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VOLUME 12
NUMBER 9
APRIL
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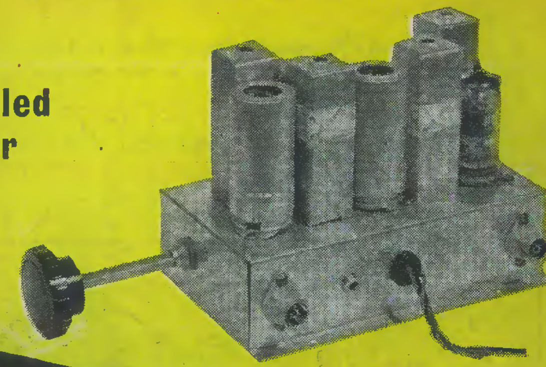

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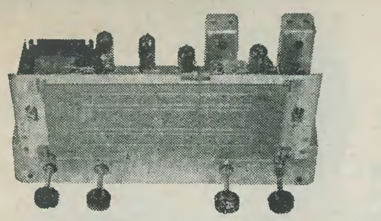

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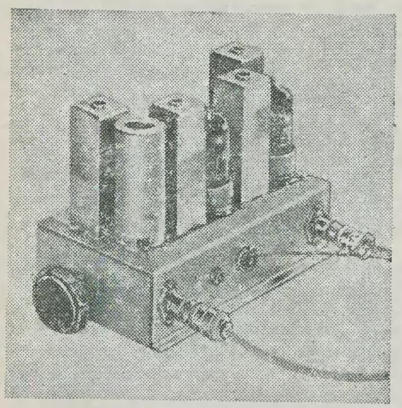

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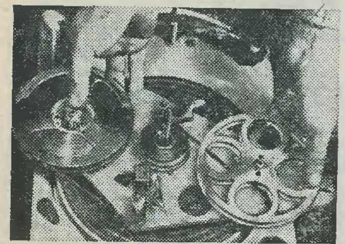

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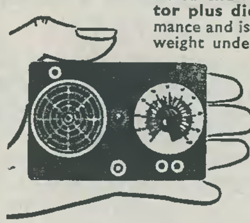

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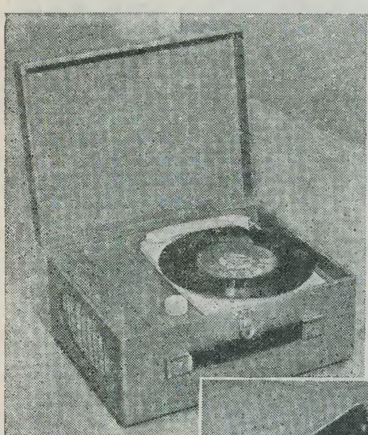

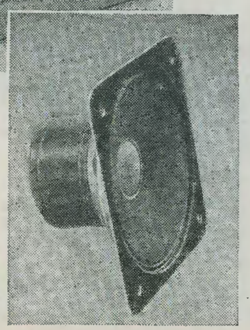

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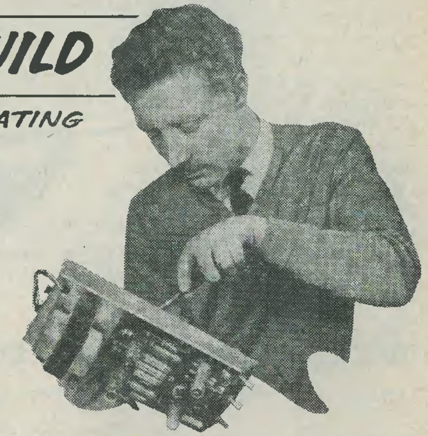

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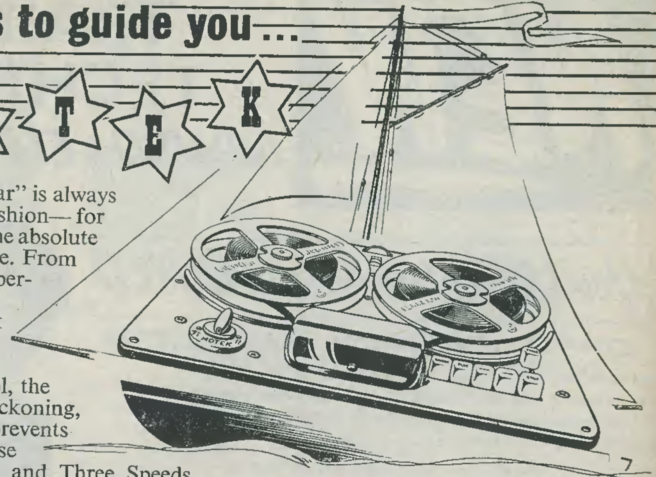

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CONTENTS

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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.

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suggested circuits

No. 101 A Keying Monitor for Amateur Transmitters

It is some considerable time since the Suggested Circuits Series included a design which would be of interest to amateur transmitters. This month's contribution is intended to make good this omission, and it covers the design of a simple and somewhat novel keying monitor for c.w. transmissions. This monitor has two important advantages. Firstly, it automatically enables a tone of controllable level to be reproduced over the receiver headphones or loudspeaker without the necessity of any transmit/receive switching circuits whatsoever. Secondly, it functions entirely from the aerial output of the transmitter, thereby providing a true picture of the signal which is being put on the air.

The Circuit

The circuit of the keying monitor accompanies this article, and it may be noted that the number of components involved is small and that power requirements are capable of being met quite easily. Indeed, the only power needed for the circuit is a heater supply for the two valves V_1 and V_2. Such a supply may be readily obtained from a small heater transformer or by taking advantage of the mains transformers in either the receiver or transmitter power packs. No external source of h.t. is needed.

The circuit functions in the following manner. The "pick-up wire" shown in the diagram is mounted close to the transmitter aerial lead or the output tank circuit, and the tuned circuit L_1, C_1 is adjusted to resonate at the centre of the band on which it is intended to transmit. Thus, when the transmitter key is depressed an r.f. voltage appears across L_1, C_1. This r.f. voltage is rectified by diode V_1, causing a d.c. voltage to appear across reservoir condenser C_2. This d.c. voltage is then applied, *as a source of high tension*, to the audio oscillator V_2.

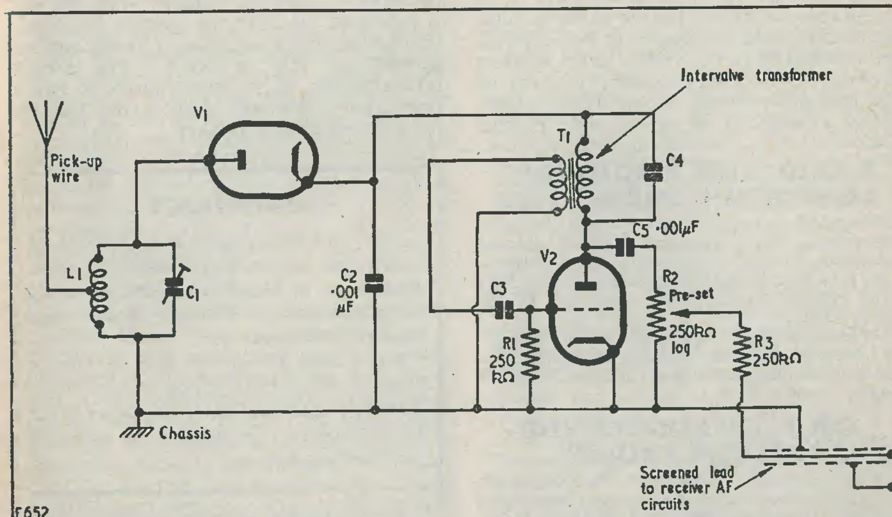
In the diagram V_2 is shown as a tuned anode oscillator, in which the inductive element is provided by an "intervalve" a.f. transformer. The secondary of this transformer (i.e. the winding having the greater number of turns) is tuned by condenser C_4, whilst the primary provides the necessary feedback to the grid. A transformer having a ratio between 1:3 and 1:5 should work well in the circuit. Any other efficient type of a.f. oscillator (Hartley, etc.) may be used in place of that illustrated, if it is felt desirable to take advantage of laminated inductors which may already be on hand. Phase-shift oscillators, whose power requirements are liable to be high, should not be used.

The tone generated by the a.f. oscillator is applied, via condenser C_5, to the pre-set potentiometer R_2. The slider of this potentiometer then connects, through the series resistor R_3, to a suitable grid circuit in the receiver a.f. amplifier stages. (If receiver grid bias arrangements are liable to be upset by this connection, a 0.01μF d.c. blocking condenser should be added in series with R_3). R_3 is included to ensure that the performance of the a.f. amplifier is not unduly modified due to the presence of the additional grid connection.

The overall functioning of the monitor circuit may be usefully summed up by considering what occurs when the transmitter key is raised and when it is depressed. When the key is raised, no r.f. appears across tuned circuit L_1, C_1, and V_2 is inoperative. Also, the receiver functions normally, the performance of its a.f. stages being only slightly modified because of the presence, in the circuit, of series resistor R_3. When the key is depressed, r.f. appears across L_1, C_1, and h.t. is applied to the a.f. oscillator. As a result an a.f. tone is passed to the receiver for subsequent reproduction over the associated headphones or loudspeaker. Thus, the device monitors the output of the transmitter, causing a tone to be heard whenever r.f. is present at this point.

power requirement. There are several important reasons for this decision. To begin with, a thermionic diode in the V_1 position offers slightly higher efficiency—with slightly less damping of the tuned circuit—than does a germanium diode; and it provides the considerable advantage of having a much higher peak inverse voltage rating. (High inverse voltages could easily be applied accidentally to the diode during initial setting up or, even, during normal running.) A second reason for employing valves is concerned with V_2. In this case it will probably be found easier to obtain a high degree of efficiency from a valve a.f. oscillator than it would if a transistor were employed with the result that, since a heater current requirement is already laid down by the choice of a thermionic diode, the valve offers perhaps the slightly more attractive choice. Also, since valve type requirements are not at all critical, the valve may prove to be more inexpensive than a transistor.

The tuned circuit L_1, C_1, should resonate at the centre of the band on which it is intended to transmit, and it is desirable to employ a fairly high-Q coil here and to aim at a high L/C ratio in order to obtain optimum efficiency. Due to the damping



Design Considerations

A number of points of design need to be discussed a little more fully. When the circuit was first being considered by the writer, it was decided, after due thought, to employ valves instead of semiconductors in the V_1 and V_2 positions, even though they introduced the disadvantage of a heater

provided by the diode and its load, the tuned circuit should be capable of providing a sensibly constant r.f. voltage over the range of frequencies covered in a single amateur band. The "pick-up wire" is coupled into the coil about a third of the way up from the earthy end. It would be desirable to keep the "pick-up wire" as short as is consistent with

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station layout. For this reason, the whole monitor unit should be mounted fairly close to the transmitter or its aerial lead.

The reservoir condenser C_2 has a slightly lower value than might normally be employed when it is considered that it performs the secondary role of completing the a.f. circuit to V_2 anode. The reason for using a low value here is that of preventing "rounding-off" of Morse characters. Such "rounding-off" might otherwise occur when, firstly, the key has just been depressed, and C_2 is charging up to its full voltage, and secondly, when the key has just been raised and C_2 is discharging into the a.f. oscillator circuit. The value chosen for C_2 should give complete protection against "rounding-off" even at very high sending speeds.

The valves V_1 and V_2 require no special consideration in so far as particular types are concerned. V_1 may be any diode which would normally be considered suitable as a detector in an a.m. receiver. V_2 may be any low-mu triode of the 6J5 class, or it may consist of a triode-strapped pentode offering approximately the same characteristics.

The A.F. Oscillator

Several references have been made above to the necessity for high efficiency in the a.f. oscillator stage. High efficiency here is, in fact, a most important feature of the monitor device if reliable working is to be achieved; and it would be very advisable to get this part of the circuit working adequately with the aid of a temporary battery supply for h.t. before finally connecting it up to the rectifier reservoir condenser, C_2. It should be quite feasible to obtain reliable a.f. oscillation with an h.t. potential of some 10 volts or less, and with an anode current which is a fraction of a milliamp only. The fact that the oscillator has to develop negligible power should help considerably in this respect. Quite a lot will depend on the choice of an inductor for the oscillator circuit which possesses sufficient inductance to maintain a high L/C ratio, and it is for this reason that an "intervalve" transformer is recommended in the diagram. Values for condensers C_3 and C_4 are not specified in the circuit, as these both have to be determined experimentally. The value of C_3 is that which offers optimum efficiency, whilst the value of C_4 is that which enables the desired tone frequency to be obtained. (Incidentally, the tone frequency may change slightly when the oscillator h.t. supply is changed from the temporary battery to the V_1 rectifier circuit.)

Setting Up

After the circuit has been completed, all that remains is for it to be set up. The coupling between the "pick-up wire" and the transmitter circuit should be varied until it is just sufficiently tight to enable the a.f. oscillator to function reliably when the key is depressed. It will quite possibly be found, in practice, that a surprisingly loose coupling suffices for this to occur. The pre-set potentiometer, R_2, is then adjusted to give a comfortable sidetone level in the receiver headphones or loudspeaker.

RADIO AND ELECTRONIC COMPONENT SHOW, 1959

The 16th annual Radio and Electronic Component Show, organised by the Radio and Electronic Component Manufacturers' Federation, is to be held at Grosvenor House and Park Lane House, London, W.1, from 6th to 9th April, 1959.

Admission (from 10 a.m. to 6 p.m. daily) is by invitation only, applications for tickets to be made to the Secretary, R.E.C.M.F., 21 Tothill Street, London, S.W.1.

C.R.T. INTRODUCE THE "GOLDEN TOUCH"

A new method of complete rebuilding of the gun in a cathode ray tube has been introduced by C.R.T. Ltd., Royston Road, Baldock, Herts.

This involves an exclusive metallising process which, it is claimed, will improve the emission characteristics and suppress secondary effects, which are found existent in normally re-conditioned guns.

A feature of this process is that proof is provided that the envelope has, in fact, been opened, because the gun has a distinctive colour —gold!

This improved and exclusive C.R.T. service will be free of extra cost.

OBITUARY

It is with great regret that we have to record the sudden death, from bronchial pneumonia, of Mr. F. J. Camm, editor of our contemporaries *Practical Wireless* and *Practical Television*.

Mr. Camm joined the staff of George Newnes Ltd. in 1930, and at the time of his death was the editor of all magazines in the *Practical* group. He was also the author of many technical books.

The death also occurred recently of Mr. T. L. Eckersley, a pioneer of radio, particularly in the field of short wave propagation.

During the last war he was Chief Scientific Adviser to the Inter-Services Ionosphere Bureau established at the Marconi research laboratories at Great Baddow. In March 1938 he was elected a Fellow of the Royal Society.

This month Smithy the Serviceman tries to explain to his assistant, Dick, that successful servicing is not entirely a matter of luck

NAPOLEON IS REPORTED TO HAVE STATED that no officer, however competent, was of any use to him unless he was also lucky. And Napoleon won a few battles in his day. Had Smithy, who in a somewhat lesser sphere had himself emerged successful from one or two conflicts, been asked his opinion of this statement he would have wholeheartedly agreed that it was also pertinent to service engineers. "But then," Smithy would have added, "if you set about the job correctly in the first place you are giving your luck the chance to show itself."

In this, Smithy differed markedly from his assistant Dick. Dick considered luck to be his natural prerogative and was vociferously indignant if, at any time, it was ever denied him. It was a consequence of these two differing outlooks that, whilst Dick occasionally managed to diagnose in a startlingly short time and entirely by accident a really difficult snag, his average time per repair was significantly longer than was that of the patient, and slightly plodding, Serviceman. Also, in the course of a day Dick was liable to be the recipient of a number of shocks, cuts, bruises, and other minor damage to his person, whilst Smithy emerged from his daily labours unscathed.

Ill-fortune

On the particular morning on which this episode opens the star which governed Dick's fortunes was in complete eclipse. Even Smithy, who had become used to a fairly constant stream of agonised grunts and mutterings from behind him, had to come to the conclusion that his assistant was having a particularly rough time of it. The climax to Dick's performance occurred when, after putting his hand inside the cabinet of a television receiver he had just been trying out, he gave a yell of surprise and jumped several feet away from his bench.

"For goodness' sake," complained Smithy, turning round, "just sit down and take it easy for a few minutes! All this morning you've been doing nothing else but gash yourself, drill holes in yourself, and electrocute yourself; all with an unbroken accompaniment of screams and cries of anguish. How on earth can I concentrate on my work when I've got what sounds like the torture chambers of *Nineteen Eighty-Four* going on at full blast behind me?"

"Sorry, Smithy," said Dick, glowering resentfully at the cabinet on his bench. "It's just that my luck's out today."

"Well, now, anybody can get a shock very occasionally," conceded the Serviceman, "but you've been giving yourself belts every five minutes with unfailing regularity. What are you trying to do, re-vitalise yourself?"

"Of course not," said Dick indignantly. "I've just had a bad morning, that's all. For instance, look at that t.v. on the bench. I've

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just taken it off the rack and given it a quick test run. I disconnect it from the mains, put my hand inside, and get the worst shock I've had for ages."

"I presume," Smithy sounded a little sarcastic, "that you applied your enquiring finger to the c.r.t. final anode connector. Cathode ray tubes *do* hold charges after the set's switched off, you know."

"In this set," Dick said, very aggrievedly, "the final anode connector is covered with a p.v.c. cap. I got *this* shock from the outside graphite coating."

Smithy chuckled.

"O.K., I'll agree with you there, you were unlucky. What are you going to do now?"

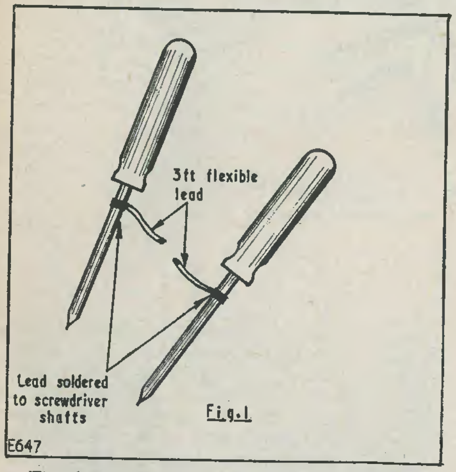


Fig. 1. A simple short-circuiting device, as shown here, performs a useful function when handling charged cathode ray tubes. The screwdrivers are cheap plastic-handled 8in or 9in types, and their blades are capable of reaching awkwardly-placed terminals, including final anode connectors covered by rubber or p.v.c. shrouds. When short-circuiting a c.r.t. the "earthy" contact should preferably be made first

"Follow your advice and take it easy! And ask *you*, if you would, to have a perfunctory butcher's at that cellulose-cased man-trap."

