position.

This month's *Suggested Circuit* gives details of a simple and relatively inexpensive indicator which is capable of registering balance in a stereophonic system by electronic means. The indicator has a high level of sensitivity and, apart from two resistors, requires no components or valves which are critical. The device is intended for use with systems which reproduce discs rather than tape, and which have push-pull output stages and identical loudspeaker systems in both channels.

Operation

The balance indicator functions on the principle that, if a stereo pick-up plays a monophonic (single-channel) record, the output fed to both channels is equal and in phase.* As a result, assuming equal gain in both channels, the amplified signals in the output stages of both channels should be similarly equal and in phase. When the output stages are push-pull it becomes possible to connect to two points having equal signal amplitude and opposite phase, these points being at the two output anodes indicated by "X" in the typical example of Fig. 1. This diagram also shows two equal-value resistors connected between the output anodes, and having their junction connected to a signal level indicator. Under conditions of equal gain in either channel the signal level at the junction of the two resistors is zero. If, due to inaccurate balance, one channel of the system provides more gain than the other, a signal appears at the junction of the two resistors and its presence is registered by the indicator.

In the device described here the indicating device consists of a magic eye following an amplifier, zero signal level at the junction of the two resistors corresponding to maximum shadow. The process of setting up the balance control is then carried out in the following manner. A monophonic record is played by the pick-up and the balance indicator switched into circuit. The amplifier balance control is then adjusted for maximum shadow in the magic eye, after which the indicator is switched out again and the system is ready for reproduction of stereophonic discs.

* Due to differing stylus radii, a pick-up intended purely for stereo may cause slightly increased wear on monophonic records. This point should be borne in mind when the balance indicator described here is employed.

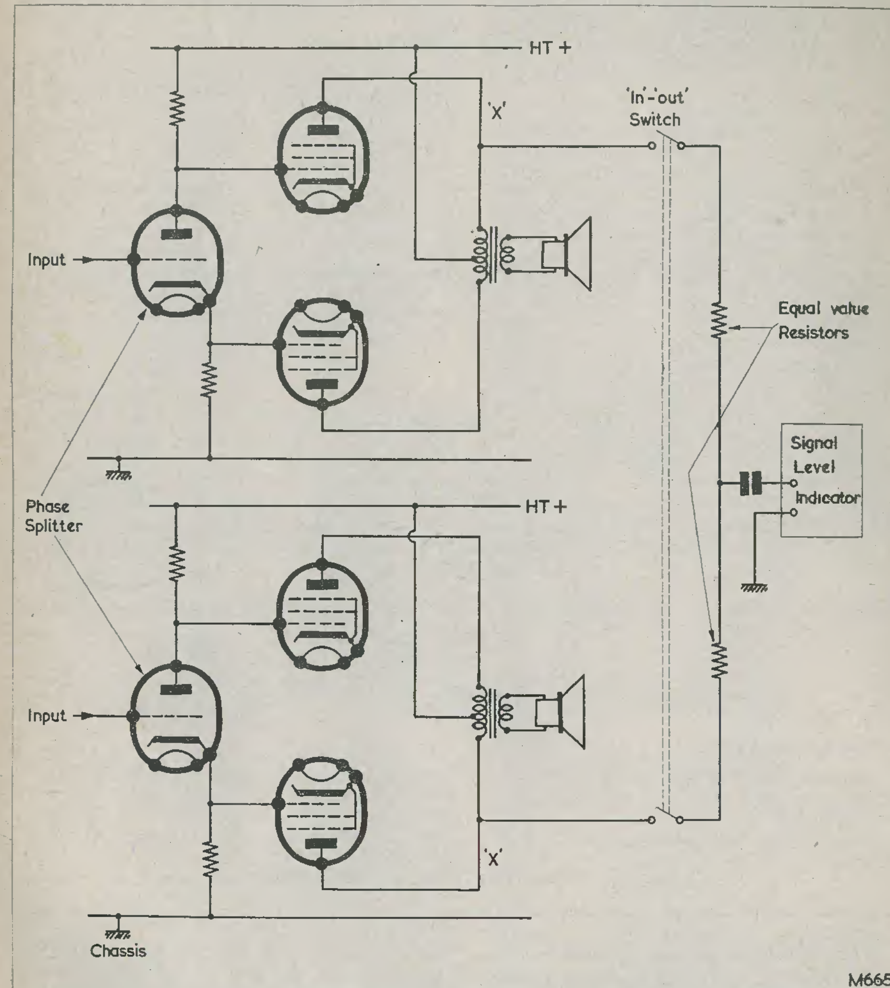


Fig. 1. If a signal of equal amplitude and phase is fed to the two channels of a stereo amplifier, the voltages at the output anodes marked "X" are out of phase. The phase-splitter stages are intended to be typical only

The Circuit

The circuit of the indicator appears in Fig. 2. It will be seen, in this diagram, that the two equal-value resistors connected across the out-of-phase output anodes appear as R_1 and R_2. From their junction a 0.005μF condenser C_1 couples to the grid of the triode amplifier $V_{1(a)}$. The amplified signal appearing at the anode of $V_{1(a)}$ is next passed to the shunt detector $V_{1(b)}$, thereby providing a rectified voltage suitable, after filtering by R_8 and C_4, for application to the grid of the magic eye V_2.

It will be noticed that switch S_1 controls the h.t. supply to the indicator as well as connecting R_1 and R_2 to the output valve anodes. Switching of h.t. is felt to be desirable in order to extend valve life. The resistor R_3 enables a low anode current to be drawn by V_1 and V_2 during the time that the indicator is switched out of circuit, thus preventing cathode poisoning.

Practical Points

Apart from R_1 and R_2, none of the components or valves employed in the circuit are

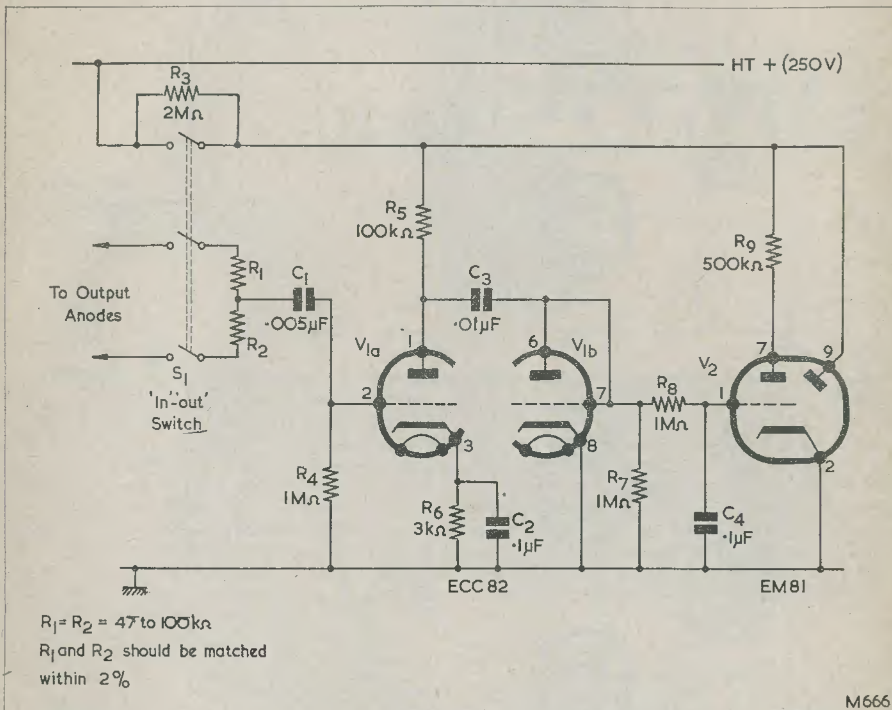


Fig. 2. The circuit of the balance indicator

When the signal level at the junction of R_1 and R_2 is zero, no voltage is passed to diode $V_{1(b)}$. In consequence, the grid of V_2 is very nearly at chassis potential (a small negative voltage is provided by contact potential in $V_{1(b)}$) and it gives maximum shadow. When a signal appears at the junction of R_1 and R_2 an amplified version is passed to the diode $V_{1(b)}$. As a result a negative voltage equal to the peak value of the amplified signal is applied to the grid of V_2, and the shadow closes.

very critical. An ECC82 (or 12AU7) is specified for V_1, one of its triodes, $V_{1(b)}$, being strapped as a diode. Any other double triode suitable for a.f. amplification could be employed in place of the ECC82 provided that the values of R_5 and R_6 are modified accordingly. An alternative to the double triode could consist of a separate triode and a thermionic diode, the values of R_5 and R_6 being again modified, if necessary, to suit the triode. It should be pointed out that the use of triodes alternative to that specified in

Fig. 2 may cause differing sensitivities to be given, and this point is discussed more fully later.

An EM81 is specified in the V_2 position but, here again, the choice of valve type is not very critical. Any other magic eye intended as a conventional receiver tuning indicator could be employed in its place. With some types, however, there may be a loss of sensitivity.

The switch employed in the S_1 position should have a construction capable of handling the relatively high voltages which will be passed to its contacts when the associated output valves handle high signal levels. A good quality single wafer switch having reasonably well spaced-out contacts should prove adequate enough.

The two resistors R_1 and R_2 have to be very closely matched, within 2% at most. High stability resistors would be ideal in this application but circuit requirements do not really justify their expense. The fact that a range of values is specified in Fig. 2 for these two resistors should assist in enabling a well-matched pair to be found.

Sensitivity

When the circuit was being initially developed, the writer considered it necessary to set down an arbitrary standard for minimum sensitivity. It was decided that the circuit should be capable of offering a significant indication when the unbalance at the output anodes was ½dB for 100mW power output in each channel.

Under these conditions of unbalance the following facts may be calculated. Assuming an individual anode loading of 5,000Ω in the output stages, 100mW corresponds, approximately, to 22.5 volts peak at the points to which R_1 and R_2 connect. An unbalance of ½dB at these anodes is equal to a voltage ratio of 1:1.06 and, ignoring the presence of the relatively high value resistor R_4, half of this difference in voltage appears at the junction of R_1 and R_2. Thus, 0.03 of 22.5 volts (=0.67 volts) is available for the indicating device.

A voltage of 0.67 is too low for direct application to a Magic Eye and some amplification is needed. A triode of an ECC82 connected as shown in Fig. 2 gives a stage gain of 12. Thus, such an ECC82 triode would be capable of raising the 0.67 volts peak available from the junction of R_1 and R_2 to 8 volts peak. This peak voltage will then become available, after rectification, for application to the EM81. The EM81 shadow is nearly closed at 10.5 volts negative grid voltage, whereupon it can be comfortably assumed that the negative voltage of 8 given by the ECC82 will give the significant change in indication initially aimed for.

It should be mentioned that, whilst the ECC82 is a low-mu valve, it is still capable of providing the sensitivity requirements considered necessary by the writer. Markedly higher sensitivities would be given by the use of high-mu triodes such as the ECC83 (or 12AX7).

DERBY MOBILE RALLY

Derby Mobile Rally will be held on Sunday, 16th August, 1959, at Rykneld Schools, St. Albans Road (off Derby Ring Road A5111), Derby. Admission is free, being organised jointly by the Derby and District Amateur Radio Society and the Derby Short Wave Experimental Society. The programme is as under. This will be amended in the event of wet weather to include indoor activity.

- 10.00 a.m. G3ERD/A 160 metres G3EEO/A 2 metres "Talk-in Stations" commence operating.
- 10.30 a.m. Refreshments available from this time onwards.
- 2.00 p.m. Sideshows and additional attractions open.
- 2.30 p.m. Mobile competition.
- 3.00 p.m. Display of radio controlled model flying. Weather permitting, an attempt will be made to fly three aircraft in formation.
- 4.00 p.m. Junk Sale.
- 5.00 p.m. Draw for prizes and presentation of awards.
- 5.30 p.m. Children's Cartoon Film Show.
- 6.30 p.m. Departures.
- 8.00 p.m. Talk-you-home stations close down.

In addition there will be an exhibition by Norman Birkett Ltd. (G3EKX), Model Control Club and Interplanetary Society.

This month Smithy the Serviceman discusses some unfamiliar faults with his able assistant, Dick

"MUCH MORE OF THIS," REMARKED DICK dolefully, "and we'll be bankrupt any time at all!"

Dejectedly, Smithy's assistant gazed round at the empty racks alongside the walls. The summer afternoon sunshine threw slanting beams of light across the Workshop and these, highlighting small eddies of dust in the air, added emphasis to the picture of insolvent desolation which was clearly forming in Dick's mind.

"Here, take it easy," chuckled Smithy. "You've been grumbling all the year about having too much to do; now you grumble when there's nothing to do at all."

"But it doesn't seem *right* to have nothing in for repair," grumbled Dick. "I've never known life so quiet."

"It occasionally happens during the summer," remarked Smithy. "You must remember that, at this time of the year, people's t.v. sets take a back seat and the main bits of electronic gear which take a bashing are portables and car radios."

"We haven't even had any of *them* in."

"O.K., O.K.," soothed the Serviceman. "But, just so that you can get things in proportion, let's go over the events which have led to the present circumstance. Up until lunch-time today we were both hard at work clearing up the sets which were awaiting repair. At half-past two precisely you said that you were out of work. I suggested that you utilised the time clearing up your bench, whereupon, judging by the noises which followed, I presumed that you had wiped most of the smaller debris on to the floor and had then swept it up into the corner. At two thirty-five you stated that you'd finished cleaning up and that, once more, you had nothing to do. So I asked you to do just that."

"And I've been doing it ever since," said Dick, looking impatiently at the clock which now registered twenty to three, "and I'm fed up with it."

The Serviceman looked a little hopelessly around him and espied a pile of magazines on the corner of his bench.

"Well, have a look through these for the time being," he remarked, passing the pile over to Dick. "They're some American radio mags I brought in the other day. They should keep you quiet for a while."

Dutifully, Dick took the magazines and proceeded to glance through them. He soon became engrossed. Smithy, who was taking advantage of the quiet spell to catch up on his paper-work, gave a sigh of relief and re-applied his attention to his task.

Unusual Faults

"Here, Smithy, listen to this!" exclaimed Dick, breaking the silence.

Smithy raised his head.

"Go on."

"It's in one of these magazines. A service engineer went to look at a t.v. whose picture broke up whenever anyone walked across the room.* The set was working on an indoor aerial and it had nothing wrong with it at all. Do you know what the trouble was?"

* "Unusual T.V.I.", by Eugene W. Klemm, *Radio-Electronics*, June, 1959.

"Yes," said Smithy. "There was a Christmas tree in the same room which was lavishly dressed with hundreds of metal-foil icicles and similar decorations. With the result that when these shook due to someone walking across the floor there were continual shorts and opens taking place amongst all this metal. These changed reception conditions around the television aerial and caused the break-up of the picture."

"Aw," said Dick, disgustedly, "I can't tell you anything."

"I read the article some time ago," chuckled Smithy, "and the details rather fixed themselves in my mind because I'm always interested in out-of-the-way faults."

"I suppose you've bumped into quite a few unusual snags yourself during your time," remarked Dick casually.

"I've seen a few," agreed Smithy, "although I suppose the reasons for the faults weren't all that far-fetched."

"Tell us about some of the less obvious ones."

"All right," said Smithy equably, glad, despite himself, of an excuse to leave his paper-work for the time being. "Well, there's one little snag which bumps up occasionally every now and again. What happens is that the set in question, radio or t.v., works quite well at low volume levels. However, if you turn the wick up to normal listening level you get violent cracks every now and again from the speaker. With radio the trouble nearly always occurs when the set is a portable or is used with the proverbial short length of aerial wire around the picture rail. With t.v. you need an indoor aerial in the same room to get the effect. In the t.v. case, also, the effect shows up more usually as a fierce interference splash on the picture, the noise from the speaker being not quite so violent. I should add, incidentally, that I'm talking about a.m. radios so far as this fault is con-

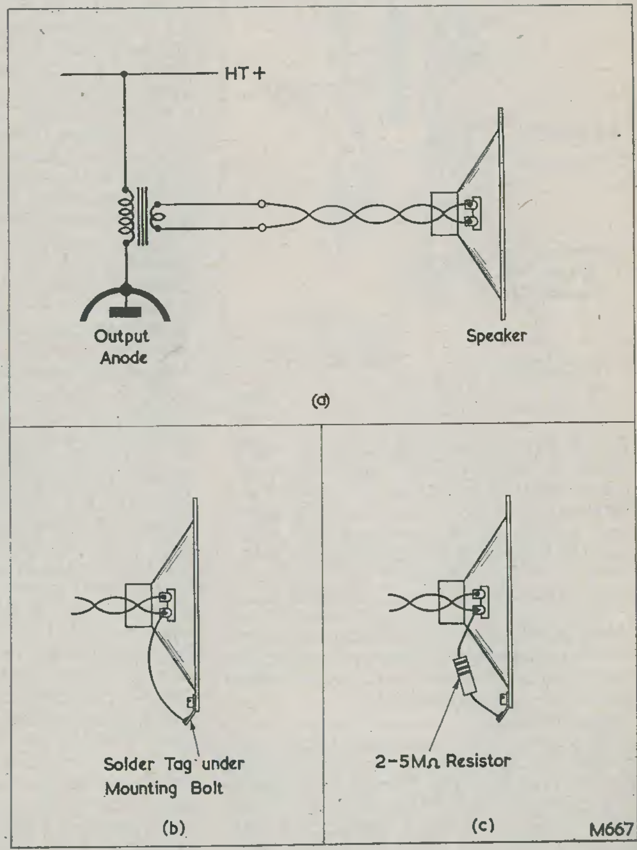


Fig. 1 (a) When the voice coil of a speaker is isolated from its frame, static voltages occasionally build up between the coil wire and the magnet gap. (b) These static voltages may be cleared by bonding one side of the voice coil to the speaker frame. (c) If the direct connection of (b) is liable to increase shock risk, a resistor having a value of 2 to 5 MΩ should link the voice coil and the speaker frame cerned. I've never had it happen with f.m. receivers."

"Hmm. It sounds interesting," remarked Dick, ruminatively. "The fact that the trouble only occurs when the aerial is either in, or very close to, the set points to a spark or similar discharge inside the receiver The fact that you don't get it with f.m. receivers seems to confirm this diagnosis."

"Correct."

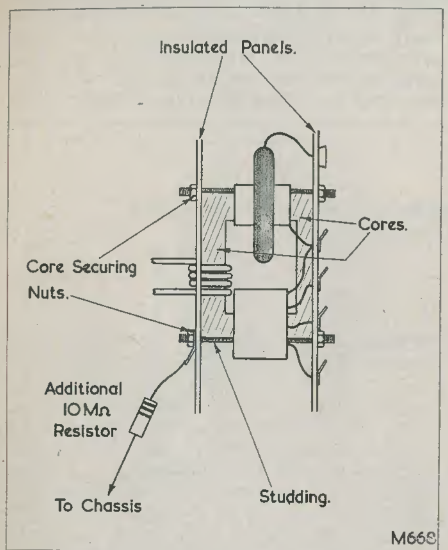


Fig. 2. Static voltages are liable to build up on the magnetic cores of line output transformers when these are mounted between insulating panels. Such voltages may be cleared by connecting a 10 *MΩ resistor between a core-securing nut and chassis*

"And the point that the trouble disappears at low volume levels indicates a discharge in the a.f. stages. Probably in the output stage, where you've got most kick."

"Fair enough."

"My guess, then," said Dick, encouraged, "is that the fault would be in the sound output tranny, a spark occurring therein, or in components connecting to the sound output tranny, similar sparks occurring similarly therein."

"You could be right," smiled Smithy, "but you aren't. Will it help you if I say that one way of clearing the trouble consists of changing the speaker?"

"What?"

"That's right! However, in most cases changing the speaker is not necessary. The trouble occurs in receivers which do not have the voice coil connected to the speaker frame. Here's a typical example of what I mean (Fig. 1 (*a*)). Since the voice coil and output transformer secondary in my diagram are floating they are liable to pick up a high static charge, and my guess is that this charge builds up to really high potentials when the speaker transformer primary handles fairly large a.f. voltages. If the speaker is a little off-centre it seems probable that the voice coil wire approaches the magnet gap sufficiently closely for a spark to hop over. That spark then causes the violent interference. It is possible incidentally so far as radio sets, and t.v. sets without sound interference limiters, are concerned, that the initial interference level may be quite small, but that the a.f. pulse resulting from it causes a bigger discharge and so on, building up in a very short time to a really violent bang from the speaker. However, I'm guessing here."

"And the cure," remarked Dick musingly, "is to replace the speaker with one which is correctly centred. Or, I presume to re-centre the one that's fitted, if this is possible."

"That's partly right," said Smithy, "although you will often find that the passage of time and the action of heat have so distorted the voice coil that really accurate centring has become impossible. Fortunately, a much easier solution consists, quite simply, of connecting one side of the voice coil to the speaker frame (Fig. 1 (*b*)). Do this, and the bangs disappear like magic. Normally, the speaker, despite its off-centredness, is still capable of working O.K. and so there's no point in swapping it anyway.