"Dear me," remarked the Serviceman, mildly, "it's only a television set, you know. Well, now, if you've just had shock from the outer graphite coating of the tube it's obvious that this isn't earthed to chassis. Whereupon there is the very probable snag that the spring contact between chassis and the tube isn't making properly. A minor possibility is that the set has its own e.h.t. reservoir condenser, and that it isn't *meant* to have a tube with an outside graphite coating fitted to it. However, this particular set isn't venerable enough to fall into that category. I can't see the earthing spring very well with the cabinet on, so I might as well take this off right now."

Taking care to avoid touching the cathode ray tube, Smithy removed the cabinet.

"The next job," he said, "is to short out the charge which caused you such anguish. In this particular case there's not much point in starting off by shorting the tube final anode to chassis. I shall first have to short it to its own outside graphite. So let us apply our patent shorter-outer."

Dick silently handed Smithy one of the simple short-circuiting devices that were employed in the Workshop (Fig. 1), whereupon Smithy proceeded to short-circuit the condenser formed by the inner and outer graphite coatings of the tube.

"Quite a nice fat spark," commented the Serviceman. "I'll short the final anode to chassis just to make certain, and then we'll have a quick look at the chassis connection. Ah! What's happened is obvious and commonplace enough—the chassis connection spring has either lost its springiness or got bent out of shape, and it's not touching the tube graphite at all."

"I don't get that," remarked Dick. "When I switched on the set I got quite a nice bright picture."

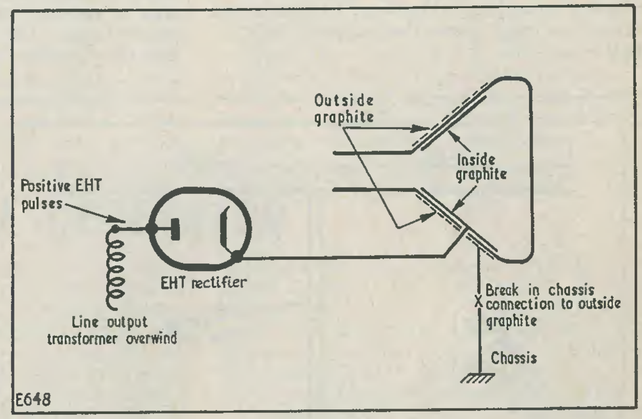
"That's not surprising," replied the Serviceman. "With this snag you get rather the same poor regulation effect as you do with an ordinary h.t. supply having an open-circuit reservoir condenser. (Fig. 2.) Provided the brilliance, and hence the tube beam current, isn't set too high, enough e.h.t. voltage should appear on the final anode to give you quite a bright picture. But as I said, the voltage regulation is poor; with the result that when the overall picture brightness goes up e.h.t. goes down, and vice versa. The drop in e.h.t. has the secondary effect of causing both line and frame deflector coils to give greater scan, and so you get a picture that opens out as the scene gets brighter and which closes up as the scene gets darker. An effect, incidentally, which is very noticeable when there are quick scene changes."

"You sound," said Dick, "as though people would be quite happy to sit in front of a picture given by a televisor suffering from this fault."

"In many cases," said Smithy, "I honestly think they are. I've had quite a few sets in for repair over the past few years where there was no chassis connection to the outside graphite of the tube. Sometimes the earthing spring had been bent out of shape or had been badly positioned. This last trouble, incidentally, is very prevalent with 21in tubes, as these do not have a large outside graphite area. In some of the cases I handled

the initial set design had left a little to be desired, because one only had to choose a tube whose outside graphite area was a bit small, or push a good tube home with too much energy, for the earthing springs to touch nothing but glass. The basic point I want to make, however, is that these sets didn't always come in with a complaint applicable to the type of snag we're talking about. Very often it was some other fault altogether which caused the customers to send them in for repair; and I only found the e.h.t. snag during normal routine checks."

Fig. 2. In a conventional e.h.t. system positive pulses from the line output transformer overwind are passed, via the e.h.t. rectifier, to the final anode of the c.r.t. This consists, partly, of a graphite coating inside the cone of the tube. The internal coating forms one plate of the e.h.t. reservoir condenser, an outside graphite coating providing the second plate. If the connection to chassis of the outside coating becomes broken the e.h.t. reservoir condenser is out of circuit, and e.h.t. voltage regulation suffers



Unseen Faults

"I see," remarked Dick, thoughtfully. "This makes me think that there must be quite a lot of other snags which set-owners put up with quite happily. Almost as though they don't realise that there *is* a fault."

"That's perfectly true," replied Smithy. "Whilst on the subject of cathode ray tubes, one of the most prevalent of these 'unseen' faults is the common-or-garden dirty screen."

"Ah, I'm on home ground here," interrupted Dick, assuming a leering expression of almost incredible depravity. "Meester, you want dirty t.v. picture? Vairy dirty, vairy feelthy?"

"I said dirty *screen*," broke in Smithy. "This is not Port Said, matey! Anyway, to return to the subject, it's almost unbelievable the amount of fine dirt which can collect on the screen of an ordinary c.r.t. in some models over a year or so. I suppose that the high potential held by the screen when the set is switched on has a lot to do with this collection of dirt. Anyway, after the screen has been cleaned up, the increase in picture brightness is almost fantastic."

"That's an easy one, anyway," remarked Dick. "I've cleaned enough c.r.t. screens with a little water and detergent to know how to overcome *that* trouble."

"Indeed you have," agreed Smithy, "and don't forget to mention that you should always use cotton wool or some similarly soft material for the process. Another snag the customers seem to put up with quite happily is bad tuner and switch contacts."

"What's the cure there? Bend up the old contacts?"

"That's the last thing you want to do. Fortunately, there's a contact cleaning product which was introduced a year or so ago and which is ideal for this sort of trouble. Indeed, it has received so many compliments from people who've tried it that I would like to mention it here. This new product is called 'Electrolube,' and so far as contact-cleaning fluids are concerned, it seems to be the cat's whiskers. I understand that one well-known set manufacturer has recently recommended it for cleaning the contacts of their turret tuners in the field."

"Fair enough," remarked Dick. "Any other snags which the customer ignores?"

"Lack of interlace and focus are two good ones," replied Smithy. "Especially in the case of the former, when interlace requires a fairly critical setting of the frame hold

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control. The trouble is that many viewers just cannot understand what interlace is. You'd be surprised, too, at how many people even nowadays like a fuzzy, slightly unfocused, picture. I've even had one or two complaints about 'all the lines in the picture' after I've re-focused a set."

"What about such things as line and frame scan getting less as the appropriate output bottles get tired of life?"

"First of all," remarked Smithy, a little acidly, "I don't like a question which also makes the assumption that reduced line or frame scan is *inevitably* due to worn-out output valves. However, that's by the way. In point of fact, set-owners are on to reduced line or frame scan like a cat on to a mouse. Perhaps they can see that they're obviously missing something! Anyway, I think we've talked enough about customer idiosyncrasies."

"Then it was probably just a minor case of M.P.P.

"M.P.P.?"

"M.P.P.," repeated Smithy, gravely, "which stands for Multi-Path Propagation. As you know, f.m. signals are put out on Band II and they act in the same manner as t.v. signals, insofar that they can be reflected by metal objects and so on. If an f.m. aerial picks up the direct signal plus one or two reflected signals the time difference between these can result in phase differences at the receiver discriminator. Such phase differences may then result in quite noticeable distortion. Usually, the effect is most liable to happen if you use the compressed internal aerial in the receiver cabinet, whereupon a cure—which is quite often successful—consists of moving the receiver to another part of the room. The reflected signal pattern at this new position may not be so conducive

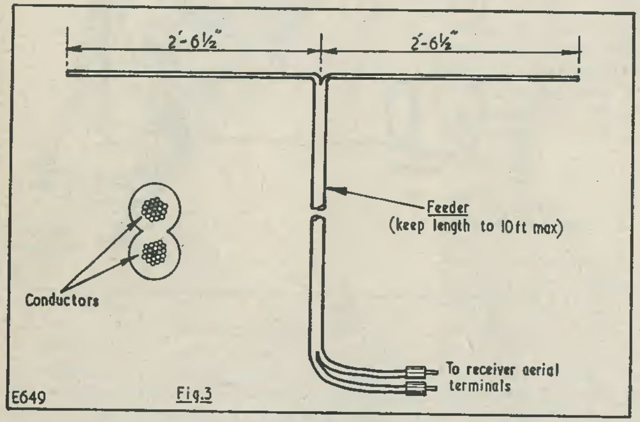

Fig. 3. Distortion in f.m. receivers caused by multi-path propagation can quite often be cleared by fitting an elementary "indoor" dipole as shown here. The dipole and feeder is made up with lighting flex, a satisfactory choice consisting of figure-8 section plastic flex (see inset) of the type which may be conveniently split down the centre

FM Receivers

"As you like," said Dick, equably, "I always agree with people who use long words. Anyway, I've got a question on quite a different subject for you."

"Fire away."

"A friend of mine bought himself an f.m. sound radio the other day and tried it out at home. So far as quiet background and suppression of interference were concerned the set seemed to work quite well; but there was a harsh sort of distortion on the programmes it reproduced. As luck would have it he then moved the set into another room, whereupon the distortion cleared. Any idea of the reason for that?"

"Did he operate the set with its own internal aerial?"

Dick nodded his head up and down.

to M.P.P. distortion. If this idea fails, a further reasonably simple cure consists of fitting an indoor aerial. A half-wave dipole, the arms of which consist of strands of lighting flex, will often cope here. Indeed, with figure-8 section plastic flex, of the type which is easily parted down the middle, one can make quite a neat dipole without the necessity for joints anywhere. (Fig. 3.) The arms of the dipole can be mounted on the picture rail and, so long as the 'feeder' section isn't longer than, say, 10ft or so, the fact that it isn't truly 75 ohms can be fairly safely ignored. Such an aerial will often overcome M.P.P. distortion without incurring too much expense."

"What about combined t.v. and f.m. sets?"

"Well, these," said Smithy, "introduce a

special problem. If they have an aerial socket which is common for both f.m. and t.v., then the f.m. circuits have to work from the t.v. aerial. This is, obviously, not a very efficient set-up for f.m. reception, because the t.v. dipole, firstly, has the wrong length and, secondly, it is vertically polarised. Theoretically, one could hardly think of a more ineffective aerial for Band II horizontally polarised signals! In practice, however, t.v. aerials seem to work fairly well on f.m. If nothing else, they normally possess the considerable virtue of being mounted in a high location. Due to their basic unsuitability for f.m. reception, the risk of getting M.P.P. distortion with t.v. aerials is, unfortunately, greater than with correctly orientated horizontal Band II dipoles.

"When a t.v. set has separate sockets for f.m. and t.v. you have a little more freedom to play around with aerial systems. There is, on the other hand, the disadvantage that, if you *do* get good f.m. signals from the t.v. aerial, then you have to split the aerial feeder so that it connects to both input sockets. With, possibly, some loss of t.v. signal strength."

"Quite an awkward problem," commented Dick.

"From the set designer's point of view, the business of working out the aerial sockets on a combined f.m./t.v. receiver is probably the least of his worries," chuckled the Serviceman. "Usually, the worst job is the switching involved in the receiver itself. For instance, when you go on to f.m. the tube and timebases have to be switched off, for a start. Then, the i.f. strip has to stop working as a television i.f. amplifier and start functioning as an f.m. strip. Also, the tuner unit has to be able to switch to Band II with enough fine tuner range to be able to pick out the three local f.m. stations. Quite a difficult bit of design work."

"Oh, well," said Dick, in a somewhat subdued tone, "perhaps I'd have better luck servicing sets rather than designing them."

"If *you* designed sets," commented Smithy, most unkindly, "I would pack up servicing altogether and become a bookmaker!"

NEW SIGNAL GENERATOR

A new A.M. Signal Generator known as Model 68AM, covering a frequency range of 100 kc/s to 240 Mc/s *all on fundamentals*, has just been released. This exceptionally wide range on fundamentals is unique on the market, particularly if one also considers the reasonable price, high accuracy, incorporated meter for monitoring r.f. output, and the separate dummy aerial. Particular attention has been paid to good attenuation, and the leakage is indeed negligible. The frequencies of 100 kc/s to 240 Mc/s are spread over eight Bands, and the total scale length is 58in.

The ranges are continuous and, as mentioned, entirely *on fundamentals*, with a calibration accuracy of $\pm 1\%$. A dummy aerial complete with a coaxial lead and socket, is supplied with each instrument. Five alternative terminations covering a wide variety of applications are available, including a special lead for a.c./d.c. receivers. The instrument is invaluable to the radio and t.v. serviceman, as well as to manufacturers and amateurs.

The list price is £32.10s. subject to the usual discounts to the trade.

SIEMENS-EDISWAN
P.T.F.E. Insulated Instrument Wire

P.T.F.E. instrument wire for use in electrical instruments and equipment is now available from Siemens Edison Swan Ltd. Initially, two types are available; for use at voltages up to 500 volts r.m.s. and 1,000 volts r.m.s. They are to Ministry of Supply (Air) Specification EL 1930 types B and C.

Applications are expected to be wide, notably in the aircraft, electronic and chemical industries. Eleven colours are available.

The wire, for use where conductor temperatures of between −75° C. and 250° C. are experienced, has either single or stranded annealed copper wires each silver-plated to a radial thickness of not less than 0.00003in.

The P.T.F.E. is extruded, which permits a high degree of concentricity to be obtained.

Whilst the insulation is not loose, it can be cleanly stripped for connections.

Electrically, P.T.F.E. has high dielectric strength and low power factor. It offers complete chemical resistance to all known solvents except molten sodium and fluorine gas. P.T.F.E. instrument wire is non-chafing owing to the low coefficient of friction; it is highly flexible, and will not harden or perish.

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The Application of... VISION A.G.C.

By

GORDON J. KING, *Assoc. Brit. I.R.E.*

WHILST ALL RECENT TELEVISION RECEIVERS feature a system of automatic gain control (a.g.c.) of the visual channel, a large number of older models are still in use in which vision a.g.c. is not incorporated. Apart from combating the effects of signal fading in areas removed from a transmitting station, the chief advantage of vision a.g.c. these days lies in its ability in avoiding adjustments to receivers, contrast and sensitivity controls when changing from one channel to another. Unless a reasonable balance of signal can be achieved at the aerials, such adjustments are frequently demanded on old style single-band receivers which have been adapted for multi-channel operation. The problem does not usually arise so far as the sound channel is concerned, since even in very early specimens some form of sound a.g.c. was engineered in the design, and this has been common practice through the years.

Selective Fading

When considering vision a.g.c., the experimenter may justifiably contemplate the connection of the sound channel a.g.c. line to the vision i.f. stages. Although such practice undoubtedly provides some form of a.g.c. for the vision channel, it is rarely very successful since it often happens that the sound and vision signals do not vary in accordance with a common pattern. In fringe areas in particular, the sound signal may be fading while the vision signal is increasing, and vice versa. A common a.g.c. line operated from the sound signal would prove most embarrassing under such conditions and, as an example, may well serve to increase the sensitivity of, say, the vision channel when it should really be decreased. In order to eliminate the effect of this random fading between the sound and vision signals (usually referred to as selective fading), it is essential to control the sound and vision channels wholly independently.

It may have been noticed by experimenters and service technicians that the sound a.g.c. line on some receivers is, in fact, connected to the vision a.g.c. line. The reason for this is to protect the controlled valves and the video amplifier valve of the vision channel in the event of failure of the vision signal, and not essentially to contribute control bias derived from the sound signal to the vision channel a.g.c. line.

Obtaining an A.G.C. Control Bias

In the sound channel it is a simple matter to secure an a.g.c. control potential by extracting a portion of the r.f. sound carrier through a diode to provide a d.c. bias which is negative with respect to chassis, and whose magnitude is dependent on the strength of the carrier. This system is adopted in all broadcast receivers and in the sound section of television receivers, and is made easily possible because an amplitude modulated radio signal varies about a mean signal level.

A television signal, on the other hand, has no mean level when the modulation rises with brightness of the scene being transmitted, which is a characteristic of positive modulation as used in the U.K. This problem is not encountered in America owing to the employment of negative modulation. When vision a.g.c. was first being investigated this side of the Atlantic, therefore, a simple method synonymous to that used in sound-only receivers was not considered desirable. However, it was later revealed that the average level of picture modulation during the course of a programme remains substantially constant, and a simple form of a.g.c. in the vision channel was developed, along with more complex methods adopting tricky circuits for sampling the vision signal at black level.

Both schemes have now been in use for a number of years, and both have been the subject of extensive tests made by the author. There is little doubt that, although the complicated methods have some advantage when the average brightness of a picture alters considerably during a programme, their complexity over the simple system is hardly warranted in the majority of cases and locations, including fringe areas.

A Simple Vision A.G.C. System

If a high resistance voltmeter is connected between the control grid of the sync separator valve and receiver chassis, it will be discovered that a negative voltage here exists whose magnitude depends upon the strength of the signal applied to the receiver; if the sensitivity control is backed off the voltage will be found to decrease, while if the control is advanced the voltage will be found to increase. If the aerial is taken from the set the voltage will disappear completely. This voltage exists due to grid current in the grid resistor of the sync separator valve as the result of the application of positive-going sync pulses from the video amplifier. It is ideal for use as an a.g.c. control bias, and is exploited in this way in almost all receivers which feature the simple method of vision channel a.g.c.

In Fig. 1 is shown a typical pentode sync separator stage, in which R_g is the grid resistor mentioned above. Now in order to obtain from this stage an a.g.c. bias which is suitable for controlling the gain of certain valves associated with the amplification of the vision signal, four extra components only are required (R_1, R_2, C_1 and C_2) as shown in the circuit. The value of R_g may vary slightly between circuits from 1MΩ to 2.2MΩ, but it is rarely necessary to alter it at all. The voltage across R_g, negative to chassis, is applied across R_1 and R_2 in series. A portion of the voltage, therefore, is developed across R_2, which itself is a potentiometer and can be adjusted to tap off any value of negative bias from zero to a maximum as governed by the voltage actually present across R_g and the values of R_1 and R_2. Average values for R_1 and R_2 are given, but if a larger value of negative vias is called for, the value of R_1 can be reduced accordingly. Capacitors C_1 and C_2 simply serve to rid the a.g.c. control line of picture signal and sync pulses.