"Before concluding on this particular subject I think I should pass on a stern word of warning. When the speaker frame is not connected to the voice coil you may occasionally find that the manufacturer is relying partially on the insulation between voice coil and speaker frame to provide isolation from a live chassis. In this case you want to check very carefully that the speaker frame mounting bolts do not protrude through the front of the cabinet, or do not touch any external conducting surfaces such as a metal speaker grille, before adding your bit of wire. If such circumstances exist I would suggest that you try connecting your voice coil to the speaker frame via a 2 to 5 MΩ resistor (Fig. 1 (*c*)). This should kill any static build-up."

"This static business is rather interesting," remarked Dick. "I seem to remember our having trouble with static voltages on line output transformers from time to time."

"Such troubles do exist," agreed Smithy, "and they occur usually when the transformer cores are mounted on insulating panels and are electrically floating in consequence (Fig. 2). Sometimes these cores

pick up a really hefty charge, with the result that they spark over to the nearest earthed metalwork. The cure for this is to connect a 10MΩ resistor between one of the mounting nuts and chassis (Fig. 2)."

"I don't quite understand this," said Dick, puzzled. "I always thought that cores of the Ferroxcube variety were non-conductive, like ceramic."

Smithy grinned.

"Well, they aren't," he said. "The next time you have the chance of examining a line output transformer when it is in pieces, you want to apply the test prods of an ohmmeter to the ground faces which meet inside the coils. You'll be surprised at how low a resistance reading you get."

Overcoupled I.F. Transformers

"Any other queer snags?"

"Plenty," replied Smithy. "I had a broadcast band receiver in the other day with a snag which I must describe to you because of the very important lesson it provides. The customer complained that he couldn't 'sort the stations out.' When I got the set on to the bench I found that, whilst sensitivity was fair to middling, selectivity was shocking. I would say that the receiver took in a band of frequencies at least 12 kc/s wide. In any case it was quite impossible to pick up any but the strongest signals free from adjacent channel interference."

"What was the trouble—i.f. transformers up the wall?"

Smithy looked pained.

"I do wish you wouldn't use these expressions," he remonstrated. "Although I must admit that you're perfectly right—the i.f. transformers *were* faulty. These transformers were of the type where the coils are wound on a single threaded tube, the cores moving up and down inside. In this particular receiver the cores in the transformers should have been positioned on the outside of the coils (Fig. 3 (*a*)). However, some bright geezer had aligned them in both transformers so that one of the cores was on the inside of the coil (Fig. 3 (*b*)). This error may not seem to you to be very important, but I can assure you that it completely ruined the performance of the receiver."

"I can't see it making all that much difference," remarked Dick carelessly.

"Well, I can assure you that it did," replied Smithy, a little sharply. "When one of the cores of an i.f. transformer of this type comes between the coils it increases their mutual inductance considerably. The result is that the response of the transformer is wrecked. I said just now that this trouble pointed out an important lesson. This lesson is that single tube i.f. formers appear very often in t.v. sets these days and, if you're aligning an i.f. strip at fixed frequencies with the aid of a signal generator, you can make exactly the same mistake with regard to core positions as occurred in the set I've just mentioned. With the t.v. set, though, the result of the incorrect core positioning may be that the picture gives bad transient

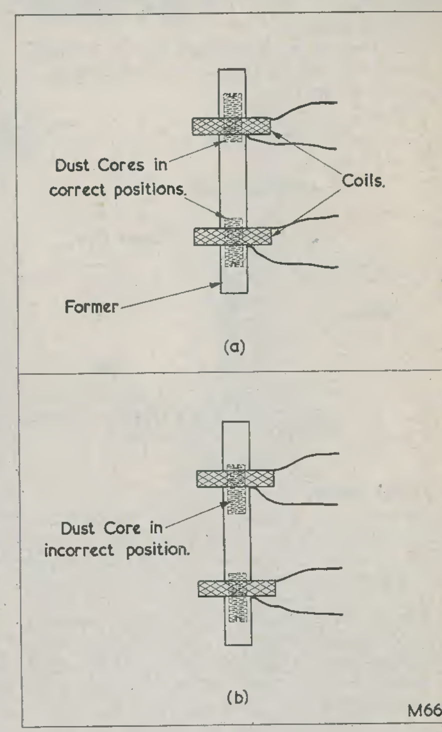


Fig. 3 (*a*) *The windings and former of a typical* 465 *kc/s i.f. transformer in which the cores are intended to be positioned, at resonance, outside the coils.* (*b*) *If one of the cores of* (*a*) *is positioned, at resonance, inside its associated coil the mutual inductance between the coils increases by a significant amount*

response, that sound rejection is poor, or that something similarly difficult to diagnose comes into existence. Whereupon you could quite easily be led to suppose that you have a really awkward fault elsewhere in the set instead of what is merely a maladjusted core."

Dick looked somewhat uncomfortable.

"I hadn't looked at it that way," he confessed. "In any case, how are you to know which side of the coil the core you're adjusting is supposed to go."

capacities which exist in the circuits across which the video signal appears.

The simplest single device for reducing the attenuating effect of stray capacities consists of providing the video amplifier anode circuit with a load resistor which is relatively low in value. See Fig. 108. Video amplifier anode load resistors in practical receivers have values ranging from some 5 to 15 kΩ.[1] The

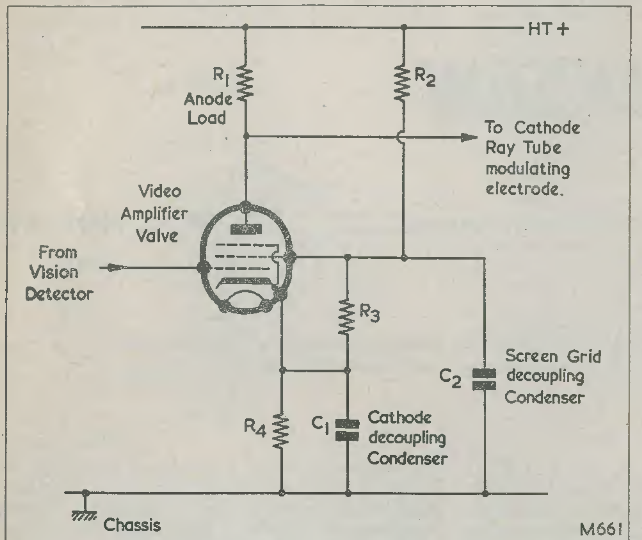


Fig. 108. *A typical single-valve video amplifier circuit. No compensating circuits are shown.*

advantage of low value load resistors is that they reduce the attenuating effect of the stray capacities between anode and chassis. If, to give a very simple instance, the stray capacities between anode and chassis were such that their combined reactance at 3 Mc/s was, say, 50kΩ, it would follow that their attenuating effect on the higher video frequencies appearing across a 10kΩ load would be very much less than if the load had a value of 100kΩ. It should be pointed out that stray capacities between the video amplifier anode and chassis are apt to be rather larger than may at first sight appear, this being due to the fact that the video amplifier anode has to couple, via a number of components, to the modulating electrode of the cathode ray tube and to the sync separator, with the result that the extra capacities to chassis introduced by these connections have to be added to that given by the video amplifier stage on its own.

Choice of Valve

A low value anode resistor necessitates the use of a valve having a relatively high mutual conductance in the video amplifier stage if adequate gain is to be realised. Mutual conductance defines change in anode current for change in grid voltage; and it will be appreciated that high changes in anode current are needed if correspondingly high changes in voltage across a low value anode load are to be achieved.

Another factor which influences the choice of video amplifier valve is that its input capacity (the effective capacity between grid and chassis presented to the input circuit) must be low, if excessive attenuation of the higher frequency video signals passed to it by the vision detector is not to occur. Due to what is described as Miller effect, the input capacity of triodes employed in circuits of the type we are considering here is liable to be much higher than that of tetrodes or pentodes[2].

Summing up the two factors just mentioned, we may now state that the preferred type of valve for video amplifier applications is a tetrode, or pentode, having a high mutual conductance. In practice, video amplifier valves are normally of the type associated with audio output stages, and are usually pentodes. Sometimes, "beam" tetrodes are employed.

[1] As is explained later, this value is liable to be qualified by the use of high-frequency compensating circuits.

[2] Miller effect causes the input capacity of a triode having a purely resistive anode load to be increased by Cag (1+A), where C_{ag} is the capacity between grid and anode, and A is the voltage amplification. Due to the presence of a screen-grid, tetrode and pentode valves have very low capacities between grid and anode, and the additional capacity resulting from Miller effect becomes reduced in consequence.

Compensating Circuits

In practical video amplifiers it is usual to provide compensating circuits in order to correct the frequency response at the higher video frequencies. Such compensating circuits boost gain at these frequencies and counteract the attenuating effect of the inevitable stray capacities to chassis. They also help to make video amplifier design more economical by allowing the use of a video anode load which has a higher value than would be permissible were compensation not provided. In this case a known attenuation of the higher video frequencies is allowed to occur by purposely employing an anode resistor having a value higher than would otherwise be required, the attenuation which results being counteracted by the compensating circuit. By means of this technique it is possible to effect an easement in mutual conductance requirements in the video amplifier valve.

Compensating circuits for the higher video frequencies employ inductances to obtain the

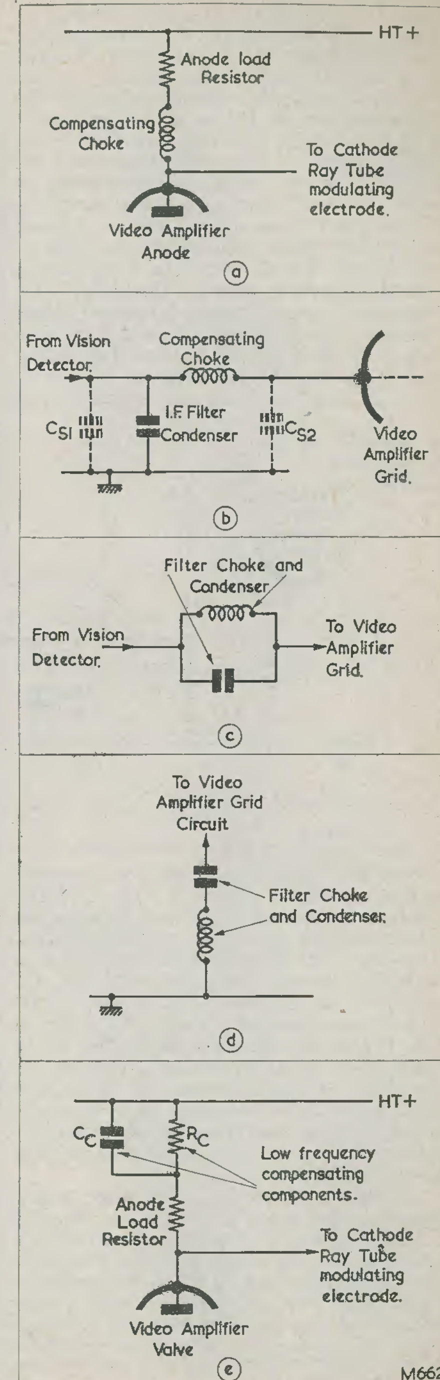


Fig. 109. *(a) A high frequency compensating choke connected in series with the anode load resistor of a video amplifier valve. (b) Another high frequency compensating circuit, in which the compensating choke becomes the inductive section of a pi network.* C_{S1} *represents the stray capacities on the vision detector side of the choke, whilst* C_{S2} *represents the input capacity of the video amplifier together with stray capacities between video amplifier grid and chassis. It is assumed that an i.f. filter condenser appears immediately before the compensating choke. In this circuit the choke is tuned by the parallel combination of* C_{S1} *and the i.f. filter condenser, and by* C_{S2}*. (c) A filter choke and condenser whose function it is to reduce video amplifier gain at the frequency at which the sound i.f. appears after the vision detector. (In the British* 405 *line system this frequency is* 3.5 *Mc/s.) The filter offers highest impedance at its resonant frequency. (d) A series filter which carries out the same operation as the parallel filter of (c). In this case the filter offers lowest impedance at its resonant frequency. (e) Low frequency compensating components fitted in the video amplifier anode circuit. If desired, the high frequency compensating choke of (a) could be added between the anode load resistor and the video amplifier anode without upsetting the functioning of the low frequency compensating circuit.*

3A

desired lift in gain. A typical example is illustrated in Fig. 109 (*a*). In this diagram a compensating choke is connected in series with the video anode load resistor. At low video frequencies the reactance offered by the choke is negligible and the circuit behaves as though the anode load were provided by the resistor only. At high video frequencies the reactance of the choke is large enough to cause the total impedance provided by the resistor and choke in series to become significantly higher than would be given by the resistor on its own. In consequence, changes in anode current at the higher video frequencies cause proportionately higher changes in anode voltage across the combination of resistor and choke, and the desired high frequency boost is effected.

shown in Fig. 109 (*c*) and (*d*). In Fig. 109 (*c*) we have a choke and condenser in a parallel tuned circuit, this resonating at the frequency at which the sound i.f. appears after detection. Such a filter normally appears between the vision detector and the video amplifier grid, whereupon it offers highest impedance at the frequency to which it is tuned. Alternatively, the parallel filter may occasionally be found inserted between the video amplifier anode and the modulating electrode of the cathode ray tube, whereupon it carries out the same function as before. The first circuit position is, however, rather more preferable because it reduces the risk of cross-modulation in the video amplifier. The series tuned circuit of Fig. 109 (*d*) may also be adjusted to resonate at the frequency at

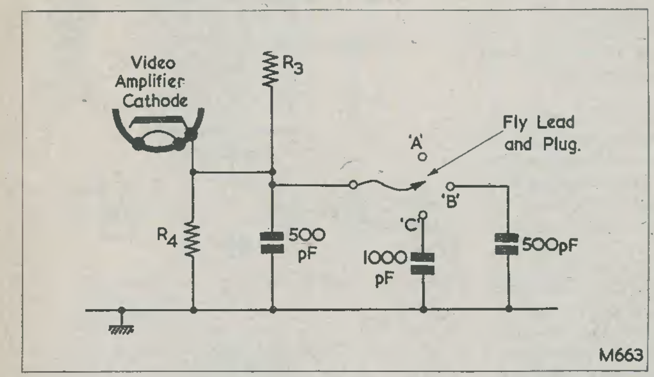


Fig. 110. *A simple "picture quality control" arrangement, by means of which the value of the video amplifier cathode decoupling capacity may be varied. Inserting the plug into socket 'A' gives 500pF decoupling capacity, into socket 'B' 1,000pF, and into socket 'C' 1,500pF. The resistors R_3 and R_4 carry out the same function as the similarly numbered resistors of Fig.* 108.

Another frequently encountered compensation circuit is shown in Fig. 109 (*b*), wherein a choke is connected between the vision detector and the video amplifier grid. This time the choke becomes part of a pi network, tuning being provided by the capacities to chassis, physical and stray, which appear on either side. The choke of Fig. 109 (*b*) has rather the same effect as the peaking choke employed in a cascode r.f. amplifier[3]. If the inductance of the choke is made such that it resonates at a frequency slightly higher than the highest video frequency to be handled, then the required boosting effect is obtained.

As was stated earlier, some video amplifiers are called upon to have a low response at the frequency at which the sound i.f. appears after the vision detector. To meet this requirement special filters are provided. Such filters are usually of a very simple nature and take up a form similar to those

which the sound i.f. appears after the vision detector, whereupon it provides lowest impedance at this frequency. The series arrangement is normally fitted between the grid of the video amplifier and chassis. It could also appear between the video amplifier anode and chassis but, once again, this raises the risk of cross-modulation in the amplifier.

Low frequency compensation is not often encountered in modern television receivers (especially in British 405 line models) as it is a relatively simple matter to design the video amplifier so that full amplification is given to such frequencies. If, however, a low frequency compensating circuit *should* be fitted it would normally be of the basic type shown in Fig. 109 (*e*). In this diagram condenser C_c and resistor R_c provide the low frequency compensating circuit, and they appear in series with the anode load of the video amplifier. At middle and high frequencies C_c has a low reactance and the video anode load is comprised, effectively, of the load resistor on its own. At low

[3] See "Understanding Television," part 10, *The Radio Constructor*, October 1958.

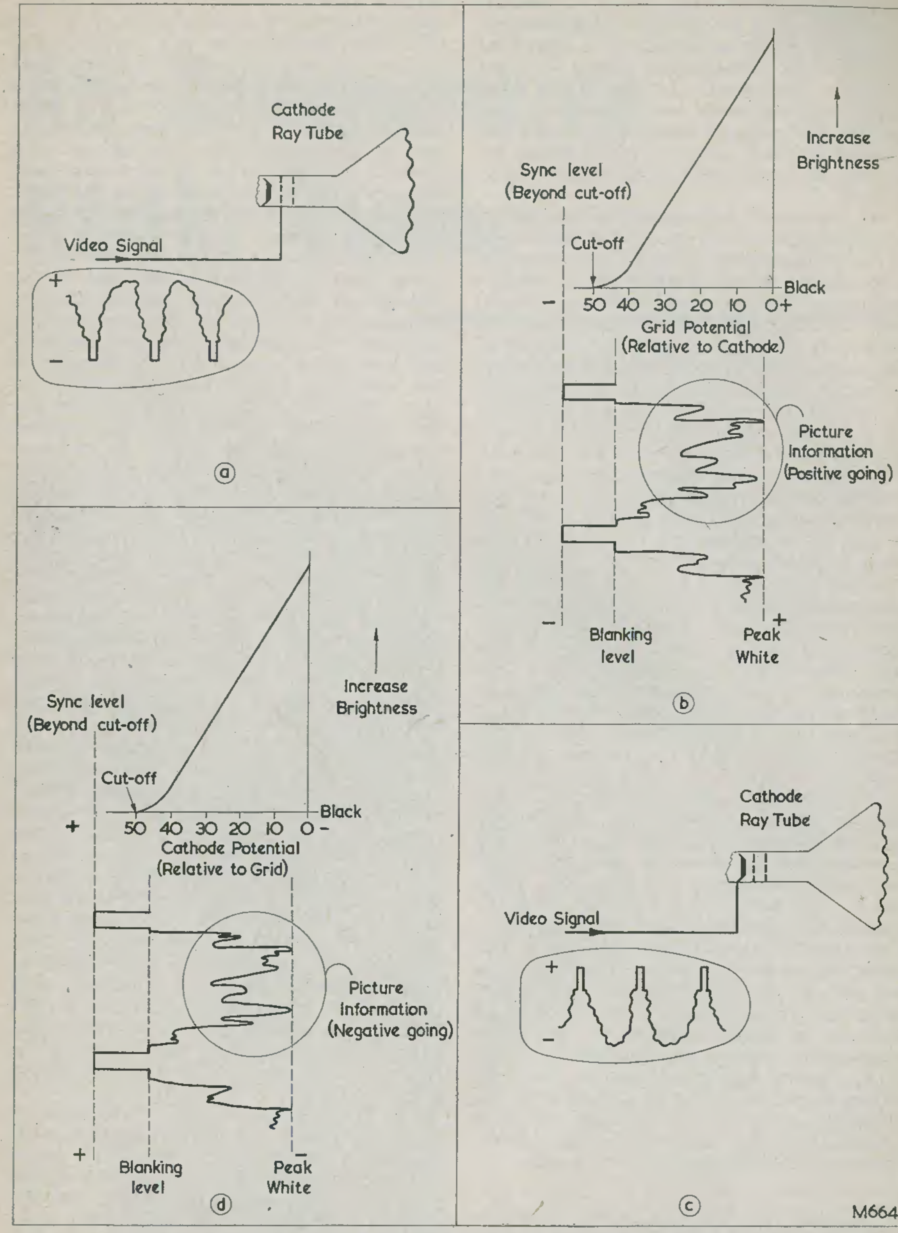


Fig. 111 (*a*) *If the video signal is applied to the grid of the cathode ray tube, the picture information in the signal must be positive-going.* (*b*) *The signal of* (*a*) *applied to the grid voltage/brightness characteristic of a cathode ray tube. It is assumed that the video signal achieves peak white at the point indicated.* (*c*) *When applied to the cathode, the video signal must have negative-going picture information.* (*d*) *The diagram of* (*b*) *altered to indicate the case which exists when cathode modulation is used* video frequencies the reactance of C_c becomes sufficiently large for the total impedance in the anode circuit to increase by a significant amount. In consequence higher voltages become developed across the combination of the anode load resistor, R_c and C_c, and the required boost of the low video frequencies takes place. Typical values for C_c and R_c would be 8μF and 10kΩ respectively.

As has already been stated, low frequency compensation is not used very frequently, as the requirements for good low frequency response can be met quite readily in modern receivers. These requirements are, mainly, that the h.t. supply to the anode, and the potentials at the screen-grid and cathode of the video amplifier, should be kept at a steady potential despite varying current demands. In modern power supply circuits the use of very large value smoothing condensers automatically ensures a steady h.t. potential. The necessity for stable screen-grid and cathode potentials is partially met by supplying these electrodes from a fixed series network, or potentiometer, of resistors connected across the h.t. supply. A typical example is shown in Fig. 108, wherein the screen-grid and cathode tap into the junctions of R_2 and R_3, and R_3 and R_4 respectively. The values of R_2, R_3 and R_4 are such that they draw a standing current on their own of some 5 to 10 mA, and this assists in maintaining the steady potentials needed at the screen-grid and cathode. Decoupling condensers C_2 and C_1 provide bypass circuits.