The Controlled Stages

In Fig. 2 is shown the circuit of the r.f. frequency changer and first vision i.f. stages of a representative old-style single-band (five-channel) receiver It is typical in most respects, though possibly more complex than some models, but serves admirably to illustrate the sections under discussion.

As no vision a.g.c. is incorporated, the gain of the r.f. and first vision i.f. stages is controlled by varying the cathode resistance of the valves concerned. The 5kΩ contrast control serves this function in the normal way. Since it is our aim to apply vision a.g.c. to this circuit, this method of contrast control is no longer possible, as the a.g.c. action would tend to maintain constant the overall gain of the vision channel within the limits of its control. The idea, then, is to re-arrange the circuit so that the contrast and a.g.c. control bias can be applied directly to the grid circuits of the controlled valves.

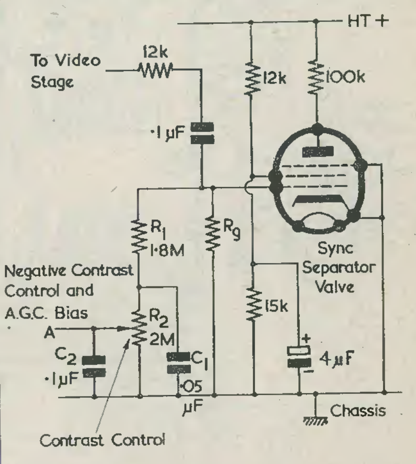

FIG.1.

A typical Pentode Sync Separator stage, to which R_1, R_2, C_1 and C_2 are added in order to provide an A.G.C. Bias.

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The circuit in Fig. 3 shows how this is accomplished. The original contrast control is removed completely, and the cathode circuits of stages V_1 and V_3 are returned to chassis, as though the original contrast control was set at maximum. The original cathode resistors should be kept in circuit, as shown, so that the valves are never operated without bias, the resistors producing a standing bias at all times. The low value resistors, 47Ω in Fig. 3, maintain a constant input impedance irrespective of control bias, and should also be kept in circuit. The return circuits of the control grids of stages V_1 and V_3 are disconnected from chassis and "earthed" from the r.f. aspect by capacitors C_3 and C_4. From the d.c. point of view they are connected to the a.g.c. and contrast

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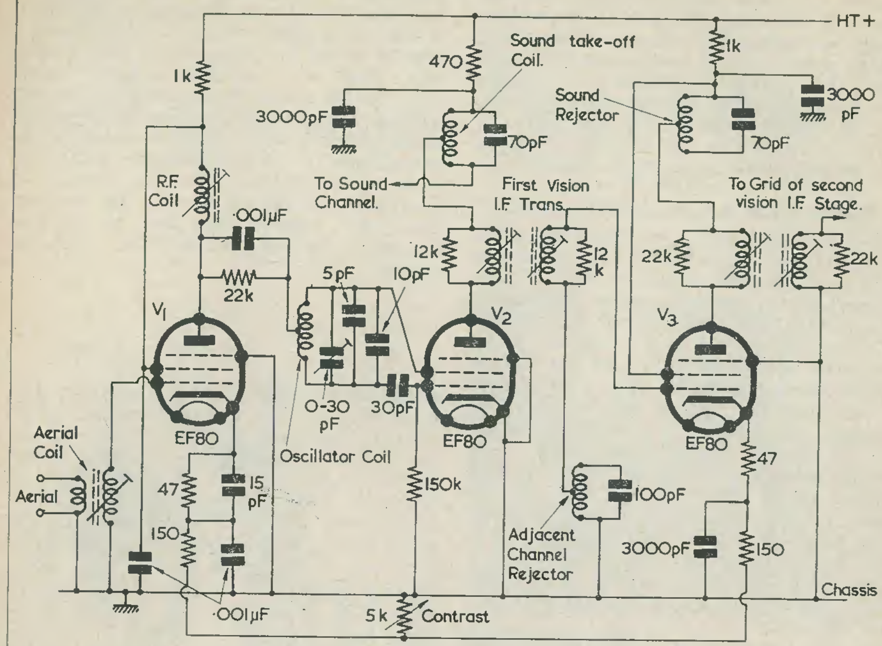

FIG.2.
Circuit Diagram of representative R.F., Frequency Changer and vision I.F. stages to which it is proposed to add Vision A.G.C.

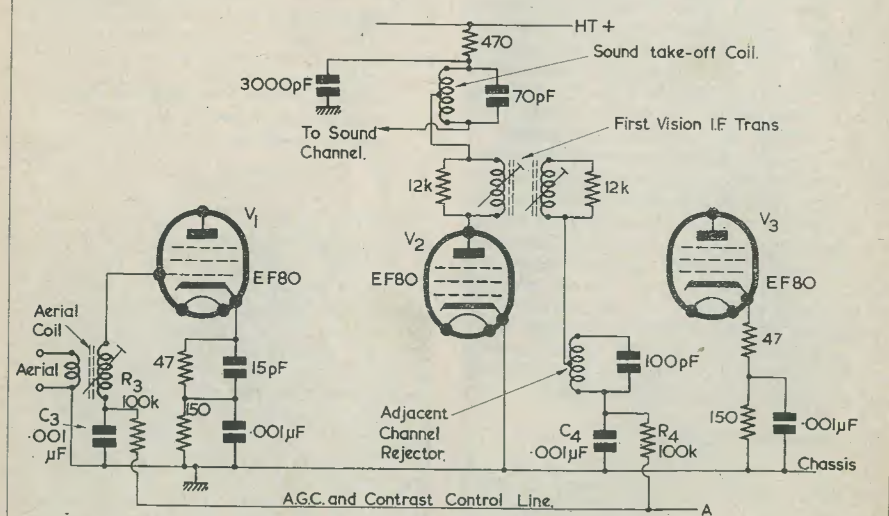

FIG.3.
Showing how the Circuit of FIG.2 is modified to cater for the application of Vision A.G.C.

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control line by way of R_3 and R_4, as indicated in Fig. 3. The modification is thus completed simply by connecting point A on Fig. 1 to point A on Fig. 3.

The general operation of the system can be realized from the fact that as the signal strength increases the bias applied to the controlled valves will rise negatively and cause a reduction in gain to combat the signal increase, and will become less negative and cause an increase in gain as the signal strength falls.

A manual form of contrast is provided by the potentiometer R_2 in Fig. 1, which for optimum automatic control, should be set as near as possible towards the R_1 side of the track.

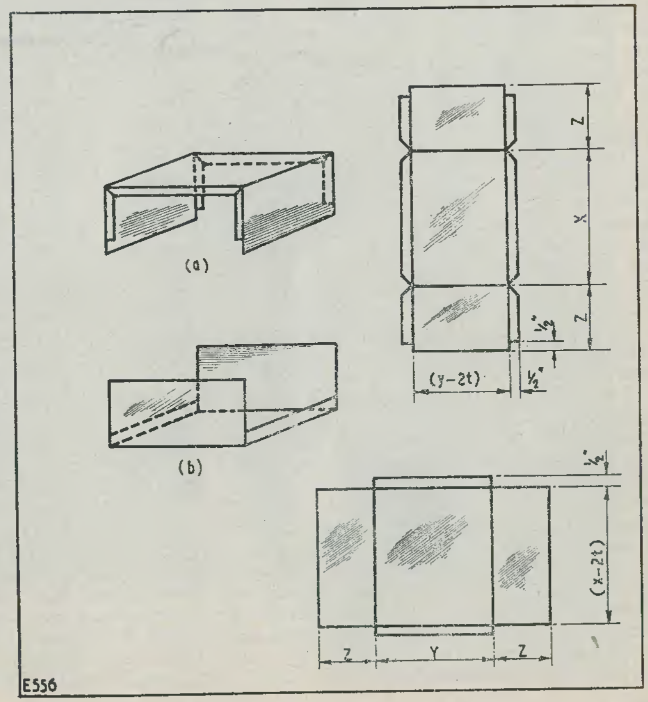
The modifications outlined above are well worth while incorporating in receivers to which have been fitted multi-channel tuners. Some tuners feature a point for connecting to an a.g.c. line, while others have a manual sensitivity control or controls. In fringe areas, it is often desirable to connect the tuner's a.g.c. point direct to chassis so that the r.f. stage is always operating at maximum gain and thus providing the best signal-to-noise ratio. In areas of high signal strength, however, connection to an a.g.c. line is desirable, and also in such areas more extensive use of the sensitivity control may be required to reduce the overall gain of the receiver sufficiently to prevent cross modulation. In ordinary reception areas, the control should be set at maximum so as to maintain the best possible signal-to-noise performance.

Making Small Instrument Cases

by C. M. PEARSON G3IUQ

The amateur without ample workshop facilities frequently has difficulty in making small instrument cases, often finding that the number of screws necessary to fasten the several pieces together wastes most of the space inside the box. Any attempt to reduce the number of parts usually results in awkward bending operations which are impossible to do neatly.

The method of construction shown in the diagram uses only two parts, fastened together with self-tapping screws, and the bending operations required are quite simple. In the diagram, *x* is the length, *y* is the width and *z* is the depth of the box, *t* is the thickness of the metal being used, and for 20 s.w.g., it may be taken as $\frac{1}{32}$in without much error.



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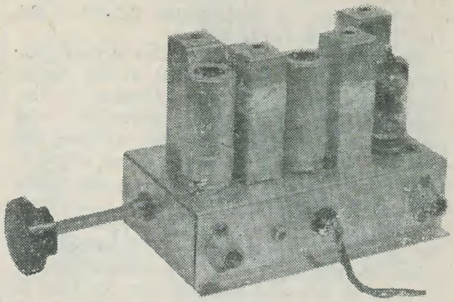
A Diomatic Frequency Controlled Switched FM Tuner



by P. MICHAEL

During the past few years many designs for tuners suitable for receiving the B.B.C. V.H.F. programmes have appeared in the pages of this magazine.

The original Jason unit, which is probably the best known, appeared over two years ago and most designs since have been based on this most excellent circuit. Quite recently a comprehensive switched tuner originated by the same designer appeared in these pages and is proving just as successful as the original design.

The very obvious advantage of switch tuning over variable tuning is sometimes neglected due to the necessity of having a complex automatic frequency controlled system to counteract drift. It will be seen that the novel and original system used in this tuner eliminated the difficulty of complex electronic circuitry to such an extent that the complete unit may be built by anybody without fears of instability and such like bugbears.

It was decided that considerable advantages were to be gained by using double valves for at least the r.f. stages, since the long wiring necessary between the separate valve holders is completely eliminated and the cost of the valves is halved. Similar saving in valveholders, valves, and wiring is gained by using double valves for the rest of the circuit. Consequently a very compact, neat and easily installed unit may be built at a very reduced cost. The circuit is both comprehensive and yet very simple to construct, being not at all critical provided that the basic layout is adhered to.

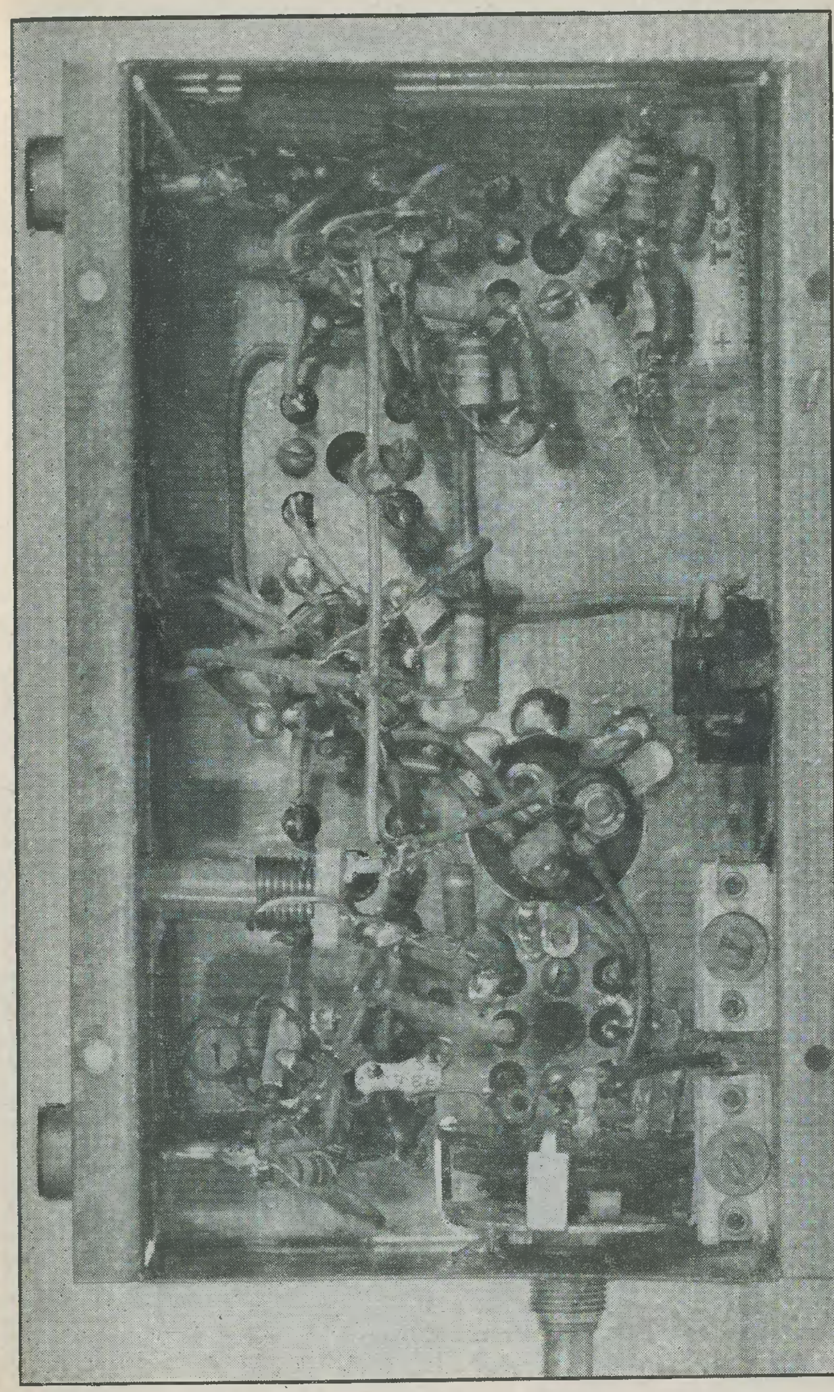
The R.F. Stage

The choice lay between a double triode and a triode pentode. The advantage of the slightly higher gain available from the pentode is largely outweighed by its requirement of at least one extra tuned circuit, and preferably two. The noise factor of triodes is also better than that of pentodes. The double triode circuit chosen has been used for some time in an excellent Band III converter, and works extremely well as the front end of this tuner.

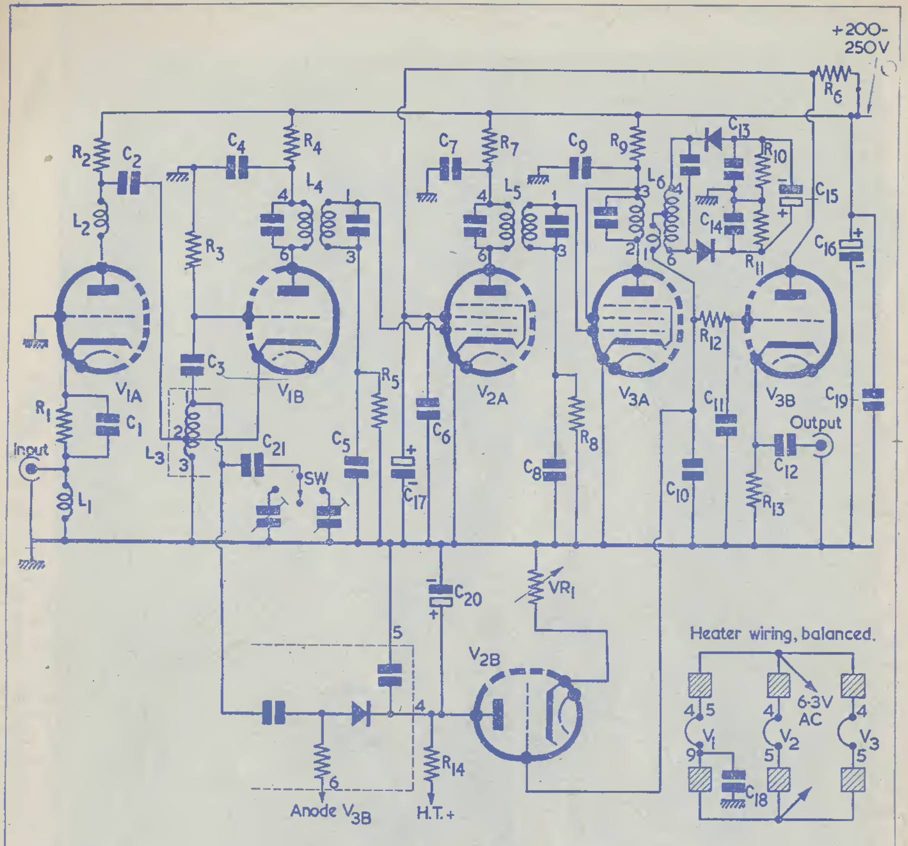
The r.f. amplifier is connected in earthed grid configuration, making it unnecessary for any neutralisation because of feedback from anode to cathode. The fairly low cathode impedance damps the input circuit to such an extent that it is entirely unnecessary to have any tuning adjustment for the r.f. aerial coil. The anode impedance, however, is considerably higher and the anode coil is tuned to the centre of the required frequency band, which is always the Third Programme. The amplified signal is fed via a low impedance C_2 to the mixer stage which is in the same envelope as the r.f. amplifier.

The Oscillator-Mixer

The oscillator is an electron coupled Hartley oscillator, the bias being derived by grid current. This system of biasing has the advantage that when the unit is switched on there is zero bias and consequently the gain is maximum to start the oscillation. The signal is introduced into the cathode of the valve and the mixed signal appears at the anode, where the i.f. transformer is tuned to



Underneath view of chassis—compare with wiring diagram



THEORETICAL CIRCUIT

10.7 Mc/s. As may be seen, the layout is fairly simple due to the use of a double triode and a centre-tapped oscillator coil with the frequency control element and its associated circuitry in the same screening can.