In present-day British receivers it has become common practice to intentionally degrade low frequency response by providing a decoupling condenser at the cathode of the video amplifier (C_1 in Fig. 108) which has a value markedly lower than would be needed for optimum low frequency gain. The cathode decoupling condensers employed in receivers of this type usually have values lying between 500 and 2,000pF only. In many cases, variation of this decoupling capacity is made available by means of simple plug and socket arrangements similar to the typical example shown in Fig. 110. Arrangements of this type are described as "picture quality control" circuits, and it is claimed that they compensate for varying characteristics in different transmitters.

Cathode Ray Tube Connections

The signal developed across the video amplifier anode load has to be applied to the cathode ray tube so that it may be converted into perceptible picture information. We have, earlier, examined the construction of the cathode ray tube, together with the manner in which its beam may be focused upon its screen to form a small spot. We have also discussed the way in which the cathode ray tube beam may be deflected so that its spot traces out the scanning pattern dictated by the system in which it is used. In order to build up our picture, the brightness of the cathode ray tube spot is then made to vary in strength by the video signal which is applied to its modulating electrode. This modulating electrode may be either the grid or the cathode.

In Fig. 111 (*a*) we see the case wherein the video signal is applied to the grid of the cathode ray tube, it being assumed that the potentials on all other electrodes of the tube are fixed. The grid now becomes the only electrode which may control the strength of the beam and, hence, the brightness of the spot. The grid of the cathode ray tube has the same effect on the electrons passing through it as has the grid of an ordinary valve. Thus if, over the range within which it exerts control, the voltage on the cathode ray tube grid goes negative, the strength of the beam is decreased and the spot travelling across the screen becomes less bright. Similarly, if, under the same conditions, the voltage on the grid goes positive, the beam becomes stronger and the spot brighter. Following these points it becomes obvious that the video signal we apply to the grid of the cathode ray tube should be such that picture information is positive going, and a typical waveform is shown in Fig. 111 (*a*). Just like the valve, the cathode ray tube requires a bias supply of correct potential, and this may be provided by applying suitable voltages to the cathode and the grid. Under correct working conditions we then get the effect shown in Fig. 111 (*b*), wherein we see a curve depicting spot brightness level against grid voltage. It will be noted that the bias and the amplitude of the video signal illustrated in Fig. 111 (*b*) allow white level in the signal to correspond to a high level of spot brightness and that blanking level corresponds approximately to zero brightness. It may be seen also that the sync pulses carry the grid beyond cut-off point, with the result that the spot is blanked out during these pulses.

Fig. 111 (*c*) shows the state of affairs which exists when the video signal is applied to the cathode of the cathode ray tube. The potential on the grid is fixed. As may be readily imagined, a negative-going signal on the cathode has exactly the same brightening effect on the spot as has a positive-going signal on the grid. (A statement that the cathode goes negative with respect to the grid is the same as a statement that the grid goes positive with respect to the cathode.)

continued on page 29

An *Inexpensive* Radio Tuner

by Michael J. Dunn

For quality reception on the Long and Medium wavebands

The outstanding features which justify the tuner about to be described are cheapness, simplicity and quality. It is quite possible for anyone with a good stock of spares to build it with practically no actual financial outlay at all. Fundamentally, the circuit is very simple and straightforward, and the conception is based on rebuilding the unit around an existing battery receiver having certain essential characteristics. It is capable of giving first-class results, especially if situated within reasonable distance of a transmitter, but good reception can also be expected over considerable distances (as occurs with the author's geographical situation) in the absence of adverse conditions.

The tuner must, of course, be used in conjunction with some amplifying system, and to obtain the best results this should include a tone compensating network giving variable bass and treble boost. Although the purpose is mainly to give quality reception from the main B.B.C. services, good results are definitely to be had from Continental broadcasts. Excellent selectivity is obtained with this simple circuit by using an "infinite impedance" detector which reflects a negligible load on the preceding tuned circuit and, in addition to this, this method of demodulation gives a minimum of distortion to the audio component of the signal. Against this must be weighed the fact that the gain in the detector stage is less than unity, but this is not a serious drawback because it is amply compensated by the use of a very high gain r.f. stage. It will be appreciated, therefore, that the gain of the entire tuner will be slightly less than that provided by the r.f. stage, and in any case there will be subsequent amplification of the audio signal from the amplifier into which the sound output is fed.

The cost of the tuner can be kept extremely low if it is found possible to obtain a suitable secondhand battery receiver which satisfies certain essential requirements; in fact, a would-be constructor may have such a one tucked away in a cupboard somewhere. The main financial outlay involved in building such a unit as this from scratch would be to provide the chassis, twin-gang tuning capacitors with their associated dial assembly, and the coils. But these can be provided all in situ on a set which can often be purchased for as little as five shillings from the local radio shop or for a similar price in the salerooms. The set need not be in working order as it is going to be almost entirely stripped and rewired, but it should be in a good, clean condition, not too antique, and the coils should be of fairly modern type, well screened. These unwanted battery sets which collect in large quantities "upstairs" at the radio shop and abound in the sale-rooms, apart from providing the useful working basis for the tuner, will also give one quite a few spares including a P.M. speaker with its output transformer, and generally constitute a "good buy." The cabinet can be used (after removing the speaker) cut down short so as to give a pleasing housing for the tuner, having the holes already in the correct places to fit the chassis bolts and control spindles.

The valves used in the prototype were an EF50 for the r.f. stage, followed by a 6J5 for the detector. If not already possessed, these valves or near equivalents can be purchased very cheaply indeed. V_1 should be an r.f. pentode with a high slope and alternatives such as 6AC7 or SP61 would be perfectly satisfactory. For V_2 any general purpose triode with a 6.3V heater will do, or a pentode strapped for triode operation, such as another EF50 or SP61; but if the latter valve is used in both positions it must be remembered that it is very greedy for heater current, although in every way an excellent valve and obtainable very cheaply. The power supply for the tuner can either be obtained from the main amplifier or from its own power pack. For an EF50 and 6J5 the requirements would be: heaters 6.3V 0.6A (1A or 1.5A rating would be adequate for the transformer) and h.t. 200–230V at about 20mA. The writer favours using the separate power pack because it is then possible to introduce a refinement whereby the main amplifier can be tucked away in a cupboard and switched on by a relay operated from the tuner; this will be described later. Now, having described the general outline of the tuner, it can be examined in closer detail.

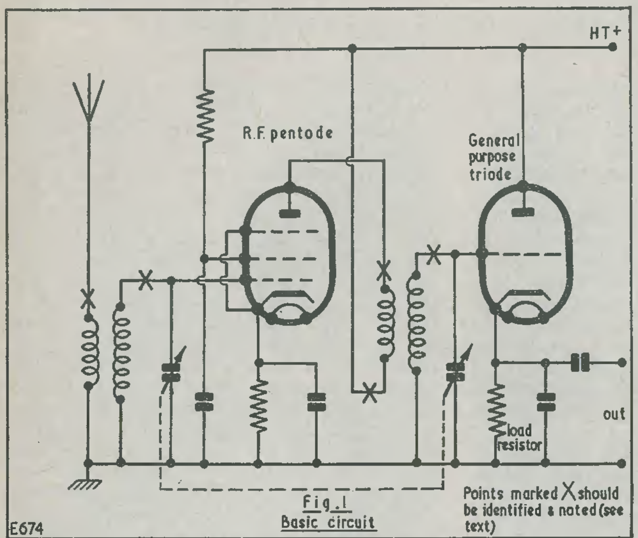


Fig. 1 Basic circuit

Choice of Set

There are a great variety of disused and unwanted battery sets of varying character and antiquity lying about in radio shops, sale-rooms and the attics of friends' houses, if not one's own, and one of these must be begged or purchased having the following essential features:

(1) It should be a straight t.r.f. set with r.f. and detector stages, and medium and long wavebands.

(2) The twin-gang tuning capacitor, coils and wavechange switch should be so placed that grid connections and all conductors carrying r.f. currents can be kept really short in the reconstructed layout. (For instance, the writer knows of at least one otherwise quite excellent commercial battery receiver where the connection from the coil to the detector grid traverses almost the entire length of the chassis!)

(3) There should be a good, clear dial and pointer, preferably semicircular, and a smooth-working slow-motion drive should be considered essential.

With regard to the coils, any would-be constructor might consider replacing the coils with more modern types, but the writer found that the existing ones not only gave perfectly satisfactory results, but because of the high Q obtainable in the grid circuit of the infinite impedance detector, the selectivity is quite up to the standard of a domestic superhet, if not somewhat sharper.

Having got a suitable receiver, although not essential it is quite a good idea to try and get it working as this will give positive proof that the tuning circuits are in order and this will save any possible search for faults in this department later.

Preliminary Procedure

(1) Remove the set from its cabinet, take out the valves and remove the loudspeaker, none of which take part in the construction of the new unit. Dust out the interior of the cabinet and place it on one side if it is decided to use it to house the tuner subsequently.

(2) Give the chassis a superficial dusting and general clean-up (it will probably need it!) enough for convenience of operating.

(3) Before proceeding any further it is most important at this stage to identify and mark all the grid and anode connections of the tuning circuits, also the aerial and any others that will be needed subsequently. It is simple enough to draw a little sketch and it will save an awful lot of speculation when wiring up again.

(4) Now strip the chassis of *all* components except:

(*a*) The twin-gang tuning capacitor and associated dial assembly.

(*b*) The coils in their cans and the wavechange switch.

(*c*) Any tag strips or anchoring points that may subsequently be found useful.

If the wiring associated with these circuits leaves anything to be desired, particularly in respect of shortness or insulation, it is best to take it out and rewire later. The valve sockets should be removed if they are not of the correct type, and they will be replaced with those suitable for the valves chosen.

After this ruthless and drastic clearance, the chassis and the few remaining components should be thoroughly cleaned and the wavechange switch would do well to have a dose of contact-cleaning fluid.

Assembling and Wiring Up

When all is cleared, cleaned and prepared, the correct valve sockets may be bolted in and any tagstrips that are going to be used may be mounted in position. It is a wise plan to draw a sketch of the proposed layout before the new components are actually fixed. So far as is possible, point-to-point wiring is strongly recommended and small components can be supported by their own wires. Any conductors between which coupling is undesirable must be kept well away from each other and their running parallel avoided.

The circuit itself is fundamentally very simple (see Fig. 1) and the wiring up should present no difficulty at all if the coil connections were carefully identified before disconnecting the original set. No minute details about the wiring can be given as this will depend entirely on the set, but procedure should follow that outlined below.

The First Stage

This is a straightforward r.f. amplifier with little or no unusual features. The only difficulties likely to be encountered are those concerned with stability, and a certain amount of care with the layout and disposition of "hot" leads is essential here. To avoid r.f. currents getting into the h.t. circuit the anode of the r.f. valve may be decoupled with an r.f. choke and 0.01μF capacitor, although in practice it may be found that this measure is not actually necessary. Every precaution must be taken to avoid stray capacities between anode and grid circuits in this stage, but if instability occurs in spite of good layout, remedies will be later described under "setting up."

The Second Stage

The amplified r.f. signal is passed on to the detector stage by an r.f. transformer with tuned secondary, this constituting the tuned circuit in the grid of the infinite impedance triode detector. The load is in the cathode circuit of the valve and this gives almost total negative feedback so that there is no amplification of the audio signal. However, this arrangement gives the tuner its remarkable selectivity and freedom from unwanted stations appearing in the background. The audio signal is taken from the cathode load resistor and fed through a coupling capacitor to the volume control, the slider of which constitutes the "live" output connection. The wiring and components in the audio output circuit should be well screened; the capacitor and potentiometer should be unquestionably reliable components; the former (even if purchased new) being tested to exclude leakage and the latter checked for a good smooth action and exonerated as a source of crackle. The writer used ordinary co-axial cable as the output connection leading to a co-axial socket. Similarly this makes an excellent method of carrying the audio signal well screened to the pre-amplifier, or amplifier, especially if this has to be a rather long connection.

The Power Pack

The power requirements of the tuner were discussed earlier, and it will have been noted that these are quite modest and could quite easily be obtained from a main amplifier without any undue extra drain; this would be a convenient and quite conventional method. Alternatively, a small power pack employing a valve or metal rectifier can easily be constructed from available spares and mounted on the chassis in the space previously occupied by the original output valve and its associated components. A vertical screen should be placed between the power components and the rest of the set. In the writer's model a small power pack was built on the chassis employing half-wave rectification with a metal rectifier and presenting no unusual features. A very useful transformer giving 6.3V and a 1:1 ratio for the h.t. is mentioned in the components list, but individual constructors will doubtless have various spares which will do just as well. The h.t. current is relatively low and smoothing presents no difficulty with half-wave rectification. It may be found necessary to take steps to prevent modulation hum and, in fact, this was present to a rather unpleasant degree in the writer's model. However, this was completely cured by the simple expedient of wiring in a 0.01μF capacitor between each mains lead and chassis immediately prior to the mains transformer. The working voltage of these *must* be sufficiently high to withstand peak mains volts with plenty to spare.

It was previously mentioned that arrangements were made for switching on the main amplifier by means of a relay. This is such a simple device that it is well worth while. The relay is mounted on or near the main amplifier chassis and one side of the coil is earthed. From the other connection a single thin insulated wire is taken to the h.t.+ connection on the tuner power pack via a resistor. This latter is mounted on the tuner

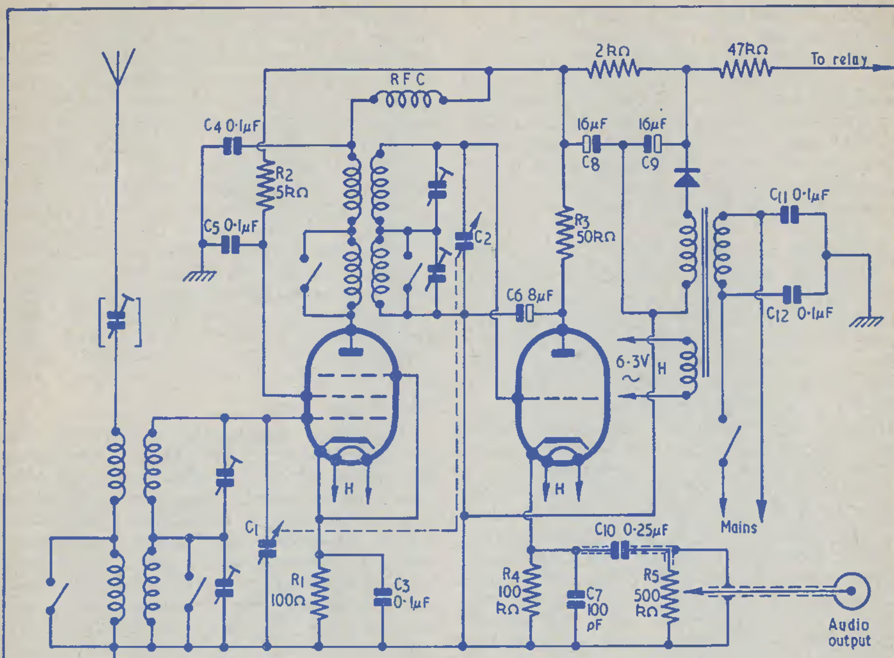


Fig. 2
Circuit of complete tuner

Components List

Resistors
- R_1 100Ω
- R_2 5kΩ
- R_3 50kΩ
- R_4 100kΩ
- R_5 500kΩ pot.

Mains Transformer
"Converter" type

Valves
- V_1 EF50 or suitable equivalent
- V_2 6J5 or suitable equivalent
- Valve sockets to suit valves chosen

Suitable battery T.R.F. Receiver which supplies:
- Long and Medium Wave switched coilpack
- Twin-gang tuning capacitor with slow-motion drive, dial and pointer.
- Chassis and cabinet

Capacitors
- C_1/C_2 500pF twin-gang tuning
- C_3 0.1µF
- C_4/C_5 0.1µF
- C_6 8µF
- C_7 100pF
- C_8/C_9 16+16µF
- C_{10} 0.25µF

and its value is found by experiment and is such as to give a good brisk closure of the relay contacts with the minimum of current. The relay contacts are wired in parallel with the on/off switch of the main amplifier so that when the tuner is switched on they close and the main amplifier is switched on a fraction of a second later (Fig. 3).

Final Setting Up

After completion of all the reconstruction and wiring it may be found necessary to adjust the trimmers in the tuning circuits. The degree of adjustment necessary will, of course, depend on the state of the set which is used. In fact, very little may be found necessary in the way of alteration, but the aerial trimmer may have to be reset to adapt the input circuit to whatever length of aerial is used. However, due to the sensitivity of the r.f. stage, accurate adjustment of the trimmers of all the associated tuning circuits is essential in order to prevent instability. The procedure is that usually followed when

aligning a straight receiver. Failing the possession of a signal generator, tune the set to a station at the bottom end of the medium waveband, say West Home Service (206) or Luxembourg, and adjust the trimmers for optimum reception. Then rotate the dial to the top end of the tuning range and make sure that oscillation does not occur on any received signal. If it does, then a slight rotation of the trimmers one way or the other should cure it, providing all

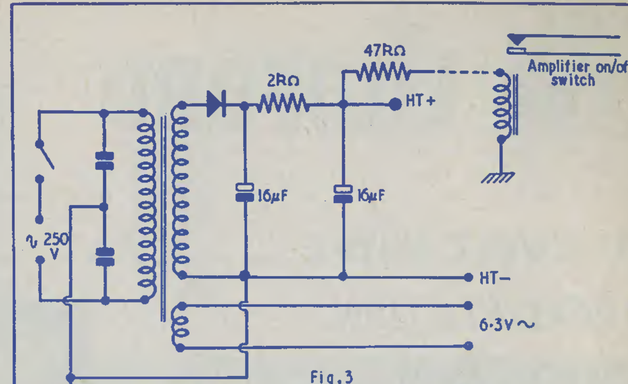


Fig. 3
Power pack & relay switch to main amplifier

stray coupling has been reduced to a minimum during construction. It goes without saying that the unit should be separately connected to a good earth. If instability proves intractable in spite of every precaution and a blameless layout, then it is necessary to introduce the barest minimum of "negative reaction" between the anode and grid of the r.f. pentode. There is probably an existing reaction coil of which use can be made. This should be connected via a very small capacitance (a few pF) between the grid of the r.f. valve and chassis, being sure so to connect the coil that the feedback is in anti-phase. The capacitance should take the form of a preset trimmer which should be increased until the instability is cured. Failing the existence of a separate coil, a few turns should be wound on to the r.f. transformer by hand. This course should not be resorted to unless absolutely necessary because it damps the tuned circuit and considerably reduces the "Q," thus destroying the otherwise excellent selectivity. (Fig. 4).

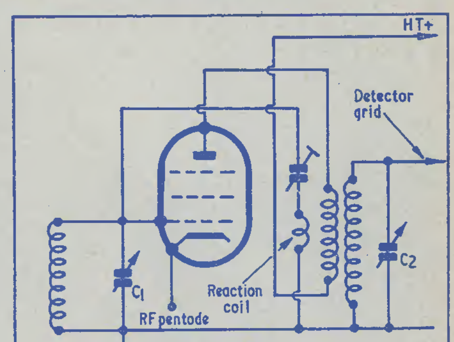


Fig. 4
Diagram showing method of counteracting instability due to anode-to-grid coupling by introducing "negative reaction" (see text)

Choice of aerial will depend on locality, signal strength and whether or not it is required to get Continental stations. One cannot go far wrong with a well designed, high outdoor aerial.

UNDERSTANDING TELEVISION *continued from page 24*

In consequence, the signal required at the cathode should have negative-going picture information. A curve illustrating cathode voltage against spot brightness is given in Fig. 111 (*d*). Apart from the differing polarity of its input signal, Fig. 111 (*d*) is identical to Fig. 111 (*b*). It will be seen from Fig. 111 (*d*) that, under correct working conditions, the cathode is always positive of the grid, and that cut-off occurs at a certain positive potential, rather than at a certain negative potential as in Fig. 111 (*b*).

We have already seen[4] that it is preferable to apply a signal to the video amplifier grid which causes the picture information in its anode circuit to be negative-going. A signal with this polarity can only be applied to the cathode of the cathode ray tube; with the result that nearly all modern television receivers have cathode modulation rather than grid modulation.

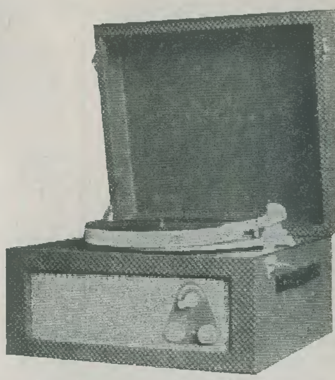
Next Month

In next month's article we shall continue to discuss the manner in which the video amplifier stage is coupled to the cathode ray tube.