Approximate Test Voltages

Earth—C_{16}	250 volts
Earth—C_{17}	120 volts
Earth—C_{20}	105 volts
Earth—C_4	235 volts
Earth—C_2	235 volts
Earth—C_7	150 volts
Earth—C_9	50 volts
Earth—R_1	2 volts

These figures are meant as a rough guide only.

The difference between C_{20} and C_{17} must not be more than 30 volts and C_{17} must be positive to C_{20}.

The I.F. Amplifier

As previously mentioned, triode pentodes are used for the rest of the circuit. The choice is limited to the modern midget B9A series and the two best suited are ECF80 and ECF82. Both these valves are suitable and either may be used; a slightly higher gain is available from the former. The bias for this stage is also obtained by grid current, making the wiring very simple indeed. Over-rating of the anode dissipation is prevented by a high value of anode series resistor, 10kΩ. At the working point the anode voltage is in the order of 150 volts. The screen potential is used for other purposes, as will be seen later. The dynamic impedance of the i.f. transformer is considerably higher than the one used between V_1 and V_2. This is to take advantage of the very high anode impedance of pentodes as against the inherent low one of triodes.

Main Component List

Condensers
- C_1 1,000pF midget ceramic
- C_2 1,000pF midget ceramic
- C_3 33pF midget ceramic
- C_4 1,000pF midget ceramic
- C_5 1,000pF midget ceramic
- C_6 1,000pF midget ceramic
- C_7 1,000pF midget ceramic
- C_8 1,000pF midget ceramic
- C_9 1,000pF midget ceramic
- C_{10} 330pF midget ceramic
- C_{11} 1,000pF midget ceramic
- C_{12} 0.1μF paper
- C_{13} 330pF midget ceramic
- C_{14} 330pF midget ceramic
- C_{15} 8μF elec.
- C_{16} 12μF elec.
- C_{17} 12μF elec.
- C_{18} 1,000pF midget ceramic
- C_{19} 1,000pF midget ceramic
- C_{20} 12μF elec.
- C_{21} 3–5pF midget ceramic

Resistors
- R_1 220Ω
- R_2 1.5kΩ
- R_3 22kΩ
- R_4 1.5kΩ
- R_5 470kΩ
- R_6 47kΩ
- R_7 10kΩ 1W
- R_8 47kΩ
- R_9 47kΩ
- R_{10} 10kΩ } match
- R_{11} 10kΩ } match
- R_{12} 47kΩ
- R_{13} 10kΩ
- R_{14} 47kΩ
- Variable 2kΩ

Valves
- V_1 ECC81
- V_2, V_3 } ECF80 or ECF82
- Diodes matched pair OA79 or GEX34

Miscellaneous
- L_3 QPCM
- L_4 QIFM
- L_5 QIFM
- L_6 QID

(L_3–L_6: C. & G. Kits, 285 Lower Addiscombe Road, Croydon)

The Limiter Stage

The limiter stage is similar to the previous stage, although the working voltages are considerably lower, about 80 volts, for both anode and screen. These conditions in conjunction with the grid circuitry gives a very high degree of limiting, preventing the voltage across the stabilizing capacitor in the detector from rising above about 10–12 volts for any signal strength. The use of this stage gives very great rejection of pulse interference, such as car ignition. A very unpleasant form of distortion known as multi-path distortion is also eliminated by the high level of limiting.

The Ratio Detector

The operation of this form of detector can be found in many textbooks and has been described in this journal. If the leads in this stage are made very long, radiation back to previous stages will result in slight instability making its presence felt by distortion. When the station is correctly tuned there is a zero voltage across C_{10}; on one side of this point there is a positive potential and a negative potential on the other. This "S"-shaped curve provides the "sensing" for automatic frequency control.

The Cathode Follower Output Stage

The triode section of V_3 is used to considerable advantage as a cathode follower. The merits of this circuit are well known for the high input impedance and the low output impedance. A very long length of screened cable may be used between the tuner and amplifier. A very simple modification to this stage converts it to a preamplifier delivering ten volts output instead of half a volt from the cathode follower. Details of this modification are given later. Note that there is no d.c. grid blocking capacitor, it having become redundant due to the d.f.c. system.

The Diomatic Frequency Control Circuit

This circuit is the most interesting feature of the tuner and provides a very sensitive frequency control without complex circuitry or stray r.f. floating about the chassis, consequently no additional screening other than that provided by the chassis sides is required.

The operation depends on a valuable property of diodes, the capacity of a diode changing approximately inversely as the square of the applied voltage.

Point contact diodes exhibit this effect, but the effect is very pronounced with junction type diodes. Consequently, if a junction diode is connected across the oscillator coil and the applied voltage to the diode changed, the capacity (and so the frequency of the oscillator) is changed.

It is important to notice that the diode should be biased off so that a high d.c. resistance is presented across the coil; obviously, if biased forward, the diode will damp the oscillator and prevent oscillation.

The error signal developed across C_{10} is amplified by a d.c. amplifier V_{2B} and the amplified signal appears across R_{14}, the anode

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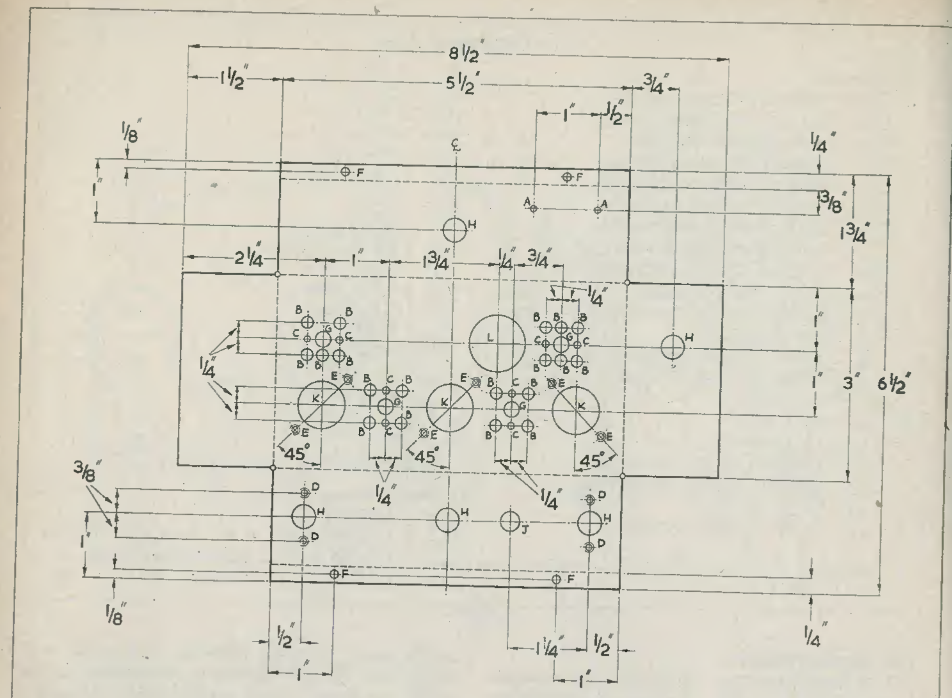

A holes $3/32''$ dia.
B holes $3/16''$ dia.
C holes Dr. No. 33 ·113" dia.
D holes Dr. No. 42
E holes Dr. No. 42 on 1·125" p.c. dia.
F holes $1/8''$ dia.
G holes $1/4''$ dia.
H holes $3/8''$ dia.
J holes $5/16''$ dia.
K holes $3/4''$ dia.
L holes $7/8''$ dia.

load. The error is then applied to one end of the diode which is contained in the screening can. The other end of the diode is at a positive potential taken from the anode of V_{3B}. This voltage is decoupled by C_{17}, an electrolytic component, and r.f. is blocked by a resistor inside the can. There is a time constant at the anode of V_{2B}, C_{20}, R_{14}, to prevent the audio signal from changing the frequency of the oscillator. An interesting test of the efficiency of the system is to remove C_{20} and note that nearly all the signal disappears due to the feedback, of about 30 dB, opposing any voltage developed.

The operation is as follows. The oscillator frequency is adjusted by the core of L_3 until a station approaches tune. A voltage of either positive or negative polarity, depending from which direction the station is approached, appears at the grid of V_{2B}. This potential is amplified by the valve and applied to the diode. This effects a change in capacity as previously described, and alters the frequency of the local oscillator. Provided that the sense of the detector is correct, the station is then brought into tune automatically. With the coils specified the diagram shows the correct wiring. The station will stay in tune until the limit of control is reached and will then suddenly disappear. It proved possible to keep the Home Service perfectly in tune until a little more movement of the core caused the Light Programme to "click" in.

Construction

A set of parts for the complete tuner is marketed and distributed by C. & G. Kits, of 285 Lower Addiscombe Road, Croydon, Surrey, who also run an alignment service for those without any equipment.

The heater wiring is shown in the circuit for balanced heaters; however, those who prefer one side of the heater earthed should earth pin 4 at all valves and also pin 5 at V_1. A ferrite bead slipped over the wire, one at each pin, takes the place of bulky heater chokes. A single wire is then used to connect the other heater pins together. It is essential that all capacitors be wired exactly as shown on very short leads, making for efficient decoupling.

All valves should have a piece of wire from pin 7 to the centre spigot and from there to earth between pins 1, 9, earthing *both ends* as shown. Wiring of L_6 is facilitated if the components C_{15}, C_{13}, C_{14}, R_{10} and R_{11} are wired separately as a sub-unit.

Take great care of the diodes as they are very prone to damage by heat. The wires should be about half an inch long and held by flat-nosed pliers to act as a heat shunt. The soldering process should be done with a hot iron and as quickly as possible.

Wire all the h.t. dropping resistors vertically on short leads and connect them to a thick busbar of 14 s.w.g. tinned copper wire. The busbar is connected to C_{16} and one tag of L_2. It is then bent at right-angles and taken in line with the valves to the end of the chassis. (See photograph.)

Alignment

A signal generator and voltmeter are required.

Connect a high resistance d.c. voltmeter on the 100 volt range with its positive terminal on C_{17} and negative on C_{20}. Adjust VR_1 for the voltage specified on the oscillator coil.

Connect meter across C_{10} and an unmodulated signal generator tuned to 10.7 Mc/s between the chassis and the grid of V_{3A} (pin 2). Adjust the top core of L_6 for maximum voltage. Repeat with input across V_{2A} (pin 2) and adjust L_5. Transfer input across oscillator coil (pin 1 QPCM) and adjust both cores on L_4 and L_5 for maximum voltage, reducing the input across the oscillator coil. Transfer the meter to C_{10} and earth. Now adjust the bottom core of L_6. When adjusted the reading will increase and then pass zero to the opposite direction; the correct point is as it passes through zero. Re-check all the coils as above, adjusting as necessary.

When adjusting the top core of L_4, the correct position is when the core is completely inside the coil, not when the core is above the coil. For the rest of the coils the contrary is correct, and it is important that no other cores should be between the two windings.

Tuning

Connect the aerial to the input socket and an amplifier to the output socket, when a hissing should be heard in the loudspeaker. With the switch in the centre position, adjust L_3 with a plastic-bladed screwdriver until the Home Service is heard. Now move the switch in one direction and adjust the trimmer for the Light Programme, and similarly for the Third in the other position.

On the Third Programme tune L_2 in conjunction with L_3 for maximum voltage across C_{10}. With the voltmeter across C_{10}, retune the unit for zero output on all three stations without altering L_2. It is usually possible to receive the stations in two positions of the core of L_3. In one position the stations will "click" into tune; this is the correct position. The unit is now ready for use.

Any change in valves or supply voltage may alter the tuning. Providing the change is small, adjustment of VR_1 will correct it. When switching from one station to another there should be no pause; if there is, it indicates that the unit is detuned.

Aerials

If you are in the primary service area of the transmitter, the tuner will probably work on a simple indoor Band II dipole, but it is highly recommended that a loft mounted dipole is used. For longer distances, a loft mounted two- or three-element aerial may be required, or even an outdoor aerial. These aerials should be rotated until the maximum signal is heard, or if a valve voltmeter is available the position of maximum negative bias across R_8.

Pre-amplifier

The cathode follower low impedance stage has a gain of slightly less than unity, and from a suitable input signal will deliver 0.5 volts into the amplifier. This should be suitable for nearly all types of medium and high gain amplifiers. In a case where the amplifier is insensitive, this stage may be modified into a conventional amplifier delivering about 10 volts, as follows:

(1) Replace R_{13} with a 1,000Ω resistor.
(2) Insert a 47kΩ resistor in series with the anode lead (pin 1).
(3) Connect C_{12} to pin 1 instead of pin 8.

Treble Response

The components R_{12}, C_{11} are de-emphasising components; this means that they reduce the high frequency response. They are included because the B.B.C. emphasise their transmission in order to increase the signal-to-noise ratio at the receiver. When the tuner is used with an amplifier whose top response is poor, they may be excluded with advantage and pin 9 connected directly to 1 on Q.I.D.

Power Supply and Modulation Hum

The h.t. required is 200–250 volts at 30–40mA. This must be adequately smoothed

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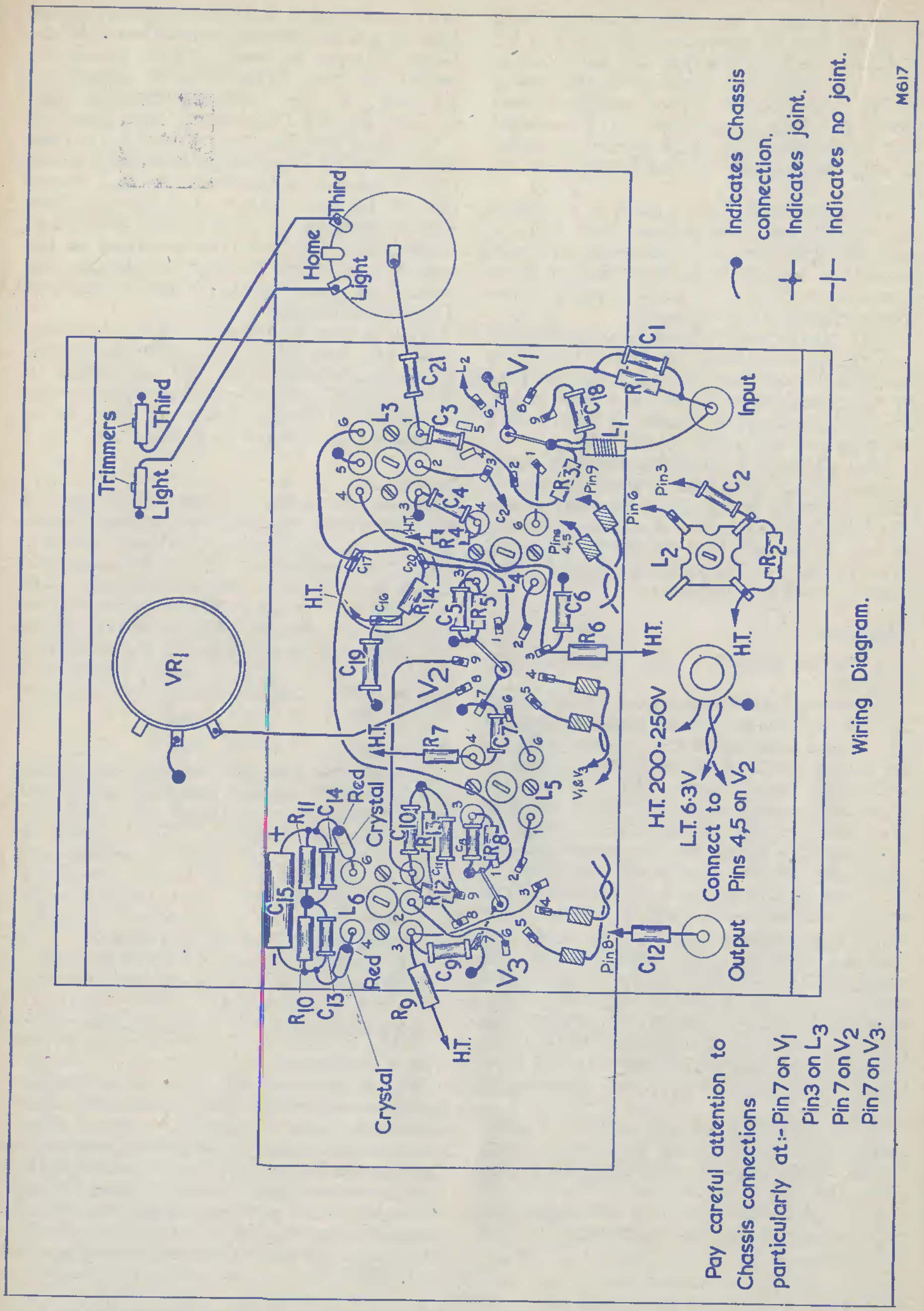
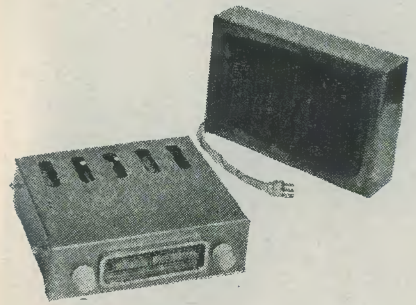


Wiring Diagram.

and decoupled. The l.t. of 6.3V at 1.2A should have one side earthed. If a centre-tapped supply is used another decoupling capacitor at pins 4, 5 on V_1 may be required to prevent modulation hum. A suitable component is a 1,000pF ceramic capacitor.

The "MAYKIT" TRANSISTORISED CAR RADIO



Part 2

by Richard Myers

This series describes fully a modern car radio design which may be built by any motorist—with or without experience of radio work—from the receipt of the components to the testing of the unit. Suggestions for car installation are included. The printed circuit and condensers are by T.C.C.

Step No. 8: General Chassis Assembly

BEFORE PROCEEDING WITH THIS, THE following items must be identified: the main chassis (identify the front and back of this item by holding it with the open end toward you; this is the *front;* the mounting plate being at the bottom open end —see illustrations). The tuner unit, the volume control, the Perspex front dial, and the metal front panel of the radio. *Open Packet No.* 3, in which the following are contained:- aerial socket; 4-pin socket; two white knobs; volume control metal bracket; two ½in rubber grommets; two 6BA solder tags; four 2BA ½in screws (the larger type); four self-tapping screws; one fuseholder and fuse; R_5 (card mounted) and C_{19} (marked TCC Picopack 25μF type TCB/PJ9169).