[4] From last month's article.

RADIO

The LUDFORD



A SINGLE-VALVE LOCAL-STATION RADIOGRAM

Part 3—Conclusion

By J. WOOLLEN, B.Sc.

This series of articles describes the construction of a simple radiogram which is capable of good quality reproduction from local stations and from records. The circuitry is simple, and the cabinet work is lucidly explained so that no difficulty should be experienced even by a beginner

COVERING THE CABINET

A SUITABLE MATERIAL OF THE NECESSARY dimensions should first be chosen, and here a considerable variety is available. The writer was fortunate in securing a very attractive remnant; and any constructor wishing to do likewise is advised to draw out on brown paper the sizes required, and take these with him when choosing the remnants. There is scope for making the case with one colour and the lid with another. The colour scheme may suggest itself on the remnant stall in the market.

Having chosen the material, the dimensions should be marked out on the two pieces, case and lid. Only the overall sizes should be cut before covering. Because of its nature the cloth may move slightly during the covering, so any other cuts should be made as the work proceeds.

Speed is essential in this kind of work, and so it is important to have all the requirements to hand before starting. Croid Aero glue was used. This must be applied hot and should be thinned by adding water. To glue too thick is fatal. It is advisable to practice with scraps of wood and cloth before attempting the real work.

PREPARATION

Tools Required

- Large scissors.
- Small scissors.
- 1 large brush (2in).
- 1 small brush (½in).
- Single-edged razor blade.
- Drawing pins.

Materials Required

- Cloth (rexine, vinyl, etc.).
- Glue (2 half-crown tins Aero glue were used).
- Newspapers.

When brushing glue over the edges of the cloth, the surface on which it stands will be fouled. In order that several clean surfaces are available three or four newspapers are required. Prepare them by cutting the edges so that there are no double pieces. Place them in one pile in the middle of the working table. As each piece is fouled with the glue it is screwed up and thrown away, leaving a clean piece ready underneath. The large brush is for covering large areas of cloth quickly. The ½in brush is for flaps and corners.

Do not apply glue to any part of the cloth other than that immediately to be dealt with. The method for the case and lid is the same except for the cut-out, which requires treatment which should be carried out before the main covering is undertaken.

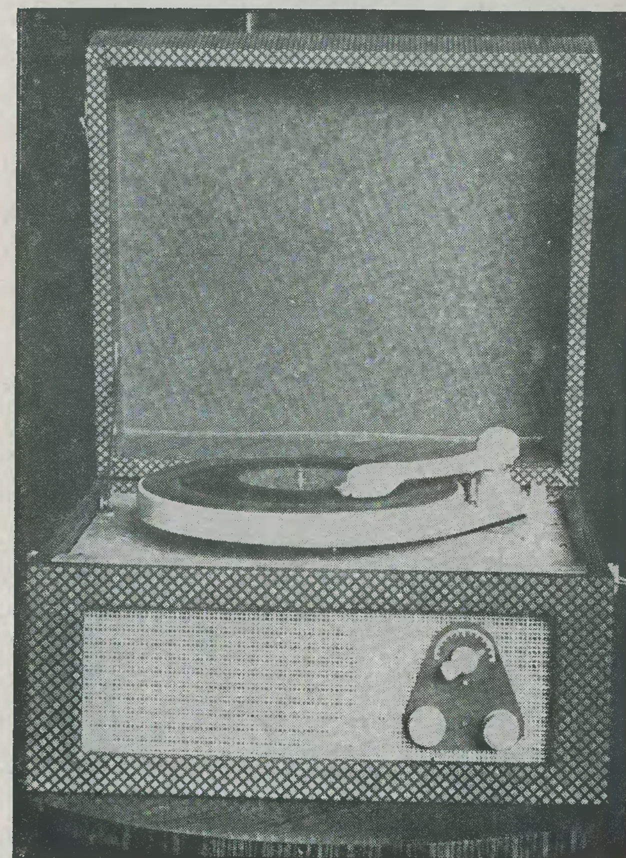
THE LID

This is undertaken before the case as it is less difficult. Glue is applied to wood and cloth in all cases. The cloth is placed face downwards in the middle of the newspapers. Glue is applied to the top of the lid and also to the space it will occupy on the cloth. The glue should be hot so as to run freely from the brush. (Glue too thick does not run freely, glue too thin will fall in drops.)

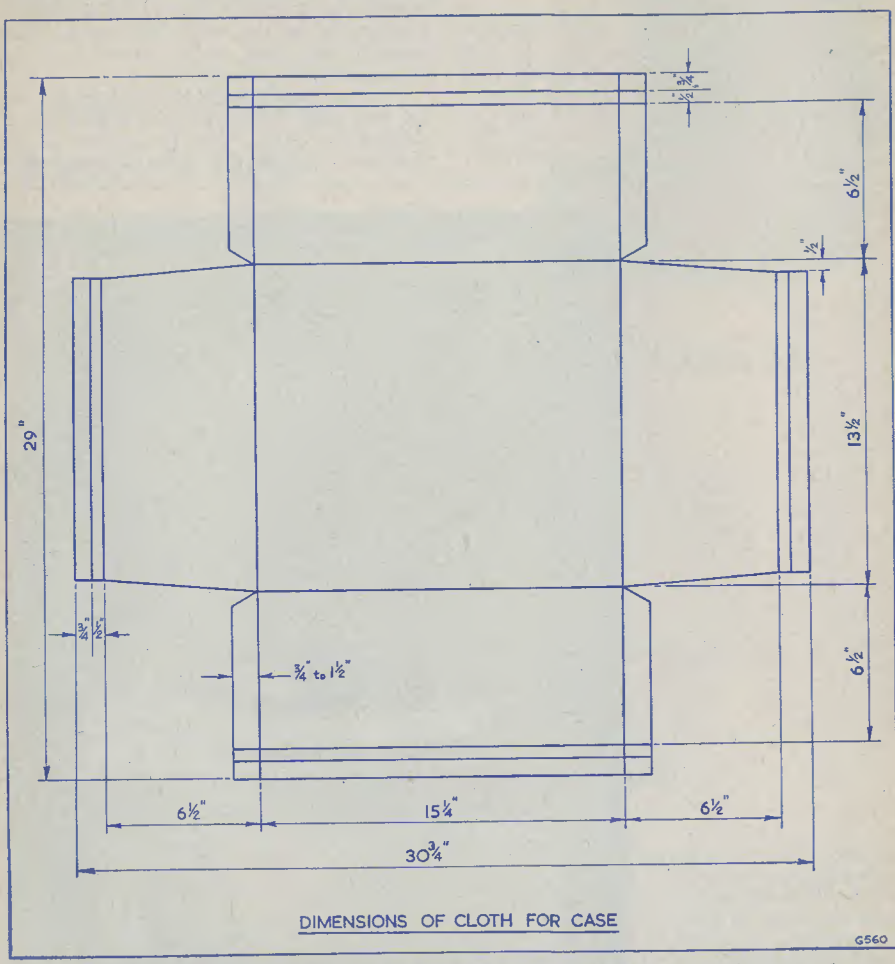
Put the lid in its position on the cloth and press down inside the lid. Lift up the lid and cloth together and turn so that the cloth is uppermost. Using a flat hand press and smooth the cloth on to the middle of the wood. Use a circular motion outwards, smoothing and pressing until the edges are reached. Press over the edges until they are clearly defined. If the work has been well done there will be no wrinkles. If wrinkles do appear, lift up the offending portion and smooth down again. Now turn the lid face downwards on the table once more. The parts of the cloth to be removed at the corners are now cut away.

The long parts (front and back of the lid) are next dealt with. Finish one part before starting the other. Glue the surface of the cloth and the wrap-over parts at the corners. Glue the wood and press the cloth over it, pressing and working towards the corners and edges.

Where the cloth comes over the corners of the edges it must be pinched and the surplus cut away with the scissors. The cloth is now smoothed over the corners of the edges in the



Another view of the completed instrument, showing the professional appearance which can be obtained even by a beginner using care and patience form of a mitre. Make sure that the mitre closes over the wood; an open corner is an ugly sight, but it should not be difficult to avoid it as you will be able to "persuade" the cloth to stretch slightly. The final fold of the before the sides are dealt with. Gluing and smoothing down the cloth on the sides will present no difficulty as there is no wrap-over at the corners.



DIMENSIONS OF CLOTH FOR CASE

The usual width of covering materials is 54in. The case and lid can be covered from a piece 54in x 30in. A separate piece will be necessary to cover the inside of the lid. The size of cloth for the lid is 23¼in x 21½in. The marking-out is exactly the same as for the case, with the exception that each 6½in measurement is changed for one of 2¾in. The overall dimensions of the cloth for the inside of the lid will be 20¼in x 18½in, but it will be an advantage to allow a bit more and to cut the edges when the cloth is glued in position

cloth will take it down ¾in on the inside of the front and back of the lid. Should it be reluctant to lie flat, it can be held down with drawing pins as long as is necessary.

Front and back should be completed

THE CASE

This differs from the lid because of the cut-out. When turning over the cloth so as to cover the edges of the cut-out, it will be found that it is not possible to cover the

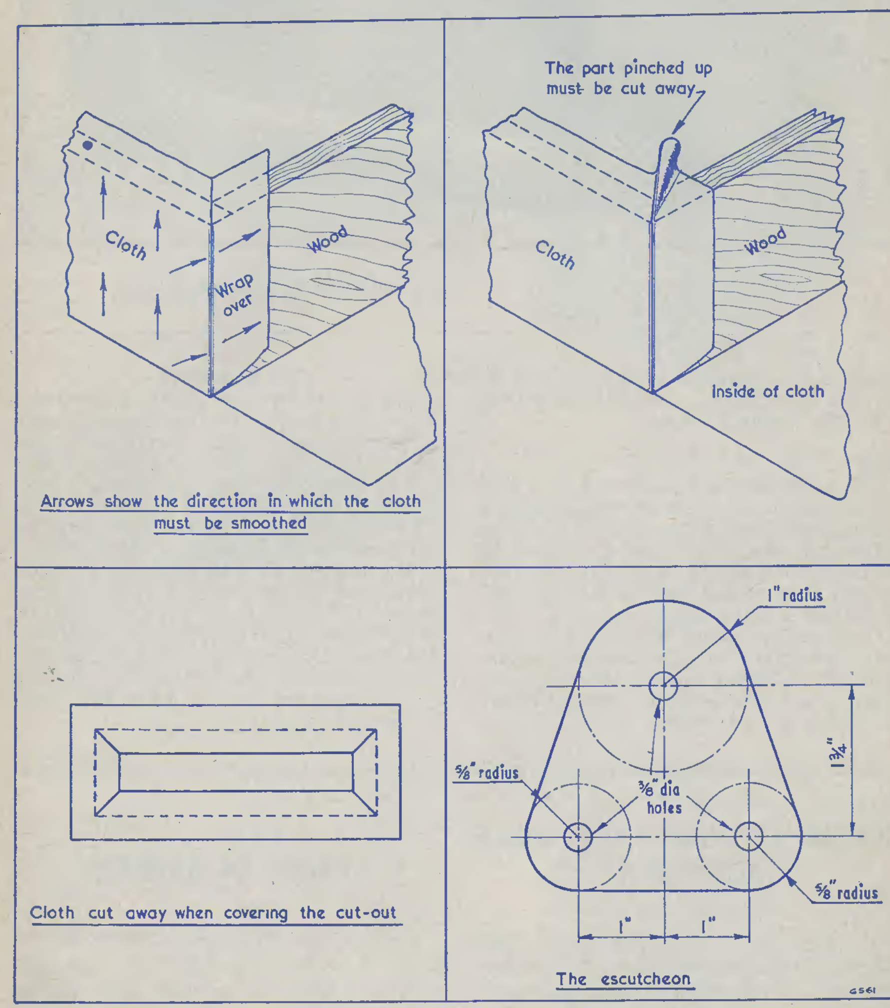
corners. A gap will be left. The corners must be covered with small pieces of cloth before the main work is started.

The main covering of the case is done in exactly the same way as the lid, ignoring the cut-out until the end. When the cut-out is dealt with, cut away as shown, and glue the wood and cloth remaining. Smooth down the cloth, finishing up inside the cut-out, and avoiding any looseness in the cloth and using drawing pins on the inside to hold the edge of the cloth until dry. The inside of the case does not require covering.

have suggested itself from the way the previous work has been done. The cloth should finish ¼in from the edge of the lid and a very neat edge should be made as this will show. Allow to dry thoroughly before any fittings are put on.

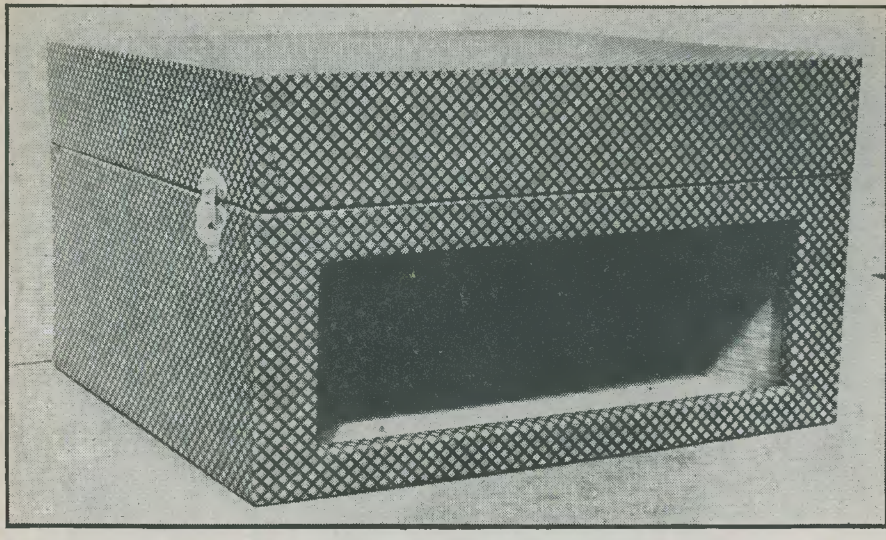
Fittings

These comprise hinges, fasteners, and lid stay. These should for preference be chromium plated. (The handle was leather.) To avoid rusting, chromium-plated screws should be used in fitting them. The writer



Inside the Lid

A second colour of cloth was introduced here. The method of covering will by now tried the lid stay on two scraps of wood, hinged together, in order to find the positions of the fixing screws. Most portable gramo-



The cabinet after covering. The hinges and fasteners are in position

phones use a combination of hinge and lid stay, but the writer was not fortunate enough to be able to obtain this type.

Frills

The motor board was covered with buff onyx Formica. The speaker fret is of white plastic, made for this purpose and cut from a standard sheet 16in x 12in. Care must be exercised when sawing as it is brittle. The escutcheon is of red lactoid, but any self-colour plastic will suffice.

These articles, while not essential, most certainly enhance the appearance and add a touch of distinction to the finished equipment. The knobs were of the smallest size obtainable in white plastic.

The Escutcheon

This was cut from red plastic material and drilled so as to allow the three spindles easily to pass through it. The markings for the pointer knob are not considered critical. Station names are not used as the tuning positions change with each change of aerial.

The escutcheon is attached to the baffle by chromium-plated woodscrews.

(The diagram of the escutcheon is to match the spindles of the controls on the writer's chassis. If the constructor varies the positioning of the controls, he must make the escutcheon in accordance. The spindle of the tuning condenser must be mid-way between the other spindles, and was 1¾in above them in the writer's case).

SIEMENS EDISWAN VALVE PRICE REDUCTION

As from 22nd June, Siemens Edison Swan Ltd. are making appreciable price reductions covering a wide range of Ediswan-Mazda valves as used in domestic receivers.

This reduction is in line with the Company's declared policy of maintaining a highly competitive sales programme.

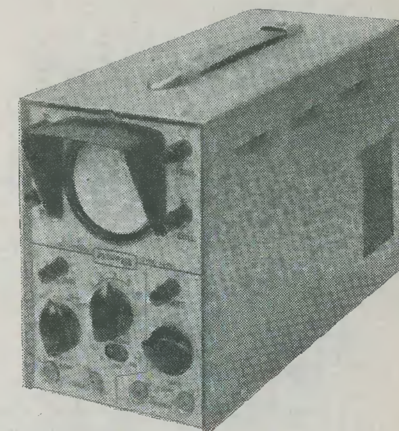
CHANGE OF ADDRESS

Due to a local council development scheme Light Soldering Developments Ltd. are moving to new office premises at 28 Sydenham Road, Croydon, Surrey, on Tuesday, the 23rd June, 1959.

The telephone number, CROydon 8589, will remain the same.

The JASON OG.10

General Purpose Oscilloscope



by G. Blundell and M. Smutny

Part One

The JASON OG.10 GENERAL PURPOSE oscilloscope is a reasonably priced instrument in which particular care has been taken to combine an exceptional performance with a layout allowing simple construction and maintenance.

A study of the specification will show that the OG.10 is capable of dealing with any work likely to be encountered by the service engineer, while the facilities provided make it equally suitable as a laboratory or demonstration instrument.

SPECIFICATION

Y Amplifier

	Direct Input	*Attenuator Input*
Input Resistance ..	1MΩ	10MΩ
Input Capacitance ..	20pF	10pF
Maximum sensitivity	6 mV/cm	60 mV/cm
Frequency response:		
(1dB)	1 Mc/s	1 Mc/s
(3dB)	2 Mc/s	2 Mc/s

Timebase

10 c/s to 100 kc/s in four ranges plus 50 c/s sine wave sweep.

Sweep width continuously adjustable from 2 cms to 20 cms (approximately 3 screen diameters). Flyback suppression operates on all ranges.

Synchronisation internal, external, or 50 c/s.

X Amplifier

Input via front panel socket providing a sawtooth voltage of about 25V peak while the timebase is operating.

Sensitivity: 1 V/cm.

X and Y shift: 6 cm.

Calibration

50V and 10V 50 c/s peaks are available on a front panel socket.

Valve Complement

V_1 ECF80 } Y amplifier.
V_2 EF80 }
V_3 ECF80 Y amplifier and sync amplifier.
V_4 EZ80 HT rectifier.
V_5 EF80 Timebase oscillator.
V_6 ECC82 X amplifier.
V_7 DH7–91 Cathode ray tube.

Power Requirements

200–250V a.c., 80VA (special transformers are available for 110V operation).

Weight

12½ lbs.

Dimensions

12¼ x 5¼ x 7½in.

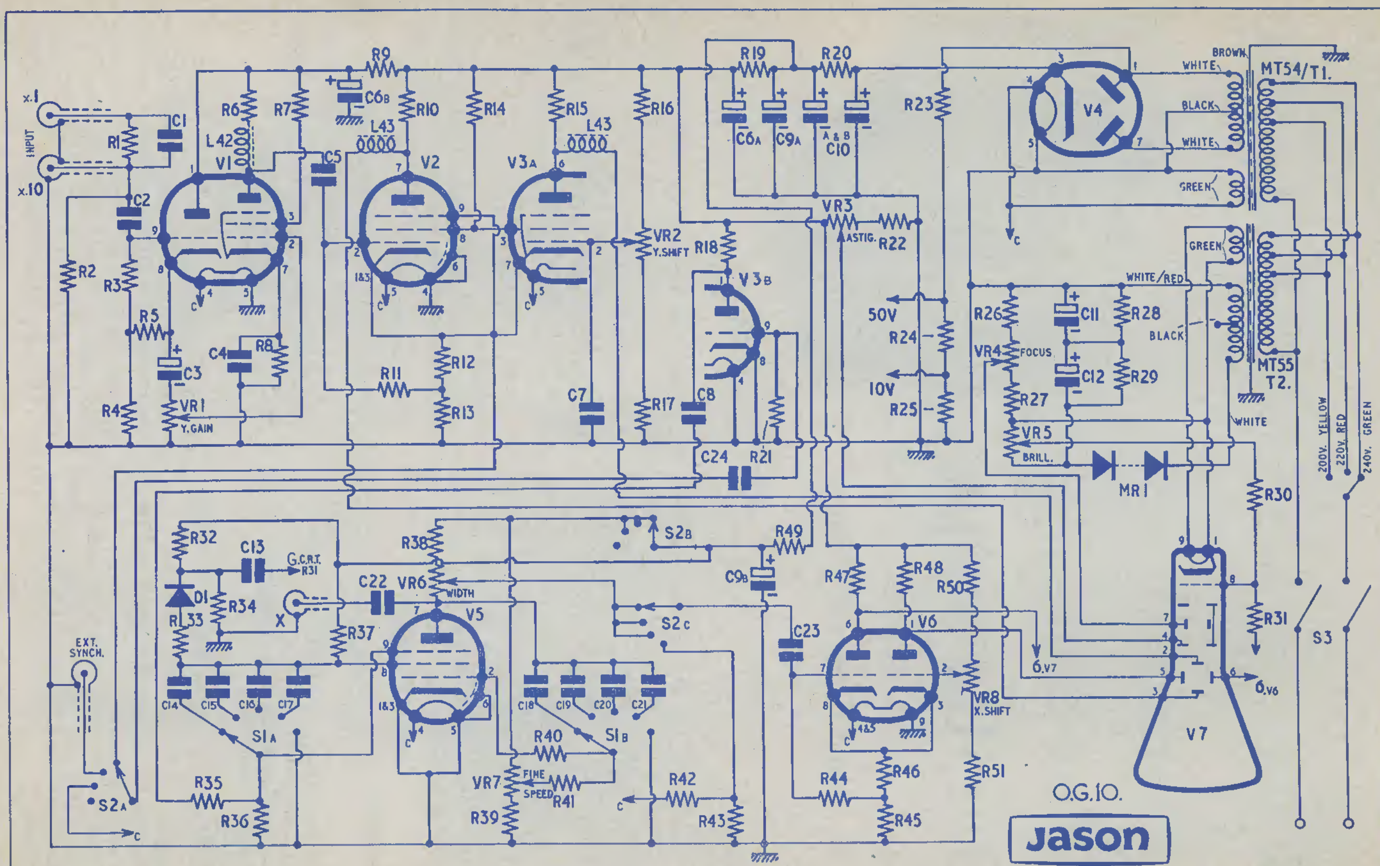


FIG. 1

COMPONENTS LIST

Resistors

R_1	10MΩ ½W 20% carbon
R_2	1MΩ ½W 20% carbon
R_3	1MΩ ½W 20% carbon
R_4	10kΩ ½W 20% carbon
R_5	470Ω ½W 20% carbon
R_6	6.8kΩ ½W 20% carbon
R_7	270Ω ½W 20% carbon
R_8	220Ω ½W 20% carbon
R_9	10kΩ ½W 20% carbon
R_{10}	6.8kΩ ½W 20% carbon
R_{11}	1MΩ ½W 20% carbon
R_{12}	220Ω ½W 20% carbon
R_{13}	3.3kΩ ½W 20% carbon
R_{14}	15kΩ ½W 20% carbon
R_{15}	6.8kΩ ½W 20% carbon
R_{16}	150kΩ ½W 20% carbon
R_{17}	22kΩ 5% hi-stab.
R_{18}	100kΩ ½W 20% carbon
R_{19}	2.2kΩ 3W 10% w.w.
R_{20}	2.2kΩ 3W 10% w.w.
R_{21}	1MΩ ½W 20% carbon
R_{22}	100kΩ ½W 20% carbon
R_{23}	150kΩ ½W 20% carbon
R_{24}	15kΩ ½W 20% carbon
R_{25}	4.7kΩ ½W 20% carbon
R_{26}	270kΩ ½W 20% carbon
R_{27}	150kΩ ½W 20% carbon
R_{28}	470kΩ ½W 20% carbon
R_{29}	470kΩ ½W 20% carbon
R_{30}	270kΩ ½W 20% carbon
R_{31}	1MΩ ½W 20% carbon
R_{32}	330kΩ ½W 20% carbon
R_{33}	10kΩ ½W 20% carbon
R_{34}	150kΩ ½W 20% carbon
R_{35}	100kΩ ½W 20% carbon
R_{36}	47kΩ ½W 20% carbon
R_{37}	10kΩ ½W 20% carbon
R_{38}	1kΩ ½W 20% carbon
R_{39}	470kΩ ½W 20% carbon
R_{40}	1kΩ ½W 20% carbon
R_{41}	390kΩ ½W 20% carbon
R_{42}	10kΩ ½W 20% carbon
R_{43}	10kΩ ½W 20% carbon
R_{44}	1MΩ ½W 20% carbon
R_{45}	3.3kΩ ½W 20% carbon
R_{46}	1.5kΩ ½W 20% carbon
R_{47}	15kΩ ½W 20% carbon
R_{48}	15kΩ ½W 20% carbon
R_{49}	22kΩ ½W 20% carbon
R_{50}	470kΩ ½W 20% carbon
R_{51}	10kΩ ½W 20% carbon

Capacitors

C_1	3.3pF ceramic
C_2	0.22μF 600V wkg paper
C_3	25μF 25V wkg electrolytic
C_4	1,000pF ceramic 10%
C_5	0.22μF 600V wkg paper
C_6	50+50μF 275V wkg electrolytic
C_7	0.04μF 150V wkg paper
C_8	0.01μF ceramic
C_9	50+50μF 275V wkg electrolytic
C_{10}	32+32μF 350V wkg electrolytic
C_{11}	8μF 450V wkg insulated electrolytic
C_{12}	8μF 450V wkg insulated electrolytic
C_{13}	0.04μF 150V wkg paper
C_{14}	0.02μF paper 20%
C_{15}	0.002μF paper 10%
C_{16}	200pF 10% silver mica or 2×100pF silver mica 10%
C_{17}	20pF 10% silver mica
C_{18}	0.05μF 500V wkg paper 20%
C_{19}	0.005μF paper 10%
C_{20}	500pF 10% silver mica
C_{21}	50pF 10% silver mica
C_{22}	0.22μF 600V wkg paper
C_{23}	0.22μF 600V wkg paper
C_{24}	0.01μF ceramic

Potentiometers

VR_1	25kΩ lin switch Y gain
VR_2	10kΩ lin preset pot Y shift
VR_3	100kΩ lin preset astigmatism control
VR_4	100kΩ lin preset pot focus
VR_5	50kΩ lin preset pot brilliance
VR_6	10kΩ lin preset pot width
VR_7	2MΩ lin preset pot fine speed control
VR_8	50kΩ lin preset pot X shift

Miscellaneous

L_1	350μH choke Jason type L42
L_2	300μH choke Jason type L43
L_3	300μH choke Jason type L43
T_1	Mains transformer Jason type MT54
T_2	Mains transformer Jason type MT55
MR_1	Metal e.h.t. rectifier SenTerCel K8-40
D_1	Germanium point contact diode Mullard OA81
V_1	Valve Mullard ECF80
V_2	Valve Mullard EF80
V_3	Valve Mullard ECF80
V_4	Valve Mullard EZ80
V_5	Valve Mullard EF80
V_6	Valve Mullard ECC82
V_7	Cathode ray tube Mullard DH7-91
S_1	2-pole 5-way 2-wafer switch
S_2	3-pole 4-way switch

Power Supplies

Magnetic fields from the mains transformer cause a deflection of the spot on the cathode ray tube. It is therefore necessary to take every precaution to reduce this external field to a minimum or, alternatively, expensive mu-metal shields are required on the c.r.t.

In this design a cheaper mu-metal shield may be used because two identical mains transformers are used with their magnetic fields in opposition to reduce the external magnetic field. One transformer MT55 supplies the negative voltage required and the c.r.t. heater, while the MT54 supplies the normal positive h.t. rail and also the valve heaters.

The h.t. for the c.r.t. is derived from both the negative and positive supplies giving a total of approximately 850 volts necessary for the DH7–91. The a.c. voltage appearing across the whole of the secondary winding of the MT55 transformer is half-wave rectified to provide a negative h.t. of 700 volts. Note carefully that the centre-tap coded black is not used. The plates of the c.r.t. are connected directly to the anodes of the amplifiers so that a further 150 volts positive is applied to the c.r.t. It is, of course, necessary for the anode of the c.r.t. to be at the same potential as the plates and this is arranged by the divider VR_3 and R_{22}. If these potentials were not the same, a distorting electrostatic field would occur in the c.r.t. which would prevent a good focus being obtained. In practice, as the c.r.t. is not perfectly made, it is useful to be able to vary the anode voltage in relation to plate voltage so that a perfectly round spot can be obtained, and VR_3 is therefore the "astigmatism" control.

Timebase

The timebase uses a single pentode V_5 in a Miller transitron circuit. This is a useful circuit in that the output is not taken across the charging condenser as in most timebase circuits. The output is taken across the anode load (R_{38} and VR_6) and the width may therefore be varied without any effect on the frequency or speed of the timebase. This is an extremely desirable requirement since it is frustrating to alter the speed every time the width is altered. The value of VR_6 is low which results in a good frequency response and therefore a short flyback time.

The operation of the circuit is as follows. Referring to Fig. 7, imagine the point at the commencement of the sawtooth oscillation after the flyback. C_2 charges through R_{41} causing the grid voltage to rise positively. This causes an increase in the current flowing

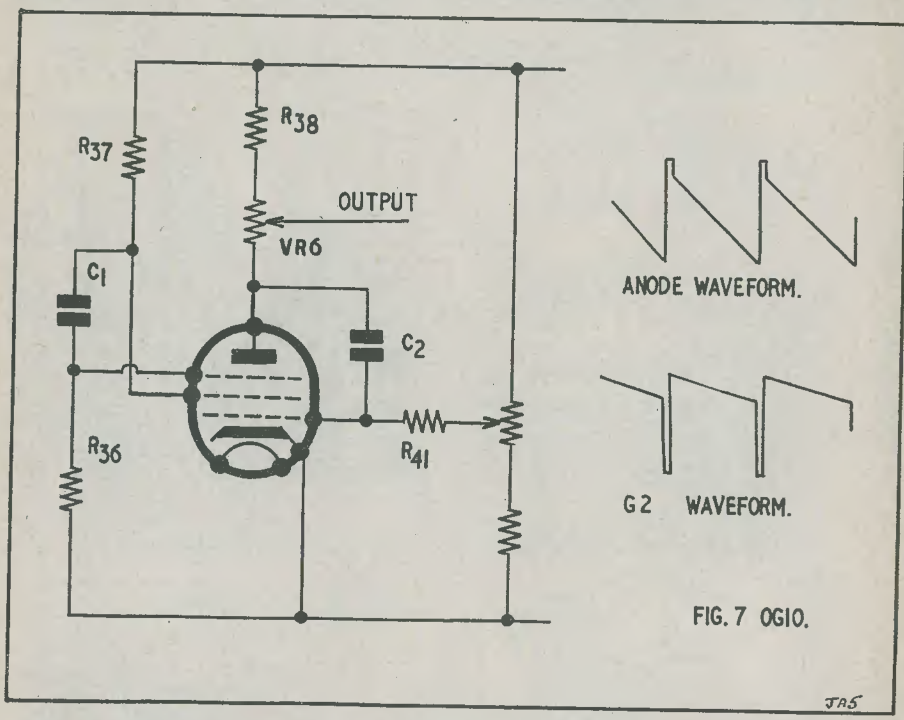


FIG. 7 OGIO.

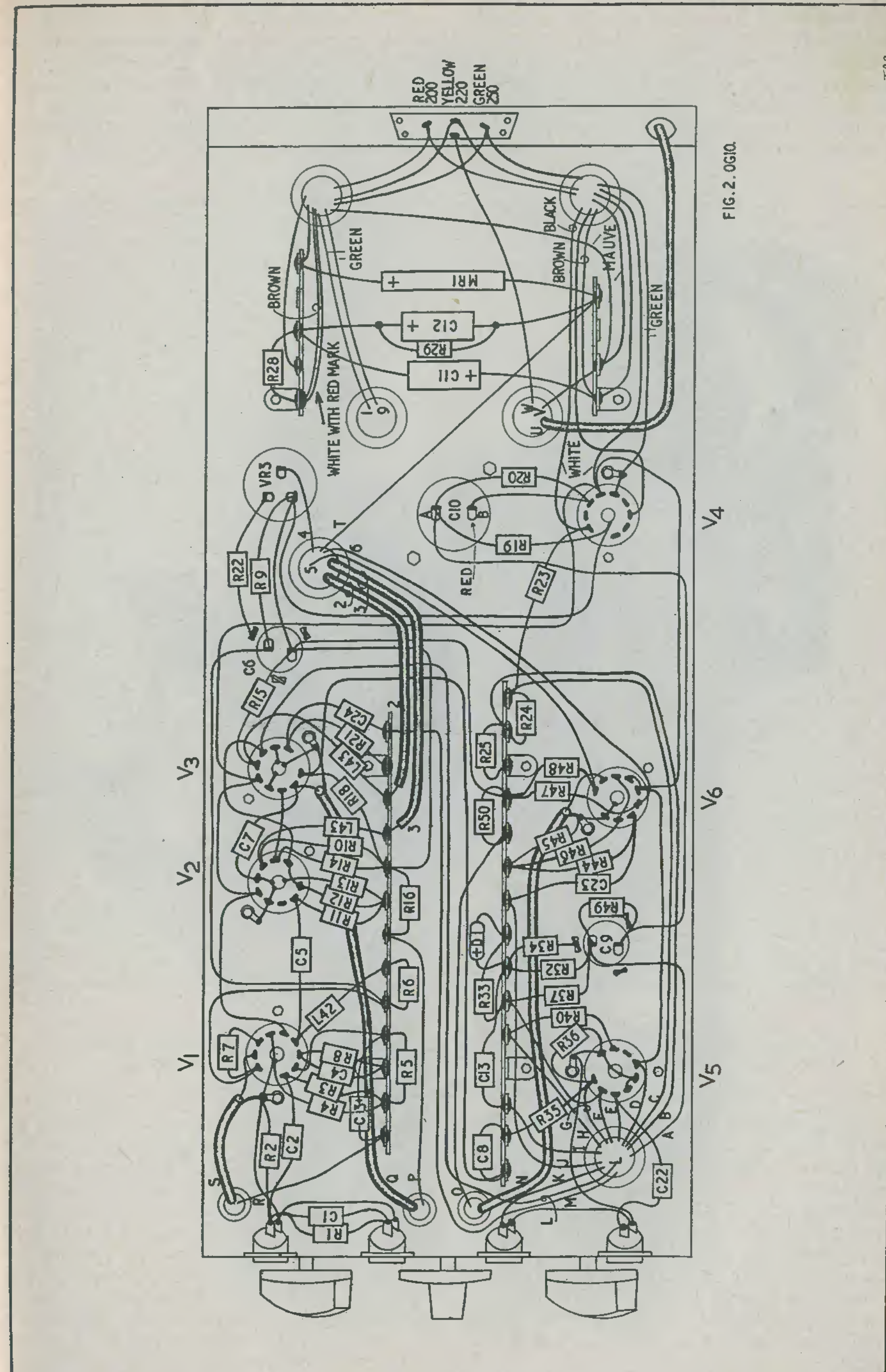
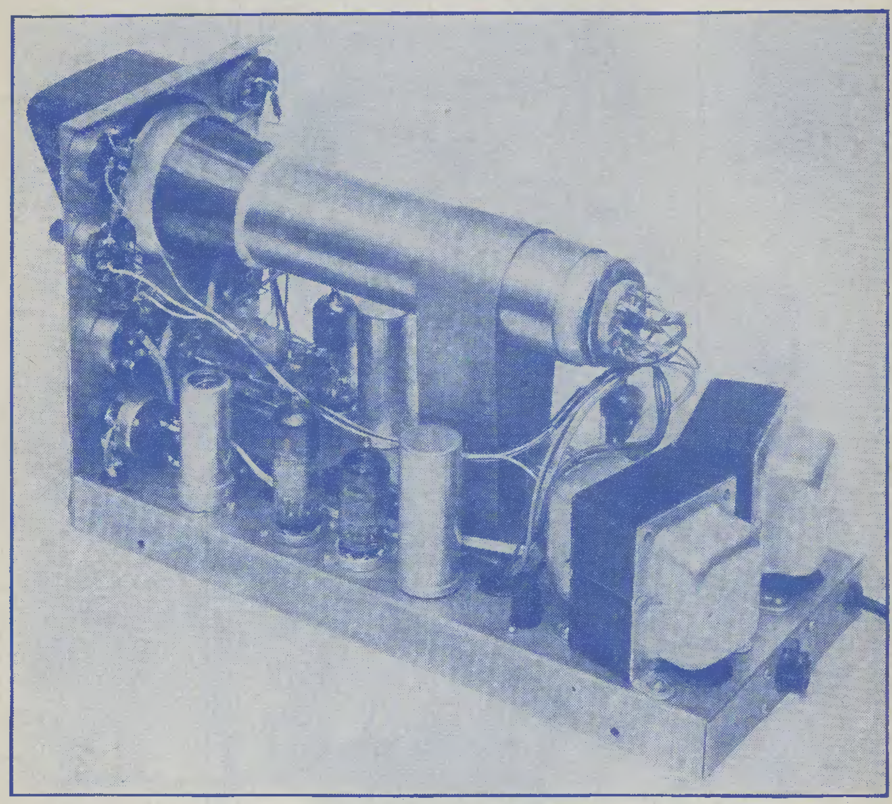


FIG. 2. OGIO.

through the valve and thus causes the anode voltage to fall. This fall is transferred to grid through the charging condenser C_2 which prevents the voltage at the grid rising at all fast. This is the Miller integrator part of the circuit which has the effect of allowing the voltage at the anode to fall slowly during the charging time of C_2.

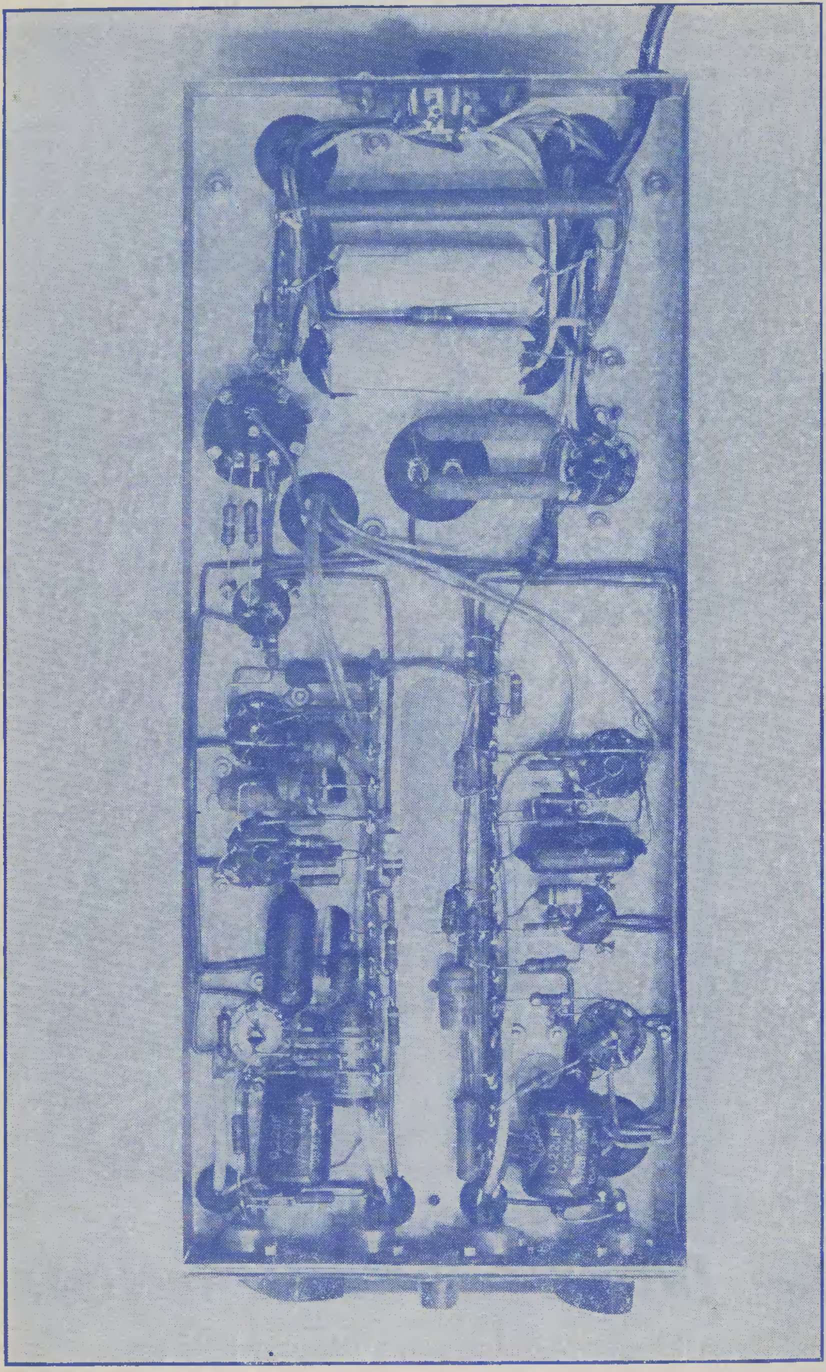
When the anode current begins to transfer to g_2 at the end of the cycle, the anode voltage is no longer falling and feeding back a negative voltage to the grid. The current transfer to g_2 therefore becomes more rapid and during the flyback part of the cycle the transitron mode of oscillation commences. What happens is that falling voltage at g_2 is



General view of the oscilloscope showing the tube and mu metal shield in position. Note the screening can on V_1, which uses the white ceramic valveholder

When the anode voltage has fallen to a low value below the knee of the characteristic of the pentode, the anode current begins to transfer to g_2. Up to this point a small voltage drop had occurred at g_2 due to the increase in valve current, but this was not transferred to g_3 because the values of C_1 and R_{36} are chosen to have a short time constant. This means that C_1 is small enough and R_{36} low enough to prevent any change of voltage at g_3 during the slow increase of the sawtooth current.

transferred through C_1 to the suppressor g_3. This negative voltage on g_3 reduces the anode current still further and as the current cannot reach the anode it returns back to g_2 causing a further drop and a further negative voltage on g_3 in a cumulative action at a rate limited only by the circuit capacitances. During this part of the cycle C_2 is recharged through R_{38} and VR_6 since there is no longer any anode current and therefore no voltage drop across R_{38} and VR_6. The negative end of C_2 is held at 2 or 3 volts above the chassis potential by



Underside view of the finished oscilloscope—compare this with Fig. 2 the grid, which takes current at this part of the cycle.