Step No. 9

In this step, we mount the printed circuit panel to the main chassis, but before doing so, fit the four self-tapping screws into the apertures and, having done this, remove them—this being a wise precaution as the holes are naturally slightly smaller in diameter than the screw thread. Should the screwdriver slip when trying and fitting these screws, no harm will result with respect to the printed circuit panel.

Mount the panel to the chassis in such a manner that the valveholders are uppermost.

Step No. 10

Take the grey hammered metal front panel of the radio, and place behind this the Perspex station marked dial. Note that this will only fit the correct way round. In front of the cutout of the panel fit the chromium bezel, having first, of course, removed the two small screws from this. Secure these three items together, from the rear, by means of the two 8BA screws.

Step No. 11

Referring to Fig. 2, fit the aerial socket,

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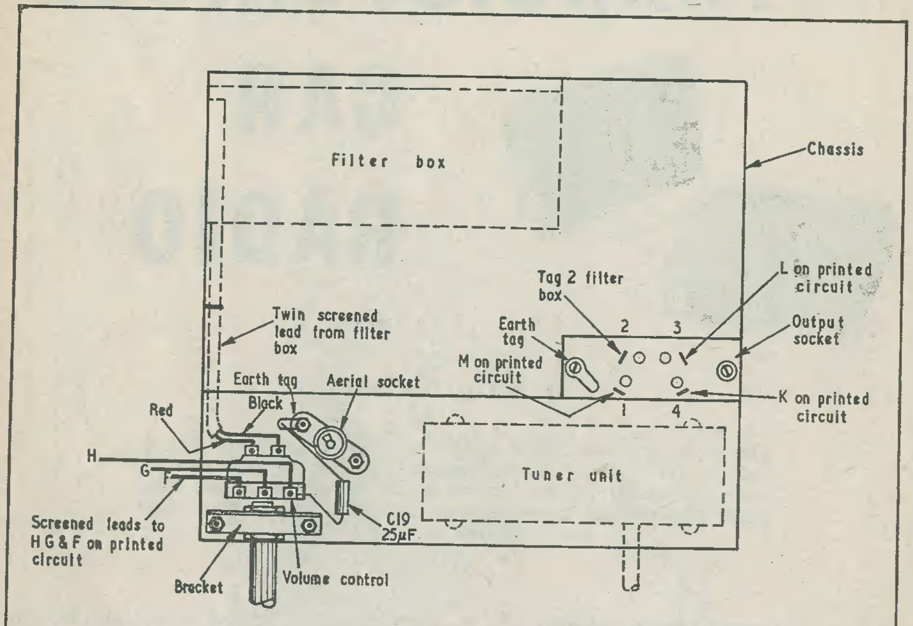
ensuring that the nuts are fitted *inside* the chassis and that one earthing solder tag is fitted as shown. In a similar manner, secure the output socket (the four-pin paxolin component), remembering correct orientation of this as shown in Fig. 2. Do not forget the earth tag. Secure the volume control to the metal bracket *before* mounting the latter to the chassis and note particularly the manner in which this bracket is fixed. Make sure that *all* the nuts are inside the chassis.

body at a point under, and to the rear, of the centre tag. It is important to ensure that this latter connection does *not* in any way make contact with the centre tag of the volume control. Solder the other end of this lead (the central stranded wire only), to point H on the printed circuit. (*NOTE:* The grey p.v.c. and the metal braiding at the point H end of the wire should be removed at some distance from the latter connection if the braiding is not to make contact with the



E642

Fig. 2
General assembly

Step No. 12

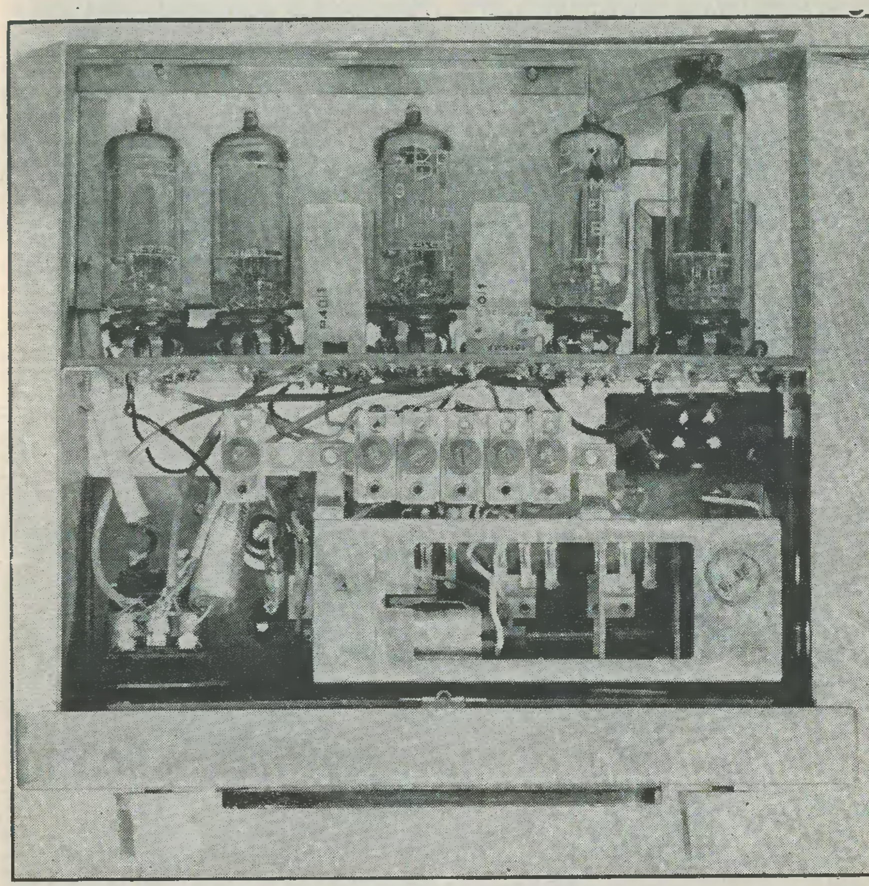
In this, we wire into circuit the volume control, using the grey outer covered wire supplied. Within this outer cover is contained a screening metal mesh known as braiding, a further cover of red p.v.c., and an inner conductor of stranded wire. (See Fig. 3.). When making soldered connections to the volume control, each separate lead *must* have its braiding earthed to the metal case of the control.

First, solder into position the condenser C_{19} with the red end being connected to the aerial socket earthing tag and the black end to the left-hand tag of the volume control —looking at the control from the rear (see Fig. 2). Solder one end of the screened wire inner conductor to the same tag and the braiding of this to the volume control metal printed circuit whilst the car is in motion. To make doubly sure that this will not occur, cut a small length of red sleeving, about $\frac{3}{8}$in will suffice, and slide this into such a position that it will effectively cover the end of the grey p.v.c. and the ends of the metal braid material. It will be found that the sleeving fits rather tightly into position, this being ideal for our purpose.

Solder one end of the inner wire to the centre tag of the volume control and earth the braiding to the same point on the metal body as previously. Connect the other end of the inner wire to point G on the printed circuit. Similarly deal with the remaining tag of the volume control and connect the inner wire from this to point F on the printed circuit. (See Fig. 2.)

The copper engraved points F, G, and H, are to be found on the underside of the panel, and they refer to the physically nearest copper connection. (See illustration of the printed circuit board.) The remaining two connections to the volume control are dealt with at a later stage.

have to be bent towards the socket somewhat, otherwise it will make unwanted contact with one of the tags of the transformer mounted on the printed circuit panel. The connection to tag 2 will be dealt with at a later stage.



Looking down on receiver with top of case removed, note top (pinch) of 12K5 is cushioned by a rubber grommet

Step No. 13

This step should not prove unlucky to the motorist as it is a comparatively simple operation! We now make three connections from the printed circuit, these already having been partly done, to the 4-pin output socket. These are from M on the printed circuit to tag 1, and from this latter tag to the nearby earth solder tag. Connect the wire from L on the printed circuit to tag 3 and the wire from K on the circuit to tag 4 of the output socket. (See Fig. 2.) Note that tag 3 will

Step No. 14

We next deal with the tuner unit *before mounting it in the chassis.* With a pair of cutters, remove the orange lead coming from the tuner unit and connect in its place a short length of the inner conductor of the grey p.v.c. covered braided wire. Here again, remove the outer p.v.c. and the metal braid some distance from the soldered connection and cover the end of the metal braid with a short length of red systoflex material. The other end of this inner conductor will be

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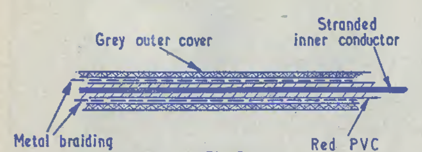
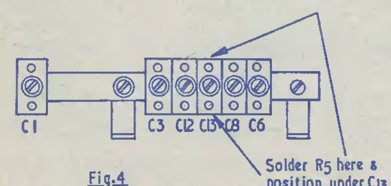
connected later.

Remove the resistor R_5 from the card (4.7kΩ, yellow, violet, red), trim the end wires to about ½in in length and solder these one to each side of the trimmer condenser C_{13}. (See Fig. 4.) Do this in such a manner that the resistor is positioned *under* C_{13} in a similar position to that occupied by the adjacent C_3 and C_8 already supplied *in situ* on the tuner unit. The adjacent Long Wave coil will have to be *slightly* depressed in order to fit R_5 in the correct manner. Care should be exercised when handling this winding otherwise the fine connecting wire may be broken. After fitting R_5, return the winding to its original position.



E643 Fig.3 Type of wire used with volume control

Having completed the above, secure the tuner unit into position on the chassis with one screw and nut only at this stage, ensuring that the nut is inside the chassis. When making the connections to be described in the following step, leave enough length of leads to enable the unit to be moved in order that a screwdriver may be inserted into the underside of the i.f. transformers when adjusting the tuned circuits at a later stage.



E644 Fig.4 Trimmer assembly of tuner unit

Step No. 15

Solder the green wire from the tuner unit to point A on the printed circuit panel, ensuring at the same time that the solder on the latter point does not make contact with the metal chassis.

Solder the red wire from the tuner unit to point E on the printed circuit.

Connect the blue wire of the tuner unit to point C on the printed circuit panel.

Similarly, connect the black wire to the central metal spigot soldered connection previously made to the valveholder of V_1.

Next, connect the end of the grey-covered metal-braided wire, inner conductor only, of course, to point B of the printed circuit. The metal braiding of this lead should now be connected to the central metal spigot of V_1 (same connection point as the black wire above).

Solder the white wire from the tuner unit to point D on the printed circuit panel. *NOTE:* Point D is a blank copper connection.

Connect the free end of the small coil, attached to the light green wire on the side of the tuner unit, to the aerial input socket connection, having first cut the wire to a suitable length.

Having completed the above, we can put aside the receiver chassis on which we have been working and commence another unit.

Step No. 16: Power Supply Filter Box

The first thing here is to open *Packet No.* 4, in which will be found the following components: C_{22}, marked TCC Micropack electrolytic 250µF type CE17BE; C_{23}, C_{24}, C_{25}, all marked TCC 0.5µF Type 246; C_{26}, being the small yellow lead-through condenser with the screw thread; L_{11}, the small p.v.c. covered choke with the red leads; L_{12}, the remaining small covered choke without the red leads; the 4-way tag board; two 6BA nuts and screws; one 4BA nut and screw; three self-tapping screws; length of tinned copper wire; and length of red sleeving. In addition to the above, the constructor will require for this unit the choke marked GB1709, this being L_{10} of Fig. 5, and the actual power supply filter chassis.

Working to the following instructions, the motorist should frequently refer to Fig. 5.

Step No. 17

Before securing the filter box to the receiver chassis, we must first mount some components in position, this being much easier to carry out with the box on the bench.

Fit the threaded type yellow-coloured condenser C_{26} through the aperture on the short side of the filter box (there is only one aperture on this side). C_{26} must be so positioned that the holed tag is *inside* the filter box.

Next fix, by means of two 6BA nuts and screws, the nuts *being inside the box*, the choke L_{10} (marked GB1709). Ensure that the two yellow wires from this choke are uppermost to you with the filter box standing on its base (see illustration of Filter Box assembly). If this choke is mounted wrongly, you may have difficulty with the yellow leads at a later stage.

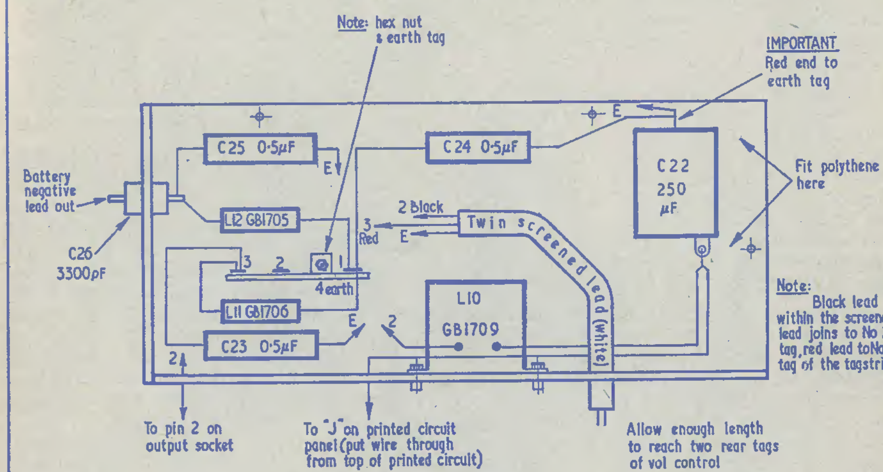
Using the single 4BA nut and screw, position the 4-way tagboard in exactly the same manner as shown in Fig. 5; again, the nut should be *inside the box.*

With the above completed, we must now secure the filter box sub-chassis to the main receiver metal frame. To do this, turn the main receiver chassis upwards so that the aerial input socket is *open* towards you, and the front of the receiver is towards you. The filter box assembly then fits on to the two metal angle pieces at the top right-hand of the receiver assembly. Fix, with the three self-tapping screws, the filter box to these angle fitments in such a manner that the open end of the box is uppermost with the components already mounted being visible (see illustration).

soldered, connect with the earth tag of the 4-way tagboard. Having cut this wire to length, cover it nearly to the end with a length of red sleeving, and solder this end to that tag, of the 4-way tagstrip, which is secured to the metal chassis by the screw and nut. *It is this tag that is referred to hereafter as the earthed tag.* When positioning components within the filter box assembly as shown in the illustration, it should be noted that no bare wires should touch the metalwork in any way whatsoever.

Solder the black p.v.c. covered choke L_{12} (the one *without* the red wires), one end to C_{26} and the other end to tag 1 of the tagstrip. It does not matter which way round the choke is connected.

Cut the wires of C_{23} to suitable lengths,



E645 Fig.5 Filter box assembly

Step No. 18

Take C_{25}, one of the 0.5µF wax-covered condensers, of which there are three (it does not matter which one is used), and cut the wire coming from the plain end to about ½in long. Solder this end to C_{26}, the yellow threaded type condenser fitted into the side of the metal filter box. Position the condenser as shown in the photograph; this is important, Fig. 5 being in diagrammatic form for reasons of simplicity and clarity. The foregoing applies to all the actual positioning of the components within the filter box assembly. The other wire of C_{25}, at that end with the black markings, should now be so shortened that it will, when

cover with sleeving, and solder the plain end to tag 3 of the tagboard and the black marked end to the earthed tag of the tagboard.

Next, solder L_{11}, the black p.v.c. covered choke (that having the red leads), one end to tag 3 of the tagboard and the other end to tag 1 of the tagboard. Again, it does not matter which way round this is connected. Note that the leads must be shortened before soldering so that the choke will take up the position as shown in the illustration.

Dealing next with C_{24}, cut the wire from the plain end of this condenser to a suitable length, cover with sleeving, and solder this end to tag 1 of the tagboard. Leave the other end of this condenser free for the moment.

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Step No. 19

We must now, for ease of construction purposes, solder into circuit the white twin screened lead shown in Fig. 5. Remove from one end about ½in of the white outer p.v.c. covering with the aid of a razor blade, that type having only one cutting edge being the best for our purposes—and much safer! Cut around the p.v.c. and thence downwards from this cut to the end of the covering; the material will then peel off easily. Do not cut the metal braiding. Tease the end of this metal braiding and push down as far as possible away from the end of the now exposed red and black wires. Roll the braiding between the fingers so that enough is available for soldering to the earthed tag of the tagstrip at a later stage. With the razor blade remove the three exposed lengths of green cording material—this not being required in the radio sense. Bare the ends of both the red and black wires, ensuring that the inner wires now exposed will not make contact with the metal braiding at any time—*especially after the soldered connections are made.*

Solder the black wire to tag 2 of the tagstrip and the red wire to tag 3 of the same strip. Run some solder over the end of the metal braid, this being the end that you have previously made by rolling between the fingers, and then solder this to the earthed tag of the tagstrip. Before proceeding any further, however, you will be wise to ensure that the metal braid is not touching any other tags of the tagstrip *other than the earthed tag.*

We now have to deal with the connections of this white screened lead at the volume control end. First, the cable must be pushed through the aperture to be found in the bottom right-hand corner of the filter box and from thence through the cut-out of the printed circuit panel and the side member to which the latter is screwed. Note the physical position of the cable within the filter box. Cut the whole cable at a point which leaves sufficient length for connections to be made to the *two rear tags* of the volume control.

In a similar manner as previously, remove the outer white p.v.c. material at a point some ½in from the end of the cable. The metal braiding should now be removed, as far as possible, to the end of the remaining white p.v.c. material remaining on the cable. Remove the green cord material. No connection is required to the braiding at this end of the cable. When the following two connections have been made, ensure that the remaining metal braiding is *not touching any other object.*

Solder the inner *red* wire to the right-hand rear tag of the volume control and the *black* inner wire to the left-hand rear tag of the control. (See Fig. 2.)