Meanwhile during the flyback the voltage at g_2 continues to fall until there is no longer sufficient voltage on g_2 to attract further current and at this stage the flyback finishes.

Then occurs a small voltage step common to this kind of oscillator as the circuit resets itself for the commencement of the next cycle of sawtooth oscillation. When the voltage at g_2 has fallen as low as possible, no further change can be transferred to g_3 and therefore the potential at g_3 begins to leak away through R_{36}. This allows some current to reach the anode instead of being turned back to g_2 and therefore the g_2 current falls and the potential rises, this rise again being transferred to g_3 through C_1. The cumulative action therefore begins again but is quickly stopped because the increasing anode current causes a negative voltage to arrive at g_1 through C_2. This reduces the current through the valve to such a low value that the transitron oscillation is stopped and C_2 again begins to recharge in the next cycle.

Referring again to the circuit diagram, it will be seen that while the timebase is operating, the sweep voltage is available via C_{22} at a front panel socket. With the coarse frequency switch in the fully clockwise position, the timebase is switched off and an external signal fed into the socket just mentioned will produce a horizontal sweep, the amplitude of which is again governed by the "width" control VR_6.

Flyback Suppression

A negative pulse, obtained from the screen of V_5, is limited by D_1 (OA81) and the resulting flat-topped wave developed across R_{32} is fed to the grid of the c.r.t. by means of C_{13} and R_{31}.

Synchronisation

Synchronising signals, which may be obtained internally from the common cathode coupling between V_2 and V_3, or from the mains or externally, are fed through switch S_2 to the grid of the triode portion of V_3 (ECF80), the sync. amplifier. The valve is operated at zero bias and after amplification and limiting the signal appears at the anode and is fed to the suppressor grid of the timebase oscillator V_5. Synchronisation is effective down to a picture height of about 5mm. One position of S_2 connects the X amplifier input to the junction of R_{42} and R_{43}, which form a potential divider across the heater winding and provide a signal of 4.5V peak giving a sinusoidal sweep of about 6cm width.

(To be concluded)

Trade Review

We have received from the manufacturers of Scotch Boy Tape (The Minnesota Mining and Manufacturing Co.) a 2,400-ft reel of their new tensilised polyester double play magnetic tape, which has just been introduced on the British market. It is known as "No. 200," and the playing time at 7½in/sec is 64 minutes. Tests were carried out on a Sonomag Adaptatape recorder through a Mullard amplifier, the results of which proved that the frequency responses on the popular speed (i.e. 7½in/sec) were well above average. The higher frequencies in particular proved to have responses which were startlingly clear and added concert hall clarity to the reproduction which very few other tapes seem to possess. The signal-to-noise ratio was excellent.

The tape is accommodated on a 7-in spool and will therefore fit all well-known makes of tape recorders. The tape is made of a polyester base tensilised to give double strength, and, being thinner than the normal tapes, the conventional 7-in spool accommodates 2,400ft easily without any risk of spillage. A further test was given for "stretch," by running the tape through the machine and stopping and starting suddenly several times. This appeared to have no ill effect on the tape and no stretching was noticed after this somewhat severe test. No breakage occurred at any time.

NEXT MONTH . . .

The TOURIST Portable Receiver

A Modern Design using Economy Valves

Radio miscellany

I AM NOW OUT AND ABOUT AGAIN AND ABLE to see something of the world around me. It was a real pleasure to have a chat with an ordinary reader once again—especially as this one seems to have made a striking discovery. Having decided on Austria for his holiday this year, where he hopes to meet one or two fellow hobbyists, he bought some of the Conversational German gramophone records mentioned in this column. Even if he does not have much luck in meeting other radio enthusiasts he felt he could at least find his way round without feeling a complete ignoramus while he was there.

Sitting with the accompanying "book of words" on his knees, he spent an hour most evenings in front of the gramophone, trying hard. To use his own words, "I just didn't seem to be getting anywhere. In fact I might just as well have read it myself from a textbook with English phonetic pronunciation, for all I learned. I almost felt a pocket phrase-book would have been more useful. I could at least have looked at it during spare odd moments. I almost got to the point of giving up in disgust as far as the records were concerned, and nearly wrote out a small ad. for your Readers' Bargain Column offering 'em at half price."

Then he recalled that some years ago he worked in an office on the main floor of a large factory where Music-While-You-Work was virtually incessant. I gather this particular Music-While-You-Work consisted chiefly of the latest Pop Records played over and over again. This sort of thing may be all right when you are doing a job requiring no thought or concentration at all but, personally, whenever I visit such factories I feel as though I am in a cheap cafe with the Juke Box going the whole time. So did our reader. He simply hated it, but even after nearly sealing himself in the office the strains of Pop seemed to creep in under the door and filter their way through the keyhole.

After a few weeks he acquired the knack of being able to ignore it and, he says, he was able to completely concentrate and not even "hear" the faint background of Pop singers. Although he never consciously *listened* his subconscious mind must have taken some notice. He discovered he knew many of the records by heart and could even hum them right through—a thing he found himself unthinkingly doing occasionally, much to his annoyance!

Worth Trying

Would the same thing apply if he kept playing his language records, even though he made no effort to give them any attention? It seemed worth trying, so he fitted up separately switchable speakers to the main rooms in the house and began to play record No. 1 whenever it occurred to him. It was an L.P. record, but even when it came to the end it simply started over again so an all-day background was available if required. First thing in the morning he would nip down and switch it through to the bedroom and regale himself with simple German while he dressed, and when he went to the bathroom he propped the doors open so the voice followed him while he washed and shaved. He even wired it up to his workshop, where he spends most of his evenings carrying on as far as possible without listening to it at all.

Perhaps it isn't so strange really—we know so little of the workings of the subconscious mind—but it is beginning to really work. He can say long passages of the first record parrot-fashion, but with perfect inflection, although he still has to stop to think out what it means in English. He is sure that now he has broken the ice the rest is coming very much easier to him. I am sure, too, that he has gained a lot of confidence and as a result is going to have a much more enjoyable holiday. There is one snag, however. His German *sounds* much too fluent. His hearers are liable to think he is quite a linguist and answer as they would to a fellow-national, so that he won't understand a word of it. When speaking "foreign" it is policy to falter or introduce a deliberate mistake or two. Then people try to help you by speaking slowly and clearly, keeping the sentences as short and simple as possible.

If any other readers try out this scheme, this column would be delighted to hear what sort of results they have.

Slow, Slow, Quick, Quick, Slow

As for the other sort of special gramophone records we discussed recently—Morse practice records—the majority of readers who have used them praise them pretty highly. Two would-be Morse students ask how the records would stand up to being played at varying speeds in order to get a greater w.p.m. range. I should imagine that E.P. or L.P. records played at slightly different speeds than those for which they were designed would not come to much harm, but big variations from their normal speed might well play havoc with the walls of the groove. Others might feel a bit of background mush may well make for better practice. In operational Code training, of course, extraneous noises are deliberately mixed with the signals, the ratio of noise being increased as the proficiency of the students increases. Perhaps readers with experience of this problem will let us know the effect on the life of records if played at widely varying speeds to the original.

useful for slow stuff such as hand signalling with lamps. For radio purposes the symbols must be learned as *sound*. Visualising what they look like on paper simply confuses the beginner when he actually hears it coming at him as sound. He wastes time trying to translate it into dots and dashes (the form in which he has learned it) until he realises he has the additional bother of unlearning this bad habit and starting properly.

Fancy Free!

The articles on radio teletype operation which appeared in *R.C.* during the early months of this year not only aroused considerable interest, but helped to break down many erroneous ideas. These articles, as far as I can trace, were the first dealing with the amateur aspect of this subject to be published in this country.

At one time it was generally thought by those unread in RTTY writings (of which, in the U.K. and Europe generally, there is a serious shortage) that this mode of transmission was a contravention of the conditions of the amateur transmitting licence. It isn't —upon the assurance of the G.P.O.— although it is suspected that from certain quarters approaches have been made to that Authority to have these facilities withdrawn. I can only assume that this has emanated from those with an unfounded fear that

Centre Tap talks about items of general interest

By the way, the same tip as quoted above *re* foreign language speaking applies equally to Morse. Everyone can send much faster than they can receive, especially those who can read at only low speeds. Hence there is a real danger of newly licensed amateurs pounding the key merrily on their first QSO's. The chap the other end naturally sends back at the same speed—one of the golden rules of good operating—and the poor beginner is sometimes left far behind, often getting in a flap and missing whole passages.

Still on the same subject, a reader since our No. 1 issue, of Staffs, who wishes to remain anonymous sends along a handwritten copy of a 10-minute Morse Memoriser. He loaned the original to the Civil Air Guard in 1939 and never got it back! Basically, the letters appear in faint outline, appropriately thickened with the dots and dashes of the Code symbols. The original card, he says, was sold for 6d. and also contained the Q-code similarly done in monograms. Such a system is, of course, useful to memorise the course and might be

RTTY is simply another form of "QRM-machinery".

To defend the interests of those who have already started off with this comparatively new branch of our hobby, and the many more on the verge now it is more generally realised that it doesn't cost the earth, the British Amateur Radio Teletype Group has been formed. Its aim is also to help enthusiasts with gen on the best amateur techniques and advice on the suitability of the available surplus gear. Already a small circulating library has been formed and No. 1 of their News Sheet circulated; and unlike most similar organisations, *no subscription* is required.

Licensed amateurs genuinely interested are invited to communicate with the Hon. Sec. B.A.R.T.G., who is none other than our old friend, Arthur C. Gee, G2UK, too well-known for his vigour and enterprise in the amateur world (especially in pioneering new movements) to need further introduction. His address is "East Keal," Romany Road, Oulton Broad, Suffolk.

Grateful Thanks

Before proceeding further, I should like to thank those kindly readers who sent get-well wishes during my recent illness. Their letters were greatly appreciated, easing as they did the monotony of bedfastness, and their encouraging words contributed to a speedier recovery.

This is not the first time I have had to publicly thank readers for their warm-hearted thoughtfulness, and on this occasion, as before, it gives me a feeling of embarrassment. It must appear almost as if I were trying to swank to any who are bored by this column that there are those who regularly read it. During a long career of radio journalism I have eagerly joined in whatever opportunity presented itself in furthering the spirit of fraternity which exists amongst radio hobbyists. Those letters, for which I am most humbly grateful, once again brought home to me just how real and unselfish that spirit is.

The Best, The Very Best

A letter has just come to hand from J.P. (West Worthing) who writes: "I especially enjoyed your reminiscences regarding stretch-and-doped linen speaker cones last month and I laughed outright at the idea of enthusiasts paying far more for better quality linen hankies to use as speaker cones than they ever did for those to wipe their noses on. I was one of those who did just that, and maybe I was the worst of all. I lived at Norwood at the time and made a special journey to the West End to one of the really high-class and most-gentlemanly type of Gentlemens' outfitters. I told them I wanted the best quality available. I forget exactly how much they cost but it was something in the region of what I normally paid for a dozen to use for such mundane purposes as nose-wiping.

"For days afterwards I used to wonder whether it was a 'special' price they had put on in order to convince me I was getting what I asked for—the best, the very best. Which only goes to confirm that what J.T. says is quite right. Then, just as now, we were prepared to pay through the nose for something we imagined would give us better reproduction. I certainly remember the 'Wufa' balanced armature speaker unit. I bought one in preference to the Blue Spot. What with its red painted magnet it looked impressively attractive, but I now wonder whether the real reason was that it cost a half-a-crown more—27s. 6d."

Under a Bushel

In recent months the garden-shedders have been quiescent, the problems of rust prevention and corrosion to their tools and equipment not being much of a fair weather problem. Not that the summer is entirely without its difficulties. The temperature of a garden workshop in full sun can easily soar up to well over 100° F in no time, playing havoc with dry batteries, plywood cabinets and even the enamel on copper wire.

Absence of news on the success or otherwise of the various suggestions put forward by readers is due, I imagine, to the mild, dry spring. No doubt with the cold damp nights of late autumn and winter fogs we shall be hearing some interesting verdicts.

There was an Exhibition of Corrosion Prevention beginning the 16th June last running for a month, organised by the Ministry of Supply. Ideas developed for protective packings for radar and electronic equipment for the Services were on display. These included a simple colour-changing humidity indicator and a container in which the desiccant can be changed through a quick-release moisture-proof seal which with a little ingenuity may well be adaptable to amateur uses.

Why didn't you get to hear about it? Well, the "advance news" we had about it from the Ministry was dated the 12th June—four days before the Exhibition opened—which is not much use to a monthly magazine. The only other announcement I saw about it were two placards on the Underground (which I rarely use) a few days before it was due to close. Wake up, M.o.S.—it must have been planned months beforehand.

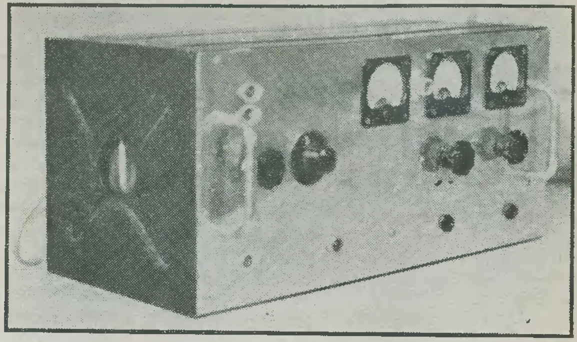
TRANSISTORS FOR THE EXPERIMENTER

Mullard Ltd. are still obtaining a fair number of enquiries for their booklet *Transistors for the Experimenter*, and no doubt several of these enquiries are from readers of this magazine.

This booklet is, in fact, now out of print and no stocks are left. It is hoped that at some time in the near future it will be possible to re-issue a new edition; if so, details of this will be published at the time.

A TRANSMITTER CIRCUIT

for 160 Metres



By **DAVID NOBLE, G3MAW,** *and* **DAVID M. PRATT, G3KEP**

NOTE: To operate the transmitter described in this article a Post Office Amateur (Sound) Licence is required. Full particulars of this, and other amateur licences, may be obtained from: General Post Office, Radio and Accommodation Department, Headquarters Building, St. Martin's-le-Grand, London, E.C.1.

The transmitter design to be described has been used by G3KEP for several years, and since then has been used with minor modifications by many other radio amateurs. All precautions have been taken in the design to ensure that no interference with broadcast and television reception is caused. Also, the mechanical layout and construction is so arranged that a frequency stability of a high degree is achieved.

Circuit

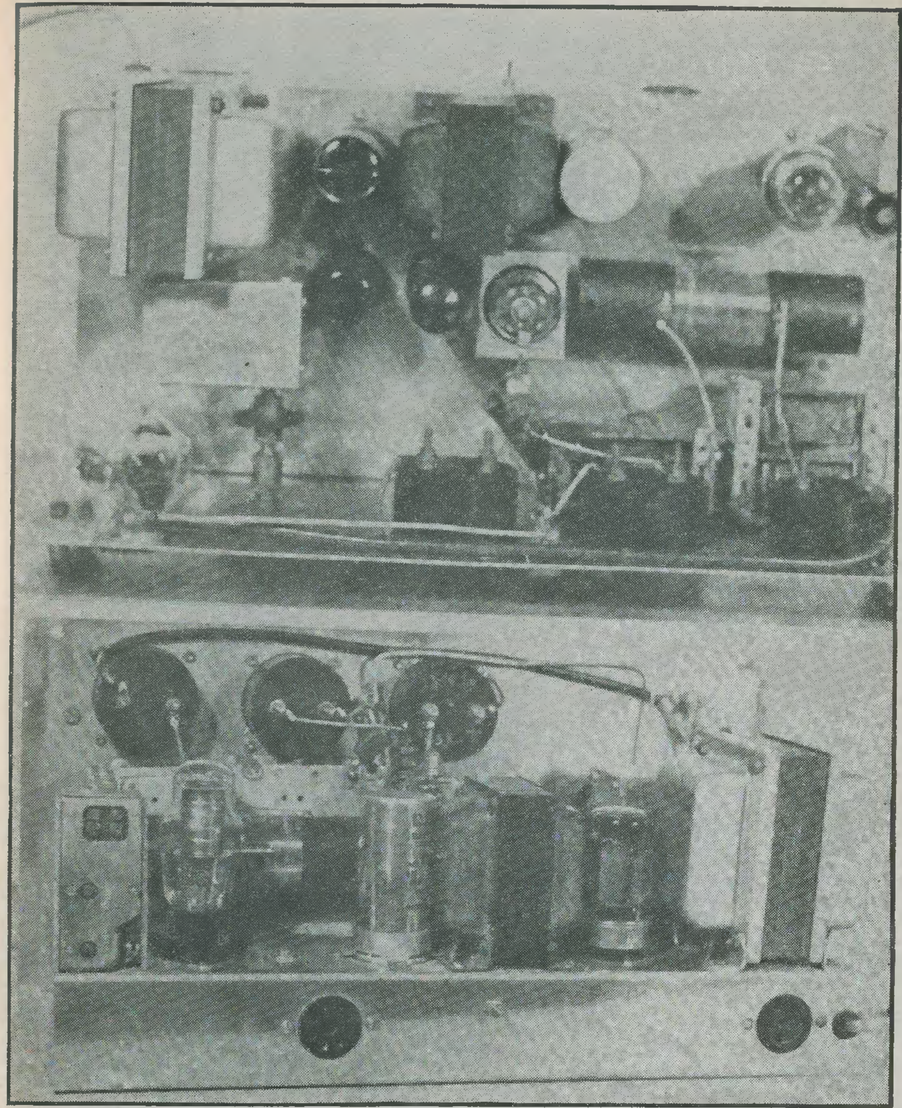
The circuit consists of a Clapp variable frequency oscillator feeding an untuned buffer amplifier, which drives the power amplifier valve. In the original design, a triode-connected 6AC7 was used in the v.f.o. stage; almost any general-purpose triode or r.f. pentode could be used in this stage. The h.t. voltage of the oscillator stage is kept constant by means of the voltage stabiliser valve V_1 connected from anode and screen-grid to chassis. Also, it will be seen that output from the v.f.o. is taken from the cathode of V_2, 6AC7. With the output taken from this electrode, the amount of "pulling" of the frequency when the output stage is tuned, is reduced.

The buffer stage employed a 6AG7 in the prototype, but a 6AC7, EF50, SP61, or EF80 should also work quite satisfactorily providing that C_{10} and C_{16} are adjusted to give a reading of approximately 1.5mA on the grid current meter, M_1.

P.A. Stage

Like the 807, and many other transmitting valves, the TT11 will stand a considerable amount of overloading without even the anode getting red hot! As the 807 is run at 150% of its recommended maximum ratings, so the TT11, rated at 8 watts input, has been run at 20 watts without *apparent* harm. This power, however, is not recommended for the 160 metre band for the simple reason that the maximum input permissible on this band is only 10 watts. Typical operation for 10 watts input is 300 volts at 33 milliamps anode current.

It will be seen that there is no cathode bias resistor in the p.a. valve. This has been omitted so as to ensure that the power amplifier is operating at its maximum efficiency. The inclusion of a cathode resistor will cause the p.a. not to draw excessive anode current when the grid drive is removed; but as keying is achieved by making and breaking the cathode circuit of the p.a., drive will always be present at the p.a. grid, and a bias resistor is not, therefore, necessary.