Step No. 20

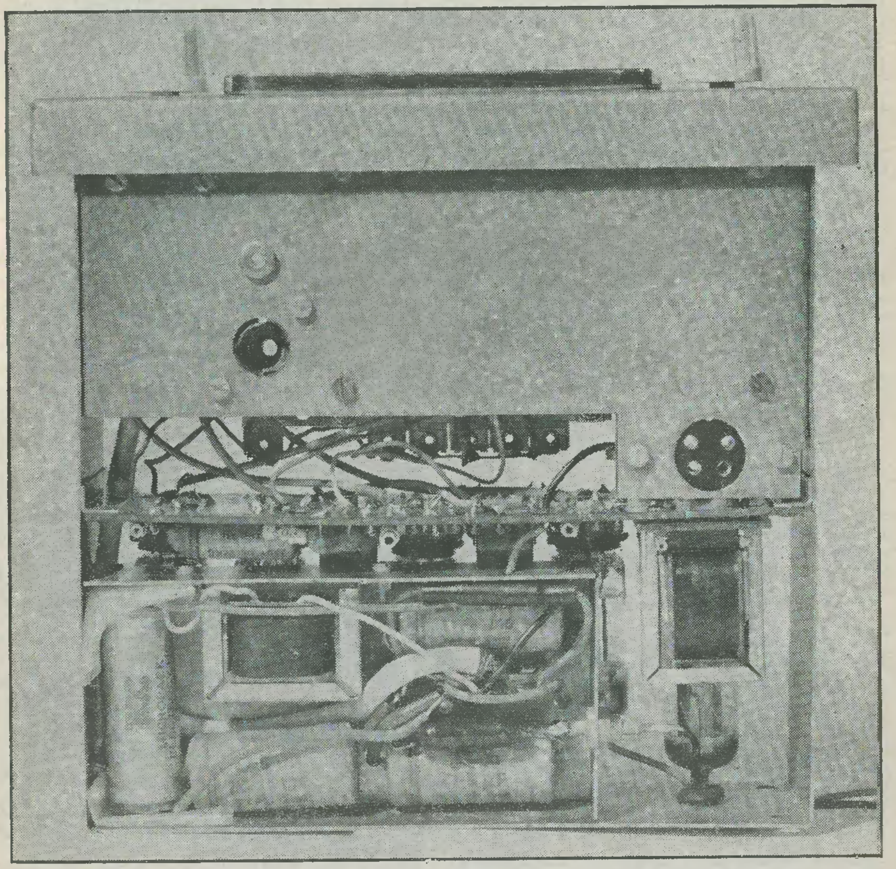
Take C_{22}, the clear plastic-covered metal condenser (*do not remove this outer material*), and connect as shown in Fig. 5. To do this correctly (remember that Fig. 5 is in diagrammatic form), first thread over the remaining free wire of C_{24} a short length of red sleeving about ½in in length. Some short distance from the end of this sleeving, cut the wire, pass through the hole in the tag at the *red* of C_{22} and bend over with a pair of pliers so that a mechanical grip is made. *Do not solder yet.* Cut a length of the bare tinned copper wire, about 3in will suffice, and cover this with the red sleeving, at the same time leaving sufficient wire exposed at each end for soldering purposes. Hold one end of this latter wire to the junction of C_{22} and C_{24} which we have just made (*red* end), and solder the three together. Now, bend the tag of C_{22} over and back on itself so that it will physically fit into the case when occupying the position as shown in the illustration. The other end of the sleeving covered tinned copper wire should now be soldered to the earth tag of the tagstrip.

To the other end of C_{22} (*black* end), solder the right-hand yellow lead from the choke L_{10} and also one end of a length of red covered p.v.c. thin wire; about 4in will suffice. Again, bend over the tag of C_{22} as previously, and for the same reason. Solder the other end of the wire coming from the *black* end of C_{22} to point J on the printed circuit panel. This lead must first, of course, be fed through the hole nearest the choke L_{10}, *through the printed circuit panel*, and then soldered on the same side as the remainder of the connections to the panel.

Returning next to C_{22}, this should be positioned with the filter casing as shown in the illustrations, but *neither of the solder tags of this condenser must touch the metal case.* To obviate this possibility, either now or at a later time with the vibrations of the car, securely pack each end with one of the now empty plastic bags sent with the components. With the white twin screened lead positioned as shown, and the plastic bags folded several times before insertion, it will be found that C_{22} fits snugly and firmly into the required position. The condenser casing is, of course, already insulated by the surrounding material.

Connect one end of a 6in length of black p.v.c. wire to tag 2 of the tagstrip and feed the other end through the hole in the side of the filter box (see Fig. 5), and thence through hole Y on the printed circuit panel (the Y is printed in white on the upper face of the panel and is, in any case, just to the rear of point J similarly printed on the upper face of the printed circuit panel). Having done this, bare the end of the wire and solder to tag 2 of the output socket (see Fig. 2 for this connection). Note that this tag will require bending towards the socket to avoid contacting the transformer tags.

Dealing now with the remaining yellow wire from the choke L_{10}, solder the bare end to tag 2 of the tagstrip, having first, of course, cut the lead to a suitable length.



View from underneath, showing arrangement of filter box components—compare with Fig. 5

Step No. 21

The remaining length of black p.v.c. wire should now be bared at one end and this soldered to the free, or unconnected, tag of C_{26} (see Fig. 5). Feed the free end of this wire through the rear of the receiver chassis, there being a suitable aperture for this purpose almost alongside the condenser itself. Fit a rubber grommet into this aperture first, however, in order to keep the wire from becoming chafed over a period of time from car vibration.

The fuse may now be fitted into this black negative battery lead at any point convenient to the motorist. Where this is fitted is left to individual requirements and the suitability of make and type of car into which the radio is to be fitted. With the prototype shown here, it has been inserted into the black wire some 6in from the rear of the receiver chassis—but wherever it is fitted, it should be borne in mind that accessibility will prove of importance should the fuse have to be replaced at some time or another.

Step No. 22

The assembly of the plastic fuse cartridge is shown in Fig. 6. To assemble, take the cartridge and, making sure that the spring inside does not "jump out" when the bayonet

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end fitting is removed, dismantle the whole assembly.

Dealing with the small bayonet end piece first, cut the black negative battery lead at some predetermined point (see above), bare the end nearest the receiver and pass through the plastic end at point A. Turn over the bare wire end and solder to the metal eyelet.

Next, bare the end of the wire going to the battery minus connection, pass through the plastic cartridge case at point B, through the centre of the spring, through the metal eyelet and solder in a similar manner as described above.

Place the spring and associated fitment (see Fig. 6) into the plastic body of the main casing, fit the 5 amp fuse and place these together into the fuse body as shown. Finally, lock securely into position the smaller plastic bayonet end.

Step No. 23

Plug the valves into the printed circuit panel in the following order and, at the same time, support the underside of the printed circuit with one hand in order to avoid any undue strain on this component; 12AC6 (V_1) on the same end as the volume control, followed in ascending order by V_2, V_3, V_4 and V_5. Thus: 12AD6, 12AC6, 12AE6 and 12K5.

Notes

The valved part of the car radio and the power supply filter assembly is now completed. Before proceeding further, however, the motorist would be wise to carefully check his radio; as it now stands; with the foregoing written instructions, the diagrams, and the illustrations.

The main points to note are: that no incorrect connections have been made to the circuit board, either from the tuning unit or from the filter box assembly; no metal braiding is in contact with any point other than that specified; the valves are inserted into the correct holders; neither the *red* nor the *black* ends of C_{22} are touching the metal casing; no bare wires are touching the metal casing except those connected to the earthed tag of the filter box assembly; all soldered connections are properly and securely made; and finally, that no instructions have been overlooked.

As a further check, there should be no actual radio components left on the bench, other than those required for later stages. *DO NOT ASSEMBLE THE DIAL AND DIAL PANEL, ETC., INTO POSITION—THIS SHOULD BE DONE LATER.*

The constructor should now ensure that no component mounted in the filter box assembly protrudes over and above the general level of the edges of the chassis. In order to ensure that this is so, having first ascertained by eye that all components are below chassis level, gently slide into position the receiver grey hammered metal outer casing. To do this correctly, feed the black wire and fuse through the rear of the casing, then, with the filter box uppermost, and the receiver casing having that side with the two round apertures uppermost, slide the casing into position. The case should slide gently into position without fouling any projecting component. *(To be continued)*

Can Anyone Help?

Requests for information are inserted in this section free of charge, subject to space being available

Multimeter.—J. Gooday, of "Woodlands," 297 Ipswich Road, Colchester, Essex, requires circuit diagram of the Radio City Products multimeter model 420SP. Alignment details of the R1155A receiver are also wanted. Will exchange B9A valve for diagrams.

Triplett Model 1632 Signal Generator.—A. MacFarlane 123 Trevor Road, Burscough Bridge, Nr. Ormskirk, Lancs, would like to buy handbook or circuit diagram, or to borrow same for a few days.

"The Clifton" Model MQ1 Tape Recorder.—Y. L. Ong, c/o G.E.C. Malaya Ltd., Campbell Road, Kuala Lumpur, Malaya, badly needs the circuit diagram of this recorder. It incorporates the following valves: 2 6V6, ECC40, EF40 and Y61. Willing to refund any expenses involved.

Baird Portable TV Receiver P1718.—R. F. Allinson, Skelton, Penrith, Cumberland, wishes to hire, borrow, or buy service sheets (circuitry and alignment data) of this televisor.

BC455 and R208.—P. Short ZS6HL, 5 Saint Mark Road, Hurleyvale, P.O. Edenvale, Transvaal, S. Africa, would like to hear from anyone who has connected the BC455 to 6.3V and modified it for amateur use and also any reader who can suggest improvements to the R208 including bandspreading.

APX1 Trans/Receiver.—D. Houghton, of 21 Primrose Drive, Huyton, Nr. Liverpool, would like to buy or borrow the manual or circuit diagram of the above ex-U.S. Air Force VHF equipment. All expenses gladly paid.

Back Numbers.—W. Hughes, 7 Cambridge Avenue Marton, Middlesbrough, Yorks, would like to obtain two back issues of *The Radio Constructor*. These are May and June 1952, containing details of a Resistor/Capacitor measuring apparatus, incorporating a neon discharge tester for condensers. Any expenses gladly refunded.

The TRANSISTOGRAM

By R. HAYES

A battery-operated 45 r.p.m. record player using transistors

Now that it is the practice of record manufacturers to provide such a variety of recordings on the 45 r.p.m. 7in disc, the advent of the "Staar" battery-driven 45 r.p.m. player unit opens up new possibilities in portable record reproducers. This unit has been adopted by equipment makers and is mostly used by them in conjunction with a transistor audio amplifier of which types range between 200–300mW output.

For some time now the amplifier itself has been available in the form of a printed wiring panel, by more than one manufacturer, which considerably simplifies the construction and reduces the amount of error on the part of the constructor to that of a dry joint or, at most, a faulty component.

The record reproducer about to be described was made up as a present for a teen-age daughter and proved to be so successful that it was thought that it would be as well to publish a description and give it a name. "The Transistogram" seemed to be a very apt one, so that is how it will be known.

Whenever transistors are used the result is a relatively small and compact unit. To the writer there is a fascination in miniaturised equipment and it is felt that on this score alone the "Transistogram" should have a wide appeal. It makes it possible to play one's favourite records on picnics, or out in the garden (taking care not to annoy others!) without having to rely on mains. The complete reproducer can be put in the car or carried, if travelling by public transport, with little or no inconvenience, and is instantly ready for use. The output is ample for average listening and the possibility exists of exchanging the amplifier itself for a higher power one as transistor technique advances. Overall the dimensions are $11\frac{1}{2}$in x $8\frac{1}{2}$in x $5\frac{1}{2}$in.

There are two separate battery supplies. The motor is driven by a 6-volt battery drawing 27mA during playing and the amplifier by two pocket lamp batteries of $4\frac{1}{2}$ volts each (Type E.R.1289), from which a current of the order of 3mA (quiescent) is drawn.

A description of the player unit is given on a leaflet issued by the manufacturers, Staar Electronics Ltd., and quotations from their description are given here. The overall weight is a mere $15\frac{1}{2}$oz, this low figure being achieved by the extensive use of some very pleasing mouldings. A protecting shell over the pick-up is pulled back and the following operations occur:

(*a*) Tone arm released from locked position.

(*b*) Tone arm lifted to a suitable position for placing on record.

(*c*) Sapphire Stylus is cleaned by wiping through a built-in brush.

(*d*) Motor idling pulley moved into the "engage" position.

A slight outward movement of the pick-up arm starts up the motor and on completing

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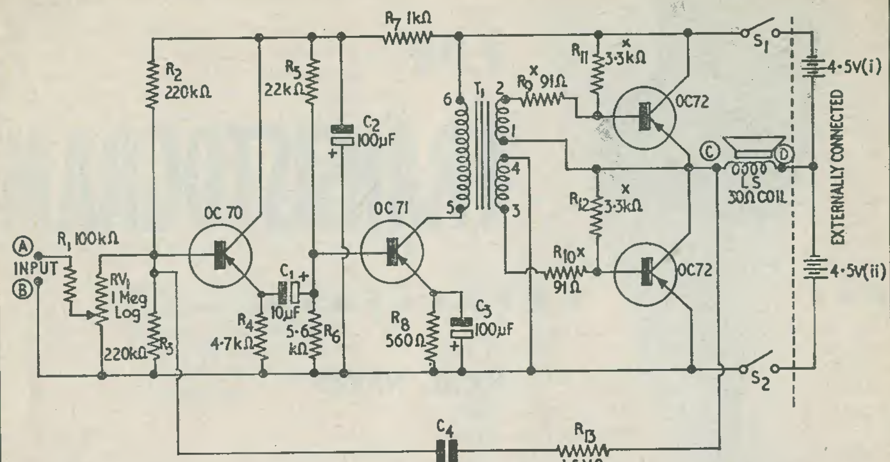

FIG.1

R & D Co BRIBOND TRANSISTOR AMPLIFIER FOR STAAR PLAYER

G 530

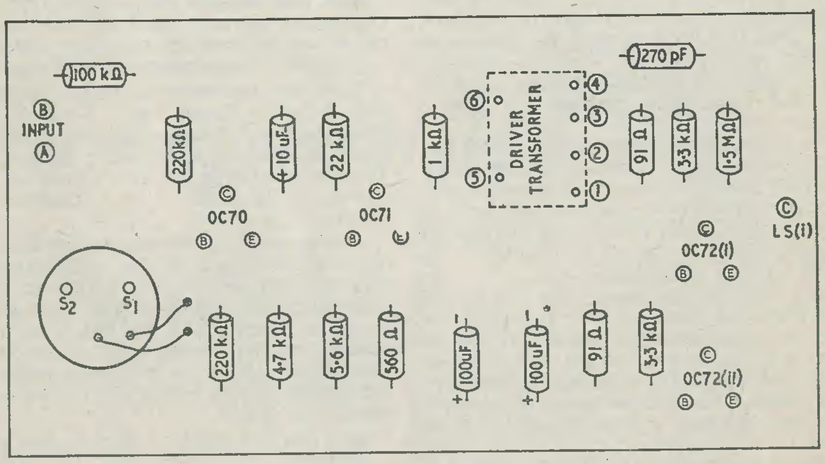

FIG.2

BRIBOND TRANSISTOR AMPLIFIER FOR STAAR PLAYER

Component Location Diagram (viewed from plain side)

G 531

Note: The OC70 shown above may be replaced by an OC71

the playing of a record, the motor is automatically switched off.

On returning the pick-up manually to the "rest" position a slight downward pressure on it pulls over the cover and locks the arm for transit, frees the motor drive pulley, cleans stylus again, and switches the motor off if the tone arm has been removed before the end of the record. A centrifugal governor on the motor ensures that speed is kept uniform to within 1% between battery voltage limits of 7.5 volts and 4.5 volts.

The pick-up consists of a ceramic transducer provided with two sapphire stylii. When eventual wear makes a change desirable, the cartridge can be withdrawn and the second stylus brought into use merely by rotating through 180°. A keyway ensures correct location. Records may be played with the lid closed provided the player unit is positioned as described later.

It is proposed to deal with two printed wiring versions of the amplifier, one which is manufactured by Bribond Ltd., Burgess Hill, Sussex, and the other by Whiteley Electrical Radio Co. Ltd., Mansfield, Nottinghamshire The latter company also manufacture the 30 ohm, 3½in speaker and the cabinet. Should the constructor wish to simplify the job of assembly, both manufacturers can supply a ready-made amplifier which only requires fixing in the case and connecting to the batteries and speaker. In both cases it is important to remember that the circuit used was designed around the Mullard transistor types given and constructors are particularly advised to adhere to the types specified when ordering. This point, of course, should always be borne in mind when using transistor circuits, the latitude allowable in many cases with valve equivalents not being so readily permissible with transistors.

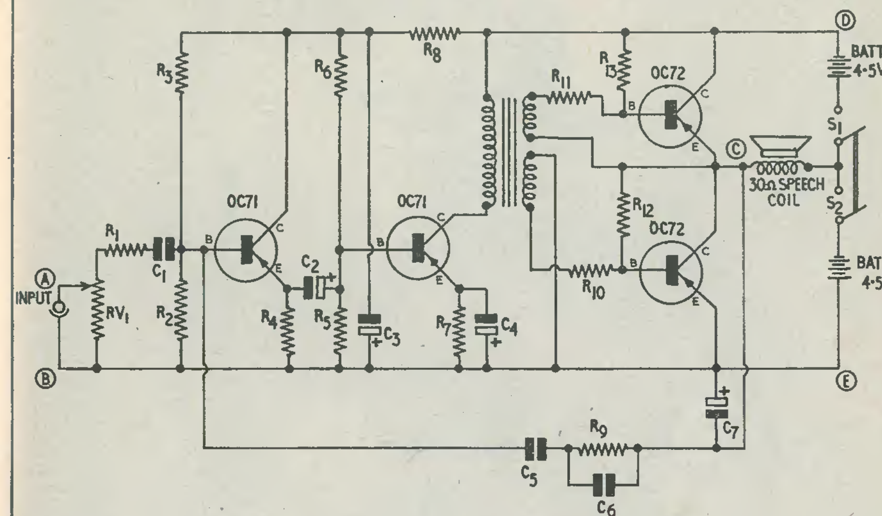

FIG.3

WHITELEY ELECTRICAL TRANSISTOR AMPLIFIER CIRCUIT

G 532

Soldering

If no experience of soldering printed boards has been obtained previously, the following notes should be observed. A miniature low wattage soldering iron should be used in order to avoid over-heating the foil. As 250 C is sufficient to cause the foil to lift off the board, the soldering job must be done quickly and with the smallest amount of heat necessary to effect a sound joint. Although the foil is already "fluxed", the use of a cored solder such as Multicore (18-20 s.w.g.) is recommended. In no circumstances use a corrosive type of flux, and irons with bits larger than ¼in should not be used. The process consists of sliding the bit down the length of wire coming through the hole in

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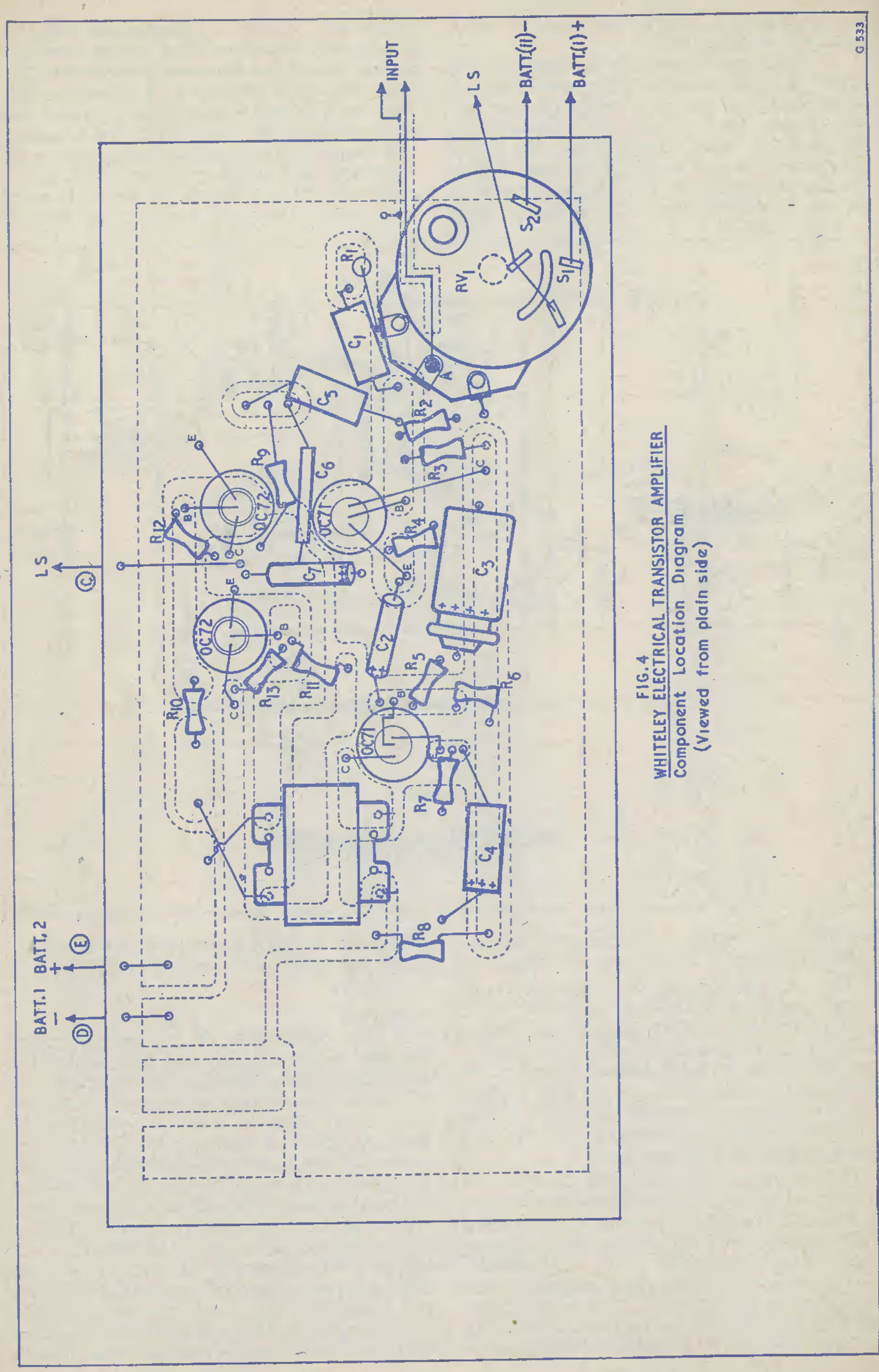

FIG. 4
WHITELEY ELECTRICAL TRANSISTOR AMPLIFIER
Component Location Diagram
(Viewed from plain side)

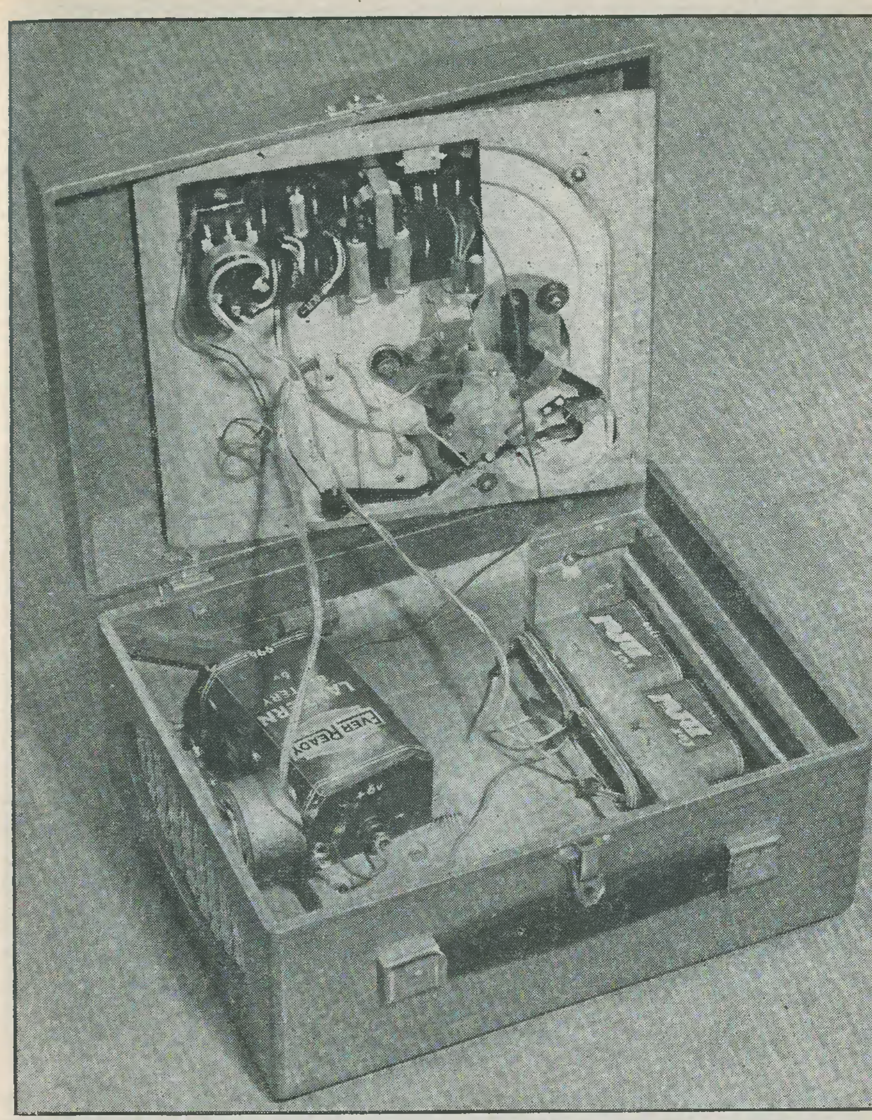

Fig. 5. Showing arrangement of batteries, speaker, and amplifier panel with Bribond panel in position

the foil with solder applied to the iron. On reaching the foil the solder will flow from the iron to the wire and foil and form a cone. Do not leave the iron on the foil longer than 10 seconds. Actually, 5 seconds should be sufficient time in which to form a good joint. Repeat the process fully if necessary to re-make a bad joint. Snip off the excess wire at the apex of the cone of solder. Avoid excessively large blobs of solder. Whilst writing of soldering, mention must be made of the care to be exercised when mounting the transistors. In the first place, leave the transistor leads as they are. Grip the lead being soldered with a pair of fine-nosed pliers so that the heat collected during the

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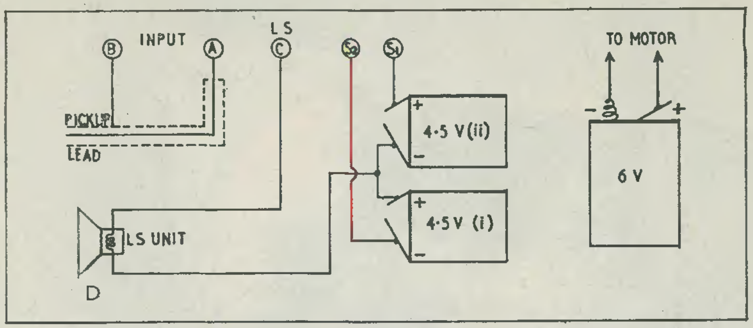

FIG 6(a) BATTERY INPUT & SPEAKER CONNECTIONS for the "BRIBOND" panel

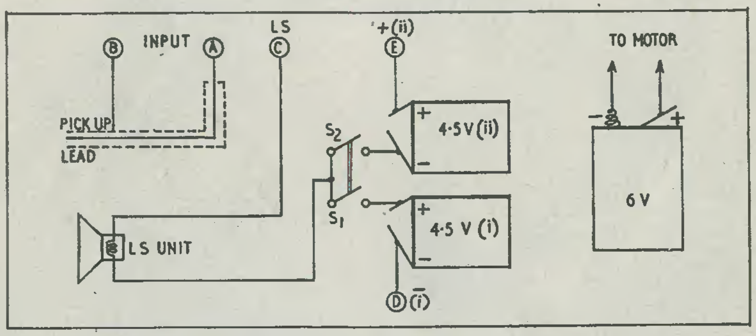

FIG. 6(b) BATTERY INPUT & SPEAKER CONNECTIONS for the "WHITELEY" panel

(References Ⓐ Ⓑ etc will be found on Figs 1-4)

G 535

soldering process will be dissipated by the pliers and thereby prevented from reaching the transistor, which would be damaged if this were to happen. Furthermore, do not bend the leads where they come out of the body of the transistor. It is advisable to put sleeving over the three leads to guard against short circuiting.

The "Bribond" Panel

It is a simple matter to mount the components on to the printed panel by referring to Fig. 2. Having soldered each connection securely, the job can be completed by attaching lengths of p.v.c. wire to the points indicated in Figs. 5 and 6 (*a*) for the battery and speaker connections, leaving sufficient length to reach the points concerned. The pair of OC72s are nicely secured on a special little bracket which accommodates the two heat fins and which clamp the transistors securely and provide a heat "sink" as an added security.

The "Whiteley Electrical" Panel

The main differences between this panel and the one described above are in the input circuit and the feedback circuit. These differences represent the individual designer's preference, no particular arrangement being preferred by the author of these notes. It should be pointed out that both versions require no output transformer, the signal being supplied direct to a special "Stentorian" loudspeaker of 3½in diameter with a 30 ohm impedance speech coil. The amplifiers will only work into this load and the use of other loudspeakers will give indifferent results. For improved results up to 8in diameter speakers of 30 ohm impedance give proportionately better results, but a larger loudspeaker can, of course, only be accommodated in a larger cabinet. Finally, the points of attachment for the loose leads are shown in Figs. 4 and 6 (*b*). Attention is drawn to the transistor mounting in that rubber grommets are let into the printed board to secure them.

to above is capable of giving a long life at the current drawn (27mA). The player unit is mounted so that the turntable spindle centre is 3½in from the right-hand edge and 3½in from the front edge of the motor board. This brings the moulded platform of the unit hard up against the rear edge, under the hinge nut and bolt and ⅝in from the right-hand edge.

Having cut the motor board to the template supplied with the player unit, mount the completed printed panel in the position shown in the photograph. To do this, drill a ⅜in hole in the motor board for the spindle of the volume control and, using two wood screws, secure the panel to the motor board using 4BA nuts as spacers between the board and the panel. For the Bribond panel this hole is 2in from the front edge of the board and 1½in from the left-hand edge. For the Whiteley panel this position is 1in and 1½in respectively. Remove 4in from the rear motor board fillet support, leaving 1in of fillet at the speaker end of the cabinet.

The lantern battery is housed on the floor of the cabinet, hard up against the speaker magnet, and is held in position by two pieces of quartering which will have to be obtained and fitted by the constructor. Fig. 5 shows this together with the underside of the motor board. Ensure correct polarity of the battery

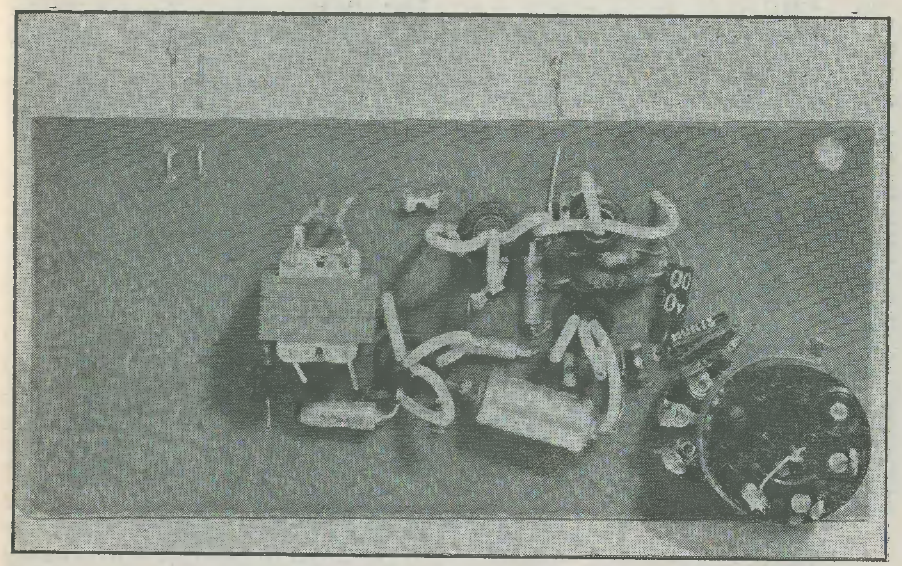

Fig. 7. The Whiteley Electrical panel, complete with transistors housed in the rubber grommets

Mounting the "Staar" Player Unit and Amplifier

A little carpentering will be necessary in order to mount the player unit. In order to make sufficient room for the extra battery for the motor, which can be an Ever Ready Lantern Battery Type 996, the motor is mounted with the pick-up parallel to the hinge of the case as near to the right-hand side and the hinge as possible. A common battery for the amplifier and motor is not recommended. The lantern battery referred

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leads unless you wish to hear everything backwards!

The two 4½ volt pocket lamp batteries are wired with p.v.c. wire as shown in Figs. 6 (*a*) or 6 (*b*) as required. They are housed in the small compartment which is provided with a sliding door to facilitate battery changing when required. Paper clips may be used for making the battery connections, but in the prototype the leads were soldered directly on to the battery contacts in order to safeguard against the possibility of the leads coming adrift.

The four holes for the Whiteley speaker unit are already drilled and the four countersunk 4BA bolts should be used. The inclined board will have to be cut where it goes under the motor board, leaving it 2⅛in wide in order to clear the motor battery.

Secure the braided pick-up lead with a piece of Sellotape to a convenient spot so that it cannot move about and short circuit a "live" component, the braid being at "earth", or positive, potential.

Operation

The only point to mention is a reminder to switch off the amplifier after use.

List of Components

Bribond Printed Panel

- R_1 100kΩ
- R_2 220kΩ
- R_3 220kΩ
- R_4 4.7kΩ
- R_5 22kΩ
- R_6 5.6kΩ
- R_7 1kΩ
- R_8 560Ω
- *R_9 91Ω
- *R_{10} 91Ω
- *R_{11} 3.3kΩ
- *R_{12} 3.3kΩ
- R_{13} 1.5MΩ
- RV_1 1MΩ Log. (Morganite Type A) p.c. potentiometer without bracket but with D.P. switch and 1in spindle
- C_1 10μF electrolytic (miniature)
- C_2 100μF electrolytic (miniature)
- C_3 100μF electrolytic (miniature)
- C_4 270pF
- 1 transistor driver transformer (Dagnall & Kendall Ltd., type 1015)
- 1 bracket (for OC72s mounting)
- 1 pair heat fins for the OC72 transistors

Whiteley Electrical Printed Panel

- RV_1 1MΩ log potentiometer with D.P. switch
- R_1 220kΩ
- R_2 180kΩ
- R_3 220kΩ
- R_4 4.7kΩ
- R_5 5.6kΩ
- R_6 22kΩ
- R_7 560Ω
- R_8 1kΩ
- R_9 680kΩ
- *R_{10} 91Ω
- *R_{11} 91Ω
- *R_{12} 4.7kΩ
- *R_{13} 4.7kΩ

* *Matched to* 10% *or better. All others* 10%. *All* ⅛*-watt.*

- C_1 0.01μF (miniature)
- C_2 8μF electrolytic (miniature)
- C_3 50μF electrolytic (miniature)
- C_4 30/32μF electrolytic (miniature)
- C_5 500pF
- C_6 22pF
- C_7 1μF electrolytic (miniature)
- 1 transistor driver transformer (Whiteley Electrical Type 48/53D), 4 rubber grommets for ¼in holes; *or*

Panel, assembled and ready for use with Mullard transistors

Additional Parts common to either panel

- 1 "Little Staar" battery-operated player unit (Staar Electronics Ltd.)
- 1 3½in 30Ω impedance loudspeaker (Whiteley Electrical Co. Ltd., type S359)
- 1 cabinet as illustrated (Whiteley Electrical Co. Ltd.)
- 1 OC70 Mullard transistor
- 1 OC71 Mullard transistor
- 2 OC72 (matched pair) Mullard transistors
- P.V.C. wire, 4BA bolts (4 ½in c.s., 3 ½in r.h.)
- 6 4BA nuts, 2 ¾in wood screws
- 1 Ever Ready battery type 996
- 2 Every Ready batteries type 1289

Television Tubes and Valves Reduced

Siemens Edison Swan Ltd. have considerably reduced the prices of many Ediswan-Mazda television tubes and valves.