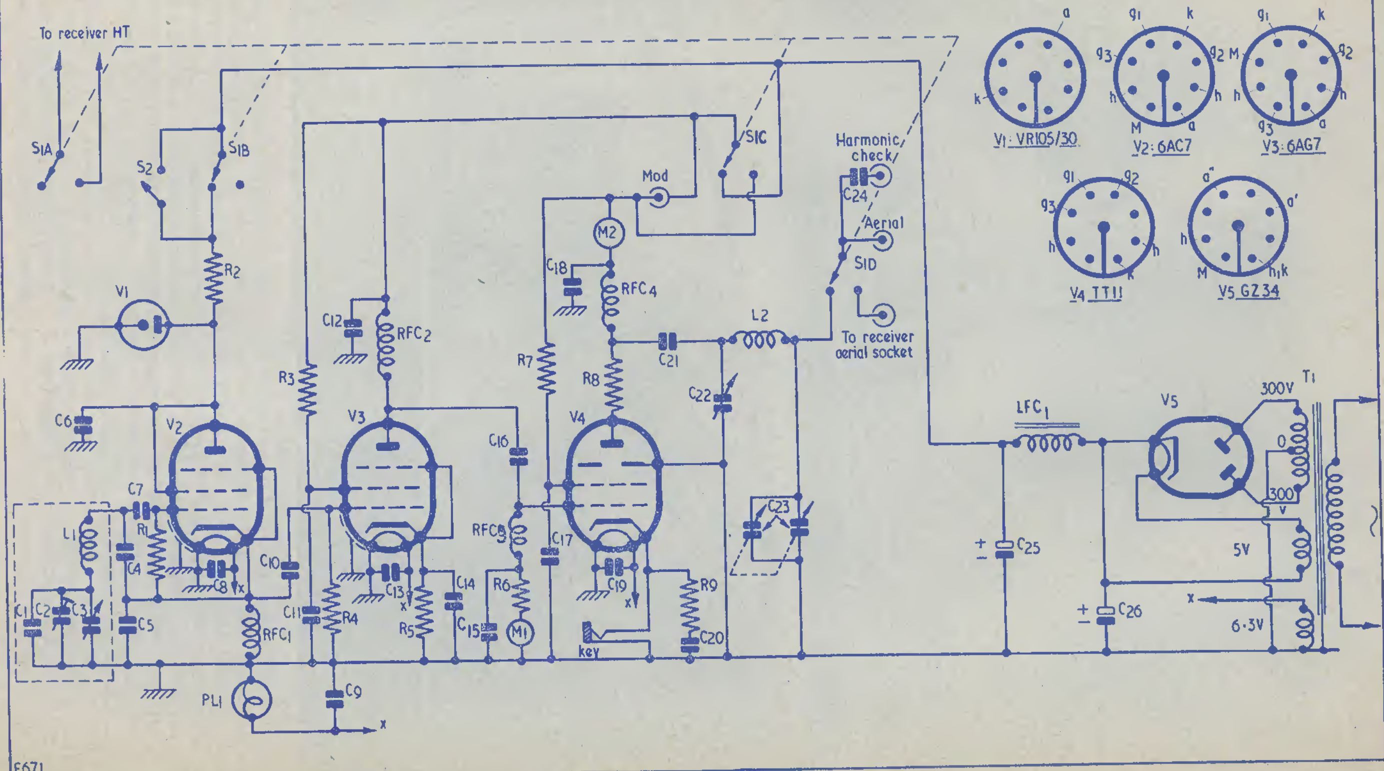


Above: Plan view of the transmitter unit. The v.f.o. screening box can be seen on the left. The power supply is built along the back of the chassis, and the voltage stabiliser valve can be seen mounted in the top right-hand corner of the picture. Round the p.a. valve is fitted another screening box, but this may not be found necessary. Below: On the back of the chassis, two valve-holders are fitted. One of these is provided so that external equipment may be fed from the transmitter power supply, and the other is the switch output to the receiver for muting

Switching

Two switches are provided; one "transmit-receive," and one "net on-off" for switching

Fig. 1. Circuit of the Transmitter designed by G3KEP and G3MAW. The change-over switch, S_1, is shown in the "Transmit" position



on the v.f.o. without the p.a. A three-position switch could be used if desired for "net-receive-transmit," thereby combining both S_1 and S_2 together. The contacts on S_1A, S_1C and S_1D would be connected in the "net" position as in the "receive" position, and S_1B as in the "transmit" position. It will be noted that receiver muting is provided for in the switching. Another feature employed in the design is that when the transmitter is switched to the "receive" position, the modulator input socket is shorted across to prevent flash-over.

Modulation

Provision for applying anode and screen-grid modulation of the p.a. valve is provided. An insulated Belling-Lee co-axial socket is fitted to the front panel. This was used because of its very good insulation characteristics. During initial experiments, jack plugs and sockets were used for transferring the modulation from the modulator to the transmitter, but under peaks of modulation the insulation was found to break down.

Power Supply

A power supply is included in the unit. It employs a standard circuit, the rectifier valve being a GZ34 as shown, or any other common rectifying valve rated to have a maximum current output of at least 80mA. The mains transformer, T_1, should have ratings of 300 volts at 80mA with 5 volts for the rectifier heater, and 6.3 volts at about 3 amps. for the other valves. The smoothing condensers in the power supply must have a working voltage of at least 500 volts as the voltage across them will increase when the transmitter is switched to "receive."

Components List

SET OUT FOR EASY REFERENCE TO FIG. 1 ABOVE

Resistors (¼ *watt unless otherwise stated*)

R_1	100kΩ
R_2	4.7kΩ, 2 watts
R_3	22kΩ, 1 watt
R_4	47kΩ
R_5	220Ω, 1 watt
R_6	27kΩ
R_7	15kΩ, 2 watts
R_8	47Ω
R_9	390Ω

Capacitors

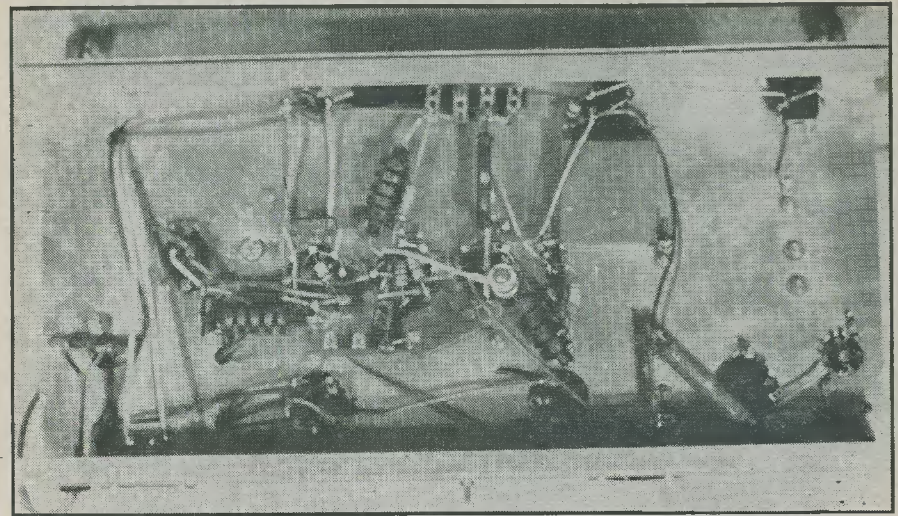
C_1, C_7	100pF silvered-mica
C_2	100pF air-spaced trimmer
C_3	50pF miniature air-spaced variable
C_4, C_5	1,000pF silvered-mica
C_6	0.1μF, 350V wkg. paper
C_8, C_9, C_{11}, C_{13}, C_{15}, C_{19}	1,000pF ceramic disc type
C_{10}, C_{16}	47pF silvered-mica
C_{12}, C_{14}	0.01μF, 350V wkg. paper
C_{17}	500pF silvered-mica
C_{18}	1,000pF, 2,000V wkg. silvered-mica
C_{20}	1μF, 350V wkg. paper
C_{21}	2,000pF, 2,000V wkg. silvered-mica
C_{22}	500pF ceramic insulated variable
C_{23}	2-gang receiving type variable 500pF per section. Both sections in parallel
C_{24}	10pF ceramic
C_{25}, C_{26}	50μF, 500V wkg. electrolytic

Coils

L_1	100 turns, 30 s.w.g. enamelled copper wire, close-wound on ⅝in former
L_2	60 turns, 22 s.w.g. enamelled copper wire, close-wound on 1⅜in former
R.F.C.	2.5mH R.F. Chokes

Miscellaneous Components

M_1	0–5mA meter (Grid current)
M_2	0–50mA meter (Anode current)
V_1	Brimar VR105/30
V_2	Brimar 6AC7
V_3	Brimar 6AG7
V_4	TT11 (VT501) (RK64)
V_5	GZ34 or 5Z4G, etc.
S_1	Transmit-Receive switch, 4-pole, 2-way
S_2	Netting switch, Single-pole, Single-throw Toggle switch
Ch_1	10 Henrys, 100mA Choke
PL_1	Panel lamp, 6.5 volts, 0.3 amps



This underside view of the transmitters shows that there is plenty of space available on a chassis $7\frac{1}{2}$ x $15\frac{1}{4}$ x 2in. The three r.f. chokes, it will be noted, are not wired such that they are mounted parallel to each other. They should be mounted as far apart as practically possible so as not to cause any instability

Conclusion

The title illustration shows the exterior view of the Top Band transmitter. In this particular unit, a meter is fitted in series with the aerial to indicate aerial current. It was not considered necessary to include this in the circuit described; but if readers wish to incorporate such a meter, it should be of the thermo-couple variety having a maximum r.f. current deflection of 0.5 amps.

As explained earlier, the design has been used by several amateur stations, and has been accepted as being satisfactory in all respects. No difficulty should be experienced in getting this rig to work correctly. If, however, any readers are overcome by difficulties, the writers would be glad to answer any technical problems that might arise.

TV SETS:

LEAD FOR SAFETY

Each year the public is being introduced to bigger and better television sets. Some concern has been expressed that the greater power needed to operate these sets will generate soft X-rays which may escape, and so add to the general background of radiation to which we are all now exposed.

Happily this is a groundless fear, because a very simple technique is available to ensure complete safety from hazards of this nature. X-rays emanating at this intensity can be effectively absorbed by thin lead foil which is readily available in this country. It can be pasted, after the fashion of paper, on the inside of a cabinet before the electronic components are assembled or, alternatively, incorporated into the body of the cabinet which is often of plywood construction.

Finally, the sheet of armour-plated glass placed in front of most television tubes can be made of lead glass, following the principle adopted by atomic scientists when dealing with this problem. In this way manufacturers can ensure that the whole set is completely encased in lead and so achieve absolute security.

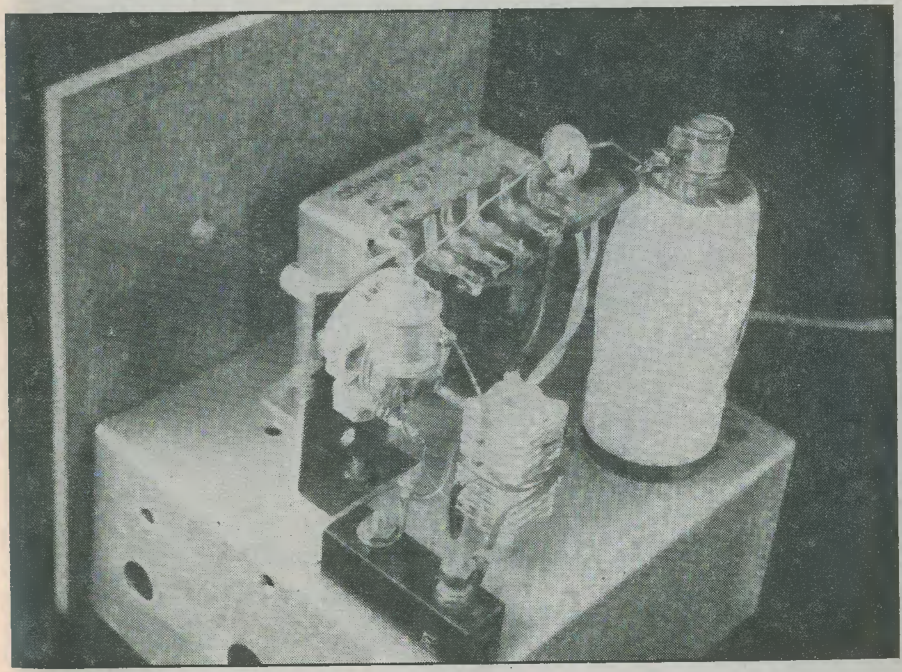
MAINS *model control transmitter*

by F. G. RAYER

A self-contained unit of this type is useful when adjusting or testing receivers or models indoors, in the garden, or any place where mains are available. It can be built at very low cost, and this is soon recovered by the saving on batteries. It is ideal for the control of model trucks, tanks or other vehicles or devices which are normally used in the house. In the case of boats and planes, it can be employed for initial adjustments, the battery-operated transmitter being retained for actual sailing or flying.

The circuit is shown in Fig. 1, and is a tunable oscillator which will operate with any triode, tetrode or pentode valve. Wiring is shown for a surplus SP61, but other valves are equally suitable. A large output is not needed, with the usual type of valve receiver, and the SP61, 6K7, 6C5, 6J5, or any similar type will give enough power. If a valveless or insensitive receiver is used, a more powerful output can be obtained by fitting a 6V6, 6BW6, or any similar output tetrode or pentode. The increased signal with such valves is very useful for the short range control of a model in which the receiver consists of a tuned circuit, crystal diode, and relay, with no valves or transistors.

When first running the transmitter, a check should be made that the maximum cathode current of the valve is not exceeded, and that



Rear view of mains model control transmitter the rectifier and mains transformer are not over-run. This will scarcely arise with small power valves, but needs checking when a large output valve is fitted. If excess current is noted, the value of the resistor "R" can be increased. The meter can be clipped across the h.t. line switch for this test. Current should rise, as the heater gains operating temperature, then dip suddenly as the valve commences to oscillate.

If a control key is wanted, this may be included in the cathode circuit. For adjustment of the model, the transmitter can, however, be brought into operation by means of the h.t. line switch. No mains switch is fitted, the mains plug being withdrawn when the unit is no longer required.

An h.t. secondary giving up to 50mA or 60mA, at 200 to 250V, will suffice even for 6V6 and similar output valves. The rectifier should be rated to suit. For smaller valves a 20mA transformer, as used in converters, etc., with a small rectifier, will give enough h.t. current. The SP61 only requires about 10mA.

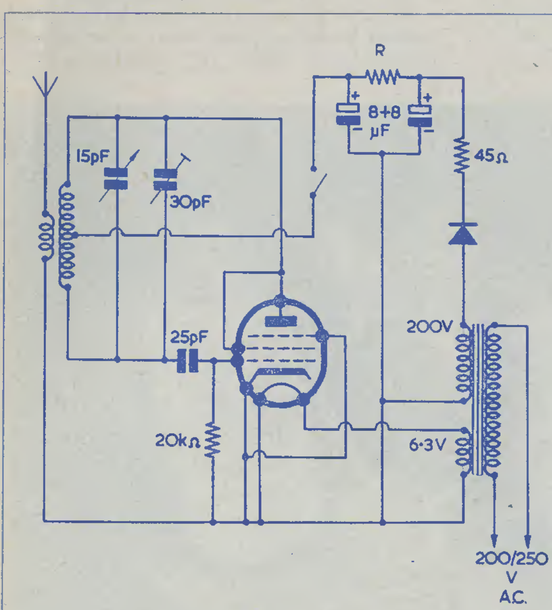


FIG.1. The Transmitter Circuit

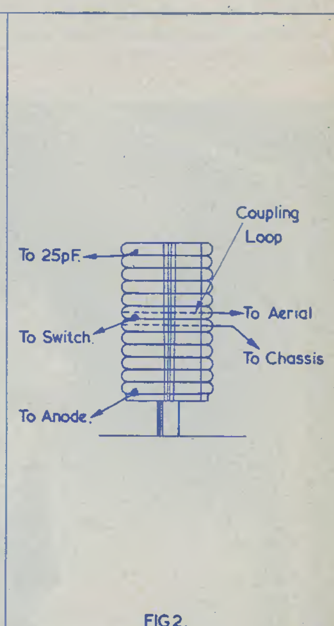


FIG.2. The Tuning Coil

M646

Tuning Coil

There is considerable latitude in diameter and gauge of wire, provided the number of turns is adjusted to bring the transmitter within the 27 Mc/s band. Using a former about ¾in across the ribs, notched for 12 turns per inch, ten or eleven turns will do, of 22 s.w.g. or 20 s.w.g. wire. A centre-tap is soldered on as shown in Fig. 2. The lower turns of the actual winding should not be in close proximity to the chassis.

The aerial coupling loop consists of two turns of insulated wire wound over the centre of the coil, as shown by the dotted lines in Fig. 2. The ends of the loop pass to two terminals. For an ordinary rod aerial, one terminal is in contact with the chassis.

Dimensions, and Building

Any small chassis able to accommodate the parts will be satisfactory, that illustrated being 4½in x 4½in x 2in deep. The components are arranged as in Fig. 3. The anode lead, from the bottom of the coil, passes down through a small hole. Centre-tap, heater, and other connections are taken through a further hole.

With the coil described, a 30pF beehive trimmer and 15pF panel trimmer were used in parallel. The beehive trimmer is initially set to such a value that further tuning comes within the swing of the 15pF condenser, which has a saw-cut in its spindle to take an insulated rod inserted through a hole in the panel. This trimmer must be insulated from the chassis. The surplus type with two small isolated inserts, to take 6BA screws, may be

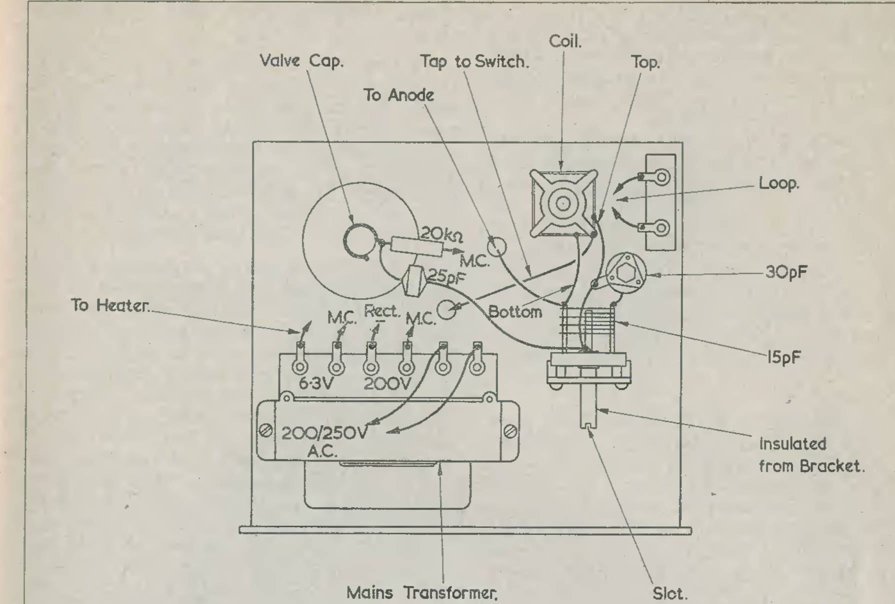


FIG.3. Top of Chassis Layout.

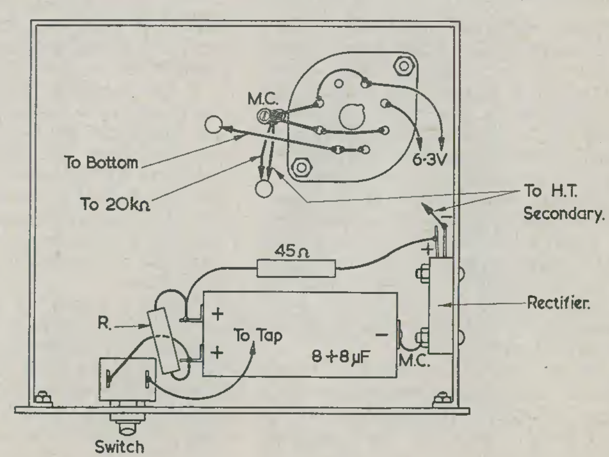


FIG.4. Wiring etc. under the Chassis

M647

bolted directly to a metal bracket.

The few connections under the chassis are shown in Fig. 4, wiring being for the SP61, which requires a Mazda octal holder with the keyway sockets slightly farther apart than the international octal type.

The small contact-cooled rectifier is bolted to a side runner. The 45 ohm resistor is to limit peak current, while resistor "R" may be 10kΩ for the SP61, with 200V h.t. secondary. If the maximum output is required from any particular valve, the value of this resistor may be reduced, or other resistors wired in parallel with it, until the maximum cathode current for the valve is approached. Larger rectifiers or smoothing condensers may easily be accommodated.

Testing

The h.t. current dip mentioned will show that the circuit is oscillating. An alternative test is to bring a lamp loop near the coil. Such a loop can consist of two turns of wire, an inch or so in diameter, soldered across a 0.06A bulb. The bulb should light as the loop is brought near the tuning coil. With power pentodes, a 6.3V, 0.3A bulb may be used, or the loop kept at a little distance, to avoid blowing the bulb.

When making adjustments, it should be remembered that the coil and trimmers are wired to the h.t. positive circuit, and they should therefore be set with an insulated tool.

To get the transmitter to the correct frequency, a calibrated bulb meter can be used, the trimmer being rotated until the meter shows that tuning is correct. Final adjustments should be made with the aerial connected, if an aerial is to be used. For short range, no aerial will be required. With most other indoor work, a vertical wire or rod some 9in to 18in long will suffice.

If a frequency meter employing a diode and meter is used, care is necessary that this is kept at sufficient distance, when the transmitter is fitted with a power valve. If not, the meter may be damaged. In addition, if a power pentode is used, and a long aerial, it should be checked that the maximum permitted radiated power rating is not being exceeded. This will not be so with small valves such as the SP61, but can arise with valves of large dissipation, when used with high voltages. The output can, if necessary, be kept within bounds by increasing the value of resistor "R." For currents up to 10mA, with a 10kΩ value, a 1-watt resistor may be used. Larger valves, taking about 25mA, with a 3kΩ resistor, will require a 2-watt rating here, while a 3-watt component will be necessary with a 1kΩ resistor passing up to about 55mA.

The First Engineering Materials and Design Exhibition and Conference 22nd-26th February, 1960, Earls Court

Engineering materials and design, embracing virtually every industry in the world, is the subject of a unique exhibition to be held in London next year—the Engineering Materials and Design Exhibition.

Under one roof, the Engineering Materials and Design Exhibition will display the largest and most varied selection of materials and components ever assembled for engineering designers in every sphere of constructional activity. Such a comprehensive display has not hitherto been available in the U.K., and in view of its obvious value is likely to attract world-wide interest among those responsible for the selection of engineering materials and components.

Engineering materials today include minerals, plastics, textiles, inorganic materials, rubber, adhesives, refractories, ceramics; numerous sintered products and compositions, as well as timber, cement, metals and alloys of all kinds, many of which are new or under active development.

New components are also under active development, particularly in the fields of miniaturisation, improved performance for operation at higher temperatures or under corrosive conditions, and incorporating new mechanical designs not hitherto available.

These materials and components embrace the activities of practically every industry, and include light and heavy engineering, manufacturing machinery, factory installations and power stations. They also cover the manufacture of medical equipment, aircraft, locomotives, ships, motor transport, radio and television equipment, nuclear plant, domestic appliances and industrial equipment of all kinds.

Associated with the Engineering Materials and Design Exhibition will be a Conference for Engineering Designers held at the same time and in the same building. Lectures and papers will be presented from leading experts whose subjects will include ferrous metals and alloys, light metals and alloys, insulating and other electrical engineering materials, refractories, plastics, adhesives, powder metallurgy, rubber, inorganic materials, bearings, clutches, casting techniques, seals, drives, couplings, control techniques, appearance design.

A.F. Signal Generator Calibration

By R. N. DAWSON

The writer recently completed an A.F. Signal Generator, and was faced with the problem of obtaining an accurate and reliable calibration. The method of Lissajous figures was considered but was rejected for two main reasons: (*a*) the figures become very complicated at the higher audio frequencies using the 50 c/s mains as standard, and (*b*) if one waveform is at all distorted the true figure is very difficult to decipher.

The final method adopted utilises a fundamental principle of the production of a stationary waveform in conjunction with the 'scope timebase.

The top trace in Fig. 1 represents the waveform which appears on the oscilloscope, the lower trace represents the timebase pulse. With the above arrangement three almost complete cycles will be shown on the screen during a timebase sweep O–A; a fraction of a cycle is then lost during the flyback stroke A–B, then three more almost complete cycles are traced out during the sweep B–C, and so on, thus a stationary waveform consisting of three peaks (counting the tops of the waves to avoid confusion) will be produced on the 'scope.

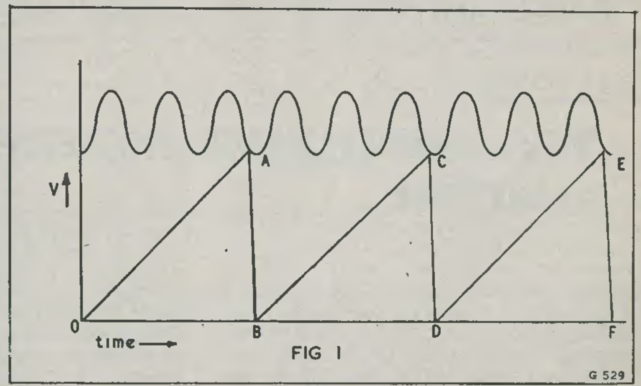


FIG 1

If the frequency of the original waveform is known, say f_o cycles per sec., then the duration of the timebase pulse in seconds may be calculated from the equation:

$$t_o = \frac{N_p}{f_o} \text{ seconds} \quad .. \quad .. \quad (1)$$

where t_o is the duration of the timebase pulse in secs.

N_p is the number of peaks (in the above case three).

f_o is the frequency of the waveform in cycles/secs.

If the timebase frequency remains constant and the frequency of the waveform is increased until the next stationary waveform appears on the 'scope, the waveform will be found to have one more peak than before, thus in the case being considered four peaks will appear, and if the waveform frequency is increased again five peaks will appear, then six and so on.

The frequency of any stationary waveform with number of peaks N'_p may be calculated from the equation:

$$f' = \frac{N'_p}{t_o} \text{c/s} \quad .. \quad .. \quad (2)$$

where f′ is the frequency of the waveform in cycles/sec.

N′p is the number of peaks.

t_o is the duration of the timebase pulse in secs. calculated from equation (1)

Method

Switch on the 'scope and the a.f. generator, and allow half-an-hour or so for the equipment to warm up and become steady.

A small voltage from a mains stepdown transformer is then applied to the input terminals of the 'scope. The timebase frequency is adjusted until three peaks remain stationary on the tube. The mains are then disconnected and the output of the generator applied to the input of the 'scope *leaving the timebase frequency constant*. The generator frequency is adjusted until three peaks of its waveform appear on the tube; the generator frequency is now at 50 c/s and the point may be marked on the dial or, as in the writer's case, if a 360° Perspex protractor is mounted behind the tuning knob so that it rotates with the tuning mechanism a handsome and accurate dial is produced and the frequency may be plotted on a graph of frequency against protractor angle.

This frequency is f_o in equation (1) and if three peaks are used the time of the timebase sweep t_o is $\frac{3}{50}$ secs. or 0.06 secs. The generator frequency is then increased until four peaks appear on the tube; from equation (2) the new frequency will be:

$$\frac{4}{0.06}=66.6 \text{ c/s.}$$

When the frequency is still further increased and five peaks are obtained the frequency is:

$$\frac{5}{0.06}=83.3 \text{ c/s.}$$

This procedure is repeated until the peaks become too close together to count. At this point the timebase frequency may be altered to give just 3 peaks again, equation (1) being applied to find the time of the new timebase pulse using the last generator frequency obtained as f_o. The number of peaks may then be increased as before by leaving the timebase frequency constant and increasing the generator frequency, applying equation (2) as each stationary waveform is obtained.

This procedure may be adopted over the entire range of the a.f. generator, thus obtaining an accurate calibration even at frequencies approaching inaudibility.

An alternative to using the 50 c/s mains as a standard is to connect a loudspeaker in parallel with the oscilloscope and tune one frequency on the generator to another note of known frequency such as middle C (c′) on a piano. For this alternative the frequencies of the middle scale of the piano are given:

c′	d′	e′	f′
512 c/s	576 c/s	640 c/s	682.7 c/s
g′	a′	b′	c″
768 c/s	853.3 c/s	960 c/s	1,024 c/s

In addition to calibrating the a.f. generator, the timebase of the 'scope has, of course, been calibrated in seconds. The 'scope may therefore be used for measuring the actual frequency of any waveform applied. Once the routine is obtained the method is extremely quick. The accuracy obtained by the writer was better than ±2% on all ranges.

TELEVISION

T.V. IMPULSIVE INTERFERENCE LIMITER

by J. A. CUSDIN

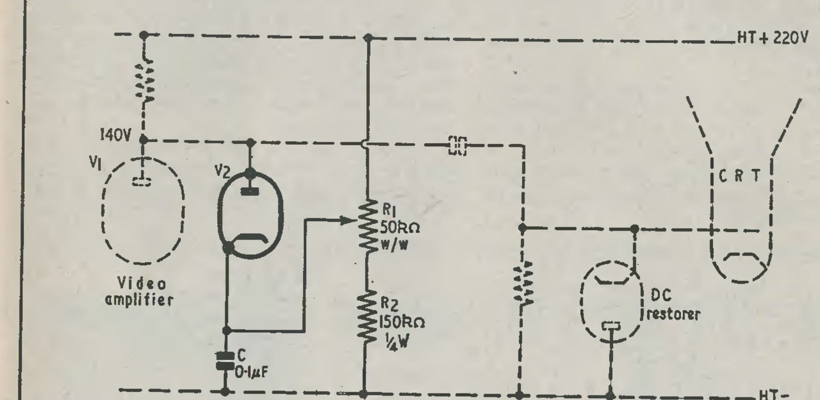
Having moved from a secluded backwater in a town to the dubious peace of the country, the nearby arterial road soon produced a steady flow of vehicles of which few could have been fitted with suppressors in the ignition system. This was plainly visible on the screen of my vintage t.v. receiver as either random snowflakes of varying size all over the screen or as horizontal chains of white blobs floating up and down the picture. At the rush-hour periods and week-ends the entertainment value of the received picture was nearly nil, so it was necessary to add a few components in the form of an impulsive interference limiter. This is a conventional circuit and in one form or another is fitted to all modern sets. The one now to be described cost about 5s. by using ex-Government parts, and should take about an hour to fit.

The Circuit

In Fig. 1 the receiver circuit is shown dotted and the new additions in firm lines. From this it will be seen to comprise a diode V_2 shunted from the anode of the video amplifier V_1 to earth via the d.c. blocking capacitor C, and a potential-divider network R_1 R_2 from h.t.+ to earth, by which a varying bias may be applied to the diode.

The Operation of the Circuit

It is known that a diode will only conduct when its anode is more positive than its cathode and that when it is conducting it is virtually a very low resistance. Hence if the voltage at V_1 anode is more positive than V_2 cathode then the video signal will be shunted to earth instead of being passed to the modulating electrode of the c.r.t.—in this case the grid. By adjustment of R_1 it is possible to set the level at which the diode begins to conduct; and remembering that the voltage at the anode of V_1 fluctuates in the example given between 140 volts (black level) and, say, 200 volts (peak white), then as interference pulses are above peak white it is advisable to set the slider of R_1 to produce a potential of just under 200 volts at the cathode of the diode. In this way the diode will just affect the peak white portions of the picture and entirely eliminate any interference which exceeds peak white. It will not, of course, eliminate white spots in the black and dark grey areas of the picture, but it does prevent them reaching an excessive size which is due to defocusing of the beam occasioned by the poor regulation of the e.h.t. supply.



E660

Fig.1

Design

The total of the two resistors should be such as to pass 1–2 milliamps (say 200kΩ) and their individual values to provide at their junction a potential equal to that at the anode of V_1 in the absence of a signal. The diode V_2 must be a special low-resistance type such as an EA50, half an EB91 or the newer germanium crystal diodes. Capacitor C may have any value between 0.05 and 0.1µF and should be of the paper dielectric type rated at 250 volts or over.

Construction

The components may be mounted on a small paxolin panel so that the knob of R_1 is accessible from the side or rear of the cabinet, taking care that the lead from the anode of V_1 is kept well away from the chassis to prevent undue capacity to the latter. Heater supply for an EA50 can usually be taken from the c.r.t. if 6.3 volt heater, or from the other valve heaters if they are 6.3 volt valves connected in parallel, since the EA50 only takes 0.15 amp.

Results

Although the set to which this was fitted had very good e.h.t. regulation (Mains e.h.t.) which allowed only moderate defocusing of the beam, it is now possible to view in comfort with the heaviest rush of traffic passing the house with only a small loss in the highlights. This limiter would be even more essential on a set with flyback e.h.t., where interference spots can reach an enormous size.

Warning

The diode will be damaged if connected with the wrong polarity, and the circuit as given is only suitable for a positive-going signal at the anode of V_1, i.e. grid modulated c.r.t. with either a.c. or d.c. coupling.

A TRANSISTOR AUDIO SIGNAL OSCILLATOR

Designed by D. J. FRENCH, Grad. I.E.E.
(Henry's Radio Ltd.)

THE AVERAGE HOME CONSTRUCTOR CAN never have enough test equipment in the workshop and, to the writer's knowledge, is always on the look-out for compact, efficient and reasonably priced units—either in published circuit form or complete kits.

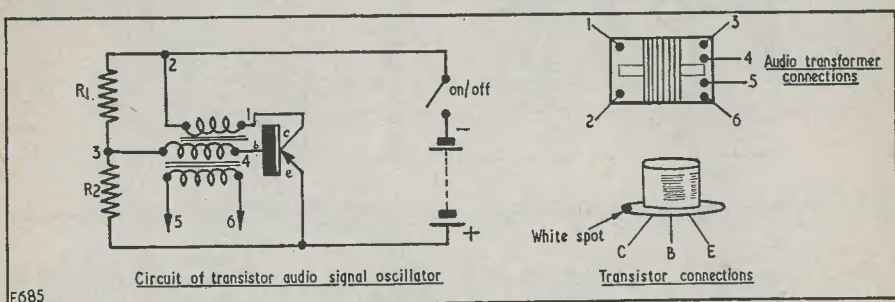
The circuit offered here is both cheap and efficient, the inclusion of a transistor ensuring portability and compactness. The unit may be used in tracing faults, particularly in audio amplifying stages, modulators, for modulating r.f. signal generators, etc., or as a morse practice unit.

The audio signal oscillator is, as will be seen from the circuit, extremely simple, but it will deliver a very large output due to the low impedance of the terminal output numbered 5 and 6 respectively. The load impedance shown is of average value and alteration to this will slightly affect the audio frequency. The total consumption of the unit is 3mA approximately.

For those requiring a morse practice oscillator, replacing the on/off slide switch with a morse key, and the connection into circuit of a balanced armature or low impedance headphones across the output terminals will result in a very cheap and compact little unit.

Constructing the unit is simple and only takes a few minutes to complete. The circuit board, complete with battery clips, is provided. Particular attention should be paid to the correct transformer connections and these are shown alongside the circuit diagram, as are the correct transistor connections.

This handy little unit, when completed, will occupy little shelf space and is capable of performing a multiplicity of services to the home constructor.



Circuit of transistor audio signal oscillator

Transistor connections

COMPONENTS LIST

R_1 220kΩ ⅛ watt ±20%
R_2 15kΩ ⅛ watt ±20%
Audio transformer EN2082 (Henry's Radio Ltd.)
Battery—Ever Ready B121 (15V)
Transistor—Ediswan XB104
Transistor holder
Chassis with mounted battery clips (Henry's Radio Ltd.)
On/off single-pole slide switch

★ BOOK ★ REVIEWS ★

TELEVISION SERVICING HANDBOOK. By Gordon J. King, ASSOC.BRIT.I.R.E., M.I.P.R.E., M.T.S. 280 pages, 165 diagrams and illustrations. Published by Odhams Press Ltd., 96 Long Acre, London, W.C.2. Price 30s.

From start to finish this is a practical book in the fullest sense of the term. Theory and principles have deliberately been omitted, for the author is concerned only with explaining how to service television receivers. He is himself an experienced radio engineer and the wide knowledge he possesses is clear to see, for throughout his book there is an abundance of information which only first-hand practical experience could provide.

The author has in effect classified faults and defects into a dozen basic types. For example, four early chapters deal respectively with (*a*) no sound, vision or raster, (*b*) no raster, normal sound, (*c*) no sound or vision, raster normal, and (*d*) no vision, sound and raster normal. Following chapters are devoted to fault-tracing in the sound channel, servicing timebases, synchronisation faults, vision a.g.c. systems, picture tube faults, receiver alignment, miscellaneous faults, aerials and feeders, and Band III conversions.

Throughout the book the line of attack follows the basic pattern of briefly describing what happens in each particular circuit and why, what can cause the faults encountered, and how to analyse and rectify it. Several commercial receivers and their circuit diagrams are used as examples, and this gives the author many opportunities to pinpoint certain characteristics or idiosyncrasies of particular models. There is a wealth of knowledge and "know-how" available in this book to anyone acquiring it. It is well worth its price for this alone; for good measure one obtains the usual quality of production for which Odhams are well known.

TAPE RECORDING AS A PASTIME. By Douglas Gardner and Ian Arnison. 141 pages, 14 diagrams and illustrations. Published by Souvenir Press Ltd., 94 Charlotte Street, London, W.1. Price 15s.

Quite a lot of people, on acquiring a tape recorder, find it to be a wonderful new toy which guarantees to produce utter amazement when their acquaintances hear their own voices played back to them. Of course, the owner himself is the first to be surprised when he hears his own voice, and just cannot believe it, but the joy in seeing his friends similarly affected is not the enduring pleasure he thought it would be. The hapless owner, sooner or later, casts around for fresh fields to conquer, and finds to his further surprise that his imagination suffers certain limitations, and that new ideas would be good to know. At this stage he needs to have this book at hand.

The authors describe many ways in which a tape recorder can be used for recording conversations, radio programmes, favourite gramophone records, or using tape for personal correspondence, as a medium for livening up a party, producing sound effects, recording for educational purposes, accompaniments to home movies, using the recorder for improving the production of amateur dramatics, and many other purposes. They have a wealth of ideas, and they write about them in a way that makes very enjoyable reading.

Taking care of the recorder and the tapes is given attention under one chapter heading, while another one tells in broad outline and non-technical terms how the recorder works. Editing and dubbing is also dealt with at some length. There is more food for thought in this little book than one would bargain for at a first glance. The writer of the Foreword calls it an exceptional book. It certainly is just that.

W. E. THOMPSON

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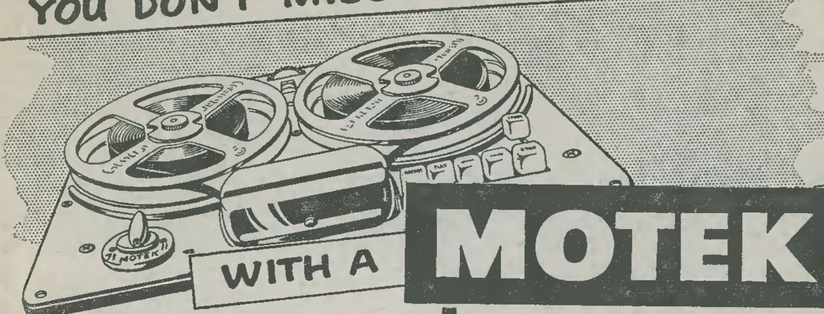

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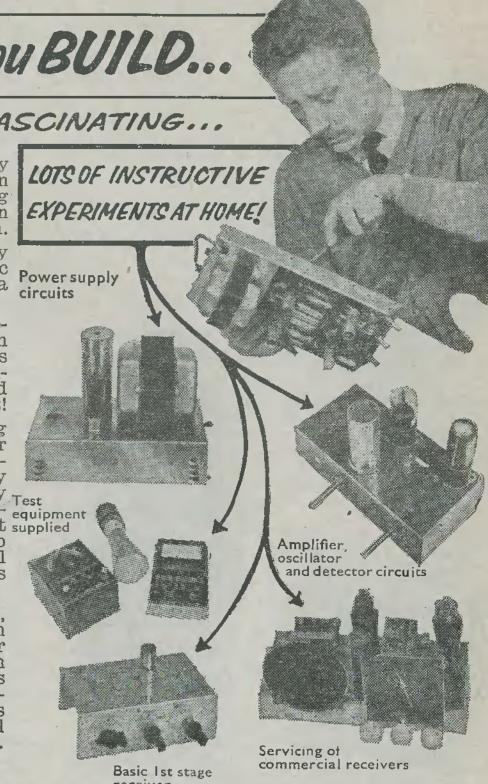

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3V4	8/–	EZ40	7/6	ECC85	7/6	PL81	11/6
*DK96	8/6	EL84	9/–	EY51	12/–	PL82	8/6
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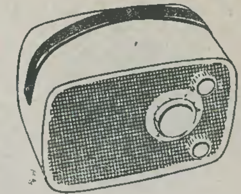

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(See page 58 this issue)

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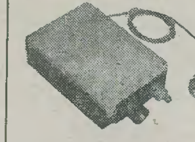

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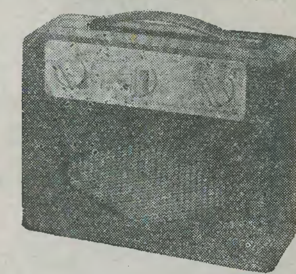

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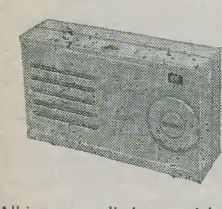

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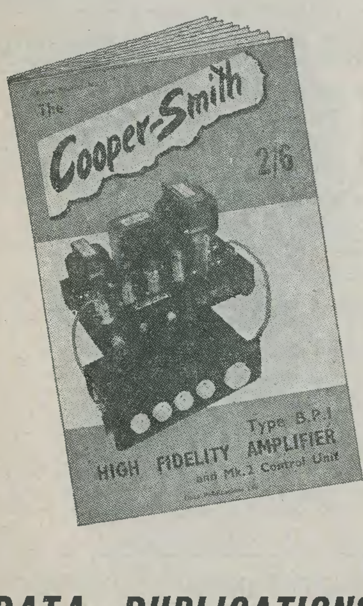

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continued on page 71

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6BH6	7/6	12BE6	8/6	ECH81	10/–	UBC41	9/6
6BJ6	7/6	12C8M	7/6	ECL80	11/6	UBF89	9/6
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6BW6	9/–	12K8M	12/6	EF36	4/–	UCH42	9/6
6C4	4/6	12Q7GT	6/6	EF39	4/6	UCH81	9/6
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continued from page 69

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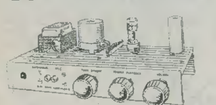

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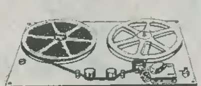

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