These reductions have been made possible by improved manufacturing methods and the use of high-speed automatic equipment in the company's Sunderland factories.

The maximum reduction is on the most popular 17in types which with the reduced Purchase Tax show a saving of up to £3 4s. 10d. to the man in the street.

Change of Address

Aga Veneers Limited, late of 1 Kingly Court, Regent Street, London, W.1, have now moved to larger premises at 62 Carter Lane, London, E.C.4. *Telephone* CITy 2209 and CITy 2200.

Understanding Television

Owing to the indisposition of W. G. Morley, we regret that we are unable temporarily to proceed with this popular series.

JINGLEBELLS

AMATEUR RADIOTELETYPE

Part 3

By JIM HEPBURN, VE7KX

In an earlier article describing a simple converter unit for the reception of RTTY transmissions, mention was made of a connection brought out from the printer keyboard for the control of frequency shift keying of a transmitter for the transmission of RTTY signals.

Referring to the accompanying diagram, V_1 is the output or keyer stage of the converter unit described earlier and the cathode of this valve is brought out through the keyboard contacts to earth. Operation of the keyboard keys the current passing through this stage and through the printer magnet coil; and at the same time a regulated d.c. voltage of approximately 50 volts appears across the open keyboard contacts.

This keyed voltage is applied across a 50kΩ potentiometer in the grid circuit of a reactance modulator V_2, which can be added to any conventional amateur station V.F.O. In this case a 6C4 triode is used. This could be any medium amplification triode, but the 6C4 was selected because it is small, rugged, excellent for r.f. work, and can be tucked away on a small bracket or added to the chassis of any small V.F.O. without space problems.

This reactance modulator is, in effect, a variable condenser connected across the V.F.O. grid coil, and it moves the V.F.O. frequency when a d.c. voltage is applied to its grid. This simple reactance modulator is not linear in operation, but fidelity in the audio sense is not necessary; we are only concerned with two positions—on or off. The installation of this modulator in the V.F.O. should follow good construction practices necessary with any part of the V.F.O. tuned circuit, as the modulator is part of the frequency determining circuit. Rigid mounting, short leads and adequate ventilation are required for good frequency stability.

On the application of a positive voltage from the keyboard to the reactance modulator grid, the V.F.O. will shift to a lower frequency. The amount of shift will be determined by the grid potentiometer setting and the setting of the 50pF coupling condenser. This condenser should be set at the minimum capacity required for full 850 c/s shift at the low end of the lowest frequency band, and will seldom require readjustment. As any frequency multiplication in the transmitter following the V.F.O. will also multiply the shift in the same ratio, it is necessary to reset the shift potentiometer control when changing bands; thus this control should be mounted on the V.F.O. front panel for convenience.

This reactance modulator can also be used on a crystal oscillator, but crystals are stubborn brutes to shift, so considerable frequency multiplication may be required to obtain adequate shift. However, crystal control is usually desired on the higher frequency bands where sufficient multiplication is available following the oscillator stage.

If not already fitted in the teleprinter machine, a "break" switch or push-button is required in series with the keyboard contacts so that we may secure steady "mark" or steady "space" conditions for calibration of the F.S.K. shift. The shift in the V.F.O. frequency on the application of a space signal can be measured with an accurate r.f. frequency meter, such as a BC–221, but a large portion of the 850 c/s difference in frequencies is swallowed up by the two fat audio nulls on each side, and it is usually necessary to listen to the sixth or eighth harmonic of the V.F.O. and frequency meter signals where a proportionally sharper zero beat can be heard. The V.F.O. signal can also be fed into a receiver fitted with a beat frequency oscillator and the shift of the audio beat note compared with a calibrated

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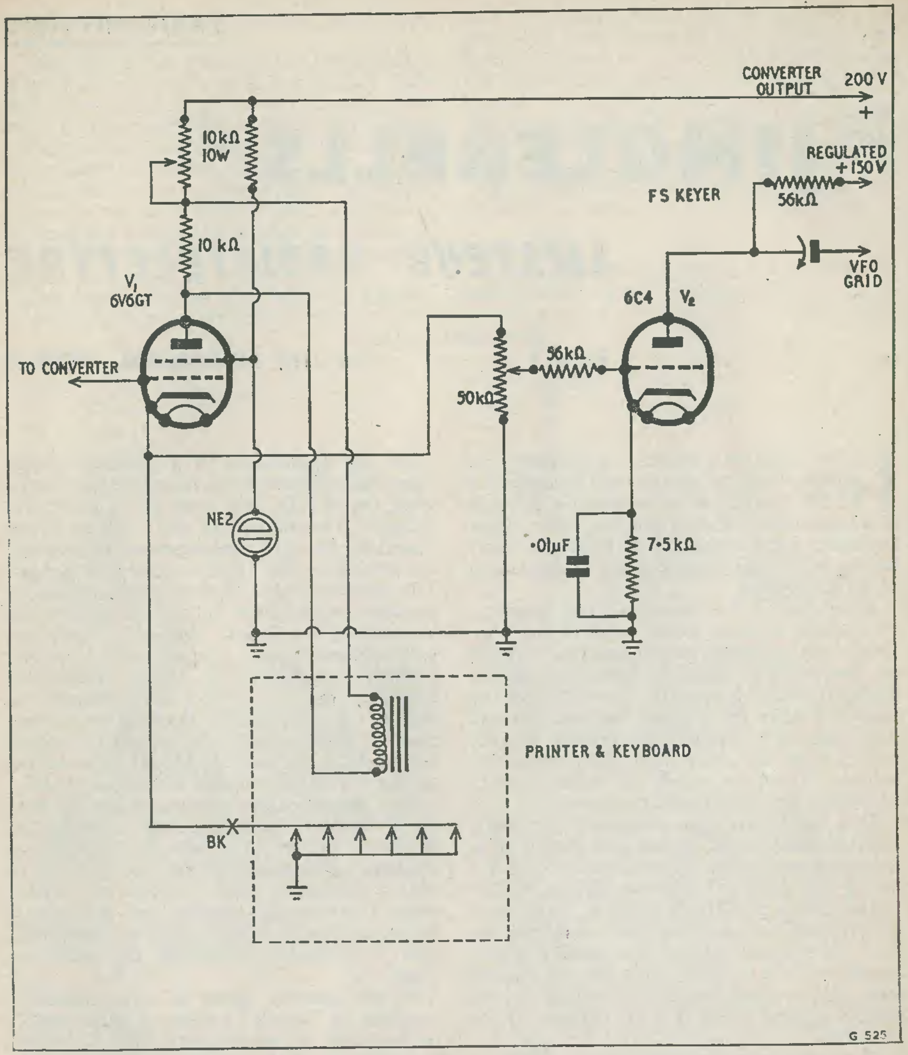

audio signal generator. However, as frequent checks of the shift will have to be made when changing bands, or even a change of more than 50 kc/s in the V.F.O. setting on the same band, a quick method of checking shift is required. The fastest and easiest method is to check the V.F.O. with the station receiver and the converter fitted with an oscilloscope as described in the previous article. The V.F.O. should be capable of being turned on separately from the transmitter and the V.F.O. signal in the receiver should be adequate on all bands for a quick check that the V.F.O. frequencies are lined up with the converter filters before any transmission is made on the air.

Alternatively, the receiver beat frequency oscillator control can be calibrated to measure shift frequencies quickly in the following manner:

1. Find and mark the centre position of the B.F.O. tuning control (if the receiver manufacturer has overlooked this detail).
2. Tune in a strong steady carrier to zero beat.
3. Move the B.F.O. control until the beat note reaches 850 c/s (again a calibrated audio oscillator is a handy tool around an RTTY station), and mark this position.
4. Repeat on the other side of the B.F.O. control.
5. *Or:* Have another amateur RTTY station transmit alternate mark and space signals 850 c/s apart and mark the B.F.O. control for the three zero beats.
6. *Or:* Tune in a commercial RTTY station known to be using 850 c/s shift. Consider his signal as two C.W. signals 850 c/s apart and juggle the receiver tuning and B.F.O. until the three zero beats can be found and marked on the B.F.O. control.
7. To check the station V.F.O. shift, tune to zero beat on the centre B.F.O. mark, press the "break" button and see how closely to the outer B.F.O. mark the V.F.O. zero beat shifted. The signal may move to either side of the B.F.O. control, depending on whether the receiver mixer oscillator is above or below the received frequency on the band in use.

The transmitter output should not change when keying the F.S.K. reactance modulator; if a difference does occur, then the V.F.O. is on the ragged edge of oscillation and improvement is badly needed. Components in the transmitter should be operated at ratings similar for phone operation. Steady R.F. power is being generated for considerable periods of time—RTTY is guaranteed to quickly weed out those overloaded or old, tired components that have been getting by on C.W. for years!!!

A Simple Tagstrip

by G5UJ

Often used in radio and electrical work, the ordinary tagstrip is quite easy to make. The bits and pieces needed to make this useful item are often to be found in the junk box! They are: a small red fibre strip $\frac{3}{16}$in thick, and about $\frac{5}{8}$in wide, by about 3in to 6in in length (depending on the number of tags required); half-a-dozen (old type) brass paper-clips; two small angle brackets—of the Meccano type—together with two nuts and bolts, to act as supports if desired.

Construction

First of all, with the aid of a pencil and steel ruler, draw a line along the centre of the fibre strip as shown in Fig. 1. Next, having decided on the number of tags needed, proceed to mark out the holes necessary to take the clips or tags. Then, with a small drill, which, incidentally, should be slightly *less* than the diameter of the clips or tags, drill out at equal distances the holes required.

This done, with the help of a fretsaw make a slot in each hole, to accommodate the clips. Having completed this operation fix each clip in a slot, and bend tags as indicated, one up, one down, so as to hold each one firmly in place. A $\frac{3}{16}$in hole may then be drilled $\frac{3}{4}$in from either end of the fibre strip, and a small Meccano, or similar metal bracket bolted to each end. If over 3in long, the strip may be stiffened by using a third bracket in the centre.

This will provide a firm mounting for the whole assembly. To facilitate soldering later, each tag may be tinned with the help of a soldering iron, and a spot of three-core solder.

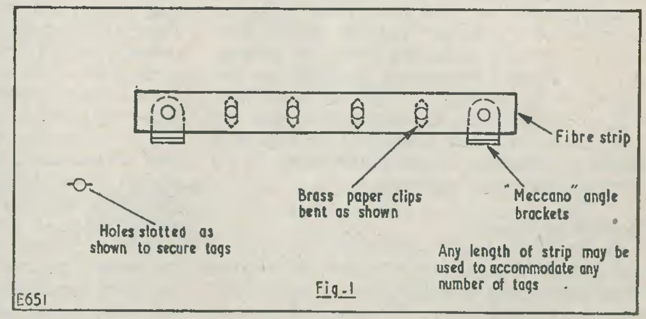

Fig. 1

Several variations of the above strip may be tried, according to circumstances, but this particular idea offered itself as the simplest way of securing several h.t. leads, in the absence of the commercial article.

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The 1959 PROVINCIAL AUDIO SHOW

A report by PETER PENLENHAM, A.M.S.D.B

Our contributor gives details of new developments in the high-fidelity world, as exhibited in the recent Audio Show held at Cardiff

THE DESIGN, MANUFACTURE AND SALE OF high-fidelity reproducing equipment now encompasses such a large proportion of the overall electronic scene in Great Britain that it is not surprising to find that exhibitions devoted to this particular art are being held with markedly increasing frequency. The Audio Show held in the earlier part of this year at Cardiff marks the start of a new technique in the staging of purely audio exhibitions, since it is the first to be presented in the provinces as a "curtain raiser" for the larger annual Audio Fair in London. This and succeeding provincial shows are intended to function in a somewhat similar manner to the provincial "try-outs" of new plays and films in America. In accordance with this intention the provincial shows are open only to *bona fide* members of the trade; and they do not incur the lavish expenditure involved in displays to which the public is invited. It is anticipated that the provincial shows will offer the considerable advantage of allowing manufacturers to sort out their ideas in advance of the larger London exhibitions, and of allowing show organisers to arrange layouts wherein competing products do not clash. It is planned to hold the 1960 provincial Audio Show in Manchester, and the 1961 Show in either Edinburgh or Glasgow (there is currently some controversy as to which is the more suitable).

Exhibition Layout

Being a "pre-view" exhibition, as it were, the Cardiff Audio Show offered an interesting and, indeed, exciting foretaste of what is in store in high-fidelity developments of the very near future.

The Show was housed in the Cwmophet Hotel at Cardiff, and it took up the now-familiar form in which single rooms are devoted to individual exhibitors and the ground floor reception rooms to manufacturers' stands and displays. The Cwmophet Hotel is not a large building, but it sufficed very adequately for its present requirements, wherein attendance was intentionally limited.

Amplifier Developments

The exhibition gave evidence of new thinking, especially in so far as amplifier development was concerned. Whilst most of the amplifiers displayed were designed on conventional lines there were several semi-experimental models which functioned on the well-nigh revolutionary new Krischmensch principle. As some readers may already be aware, the Krischmensch method of audio amplification* functions by having the input audio signal amplitude modulate an r.f. carrier frequency, this being then amplified by fairly conventional r.f. circuits. The modulated r.f. appearing at the output stage is detected by silicon diodes having a relatively linear forward voltage/current characteristic, and is then applied directly to the voice coil of the loudspeaker. The theoretical advantages given by the Krischmensch system are considerable. Firstly, the overall cost of the amplifier is reduced, as it is possible to obtain the requisite gain at r.f. with markedly fewer stages than is required for an equivalent gain figure (with similarly low distortion) at a.f. Secondly, amplifier design is made extremely simple, because distortion of the modulation envelope can only occur if the bandwidth of the r.f. amplifier stages is low, if r.f. transient response is poor, or if intermodulation occurs between sidebands of differing frequencies. All these possible causes of distortion can be almost completely obviated by the simple processes of employing tuned circuits which are flat, within some 0.2dB, up to 20 kc/s on either side of the carrier frequency, and of operating the r.f. amplifying valves at a reasonably linear part of their I_aV_g curves. Thirdly, there is the advantage that power supply regulation and decoupling requirements are considerably eased. There is, for instance, no necessity to employ decoupling condensers having values in excess of $10\mu F$ or so, as are needed in "straight" a.f. amplifiers, because it is possible to bypass individual circuits with capacities of the order of $0.01\mu F$ only. Fourthly, and perhaps most important of all, the a.f. output transformer is completely eliminated. With the Krischmensch system the output r.f. coil feeds directly into the voice coil of the speaker via a bridge demodulator network. A simplified version of the Krischmensch output circuit is shown in Fig. 1. The four diodes employed in this circuit have a low forward impedance, loudspeaker. From the point of view of a.f. the voice coil is shunted (*via* the diodes) by the secondary of the r.f. output coil, and this is wound such that its impedance at a.f. is a fraction of an ohm only. Thus, looking backwards from the speaker, the output circuit behaves almost as a short-circuit.

Krischmensch amplifiers were exhibited by two companies. One of these, Planned Reproduction Ltd., showed an amplifier in which the carrier frequency was 500 kc/s, this being amplitude modulated by means of a special device at the pick-up head. So far as the writer could ascertain the pick-up contained a variable inductance coupling element (something like a variometer) which controlled the level of r.f., at carrier frequency, passed to the main amplifier. Medusa Developments was the second company which exhibited a Krischmensch amplifier,

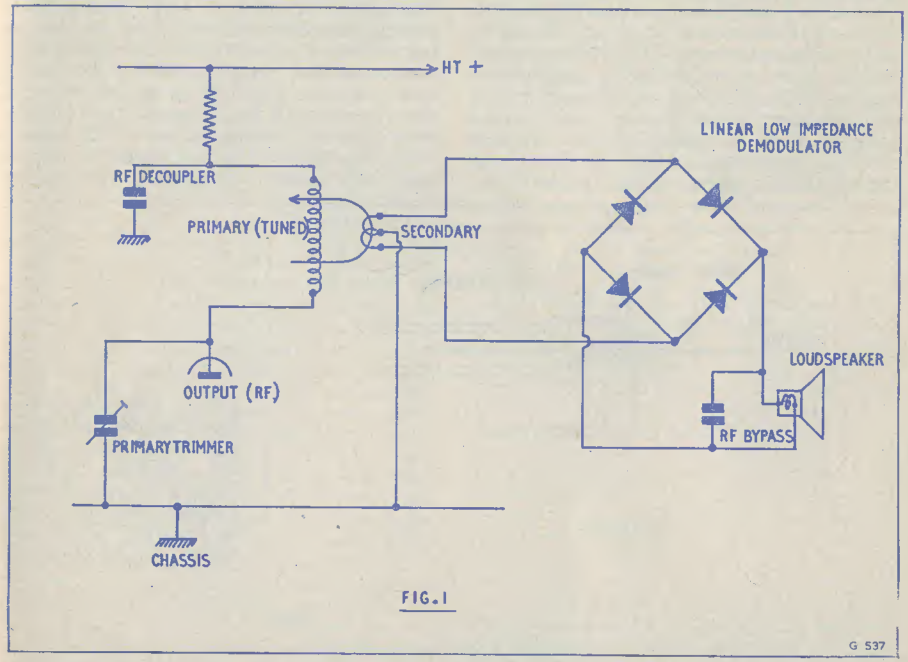

Fig. 1. A simplified version of the Krischmensch output stage. The single output valve is capable of driving the output tuned circuit at some 5 to 15 watts peak power, and it operates in Class A

with the result that power loss is almost negligible. The r.f. bypass condenser across the voice coil has a relatively low value (some 50pF or so), to avoid the introduction of distortion on transients which produce downward-going modulation. A very important feature of the output circuit is the heavy damping which is imposed on the

but in this case modulation of the r.f. carrier was carried out by conventional electronic means. Also, the carrier frequency was much higher, being of the order of 10 Mc/s. Due to its modulating circuits the Medusa amplifier was capable of functioning with any a.f. input, whether it be from record, tape, or tuner unit, whilst the Planned Reproduc-

* "A New Technique For Low-Distortion Amplification", F. Krischmensch, *The Higher Fidelity World*; Dec. 1958.

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tion equipment could be used for disc only.

Appreciation Meter

A company which, in the past, has always been well to the fore in public displays appeared once more at this exhibition. This was Kilroy Ltd. Kilroy exhibited what they describe as an Appreciation Meter, this being a device which enables the true audiophile to assess the technical performance of his equipment.

Since, according to Kilroy, the majority of high-fidelity equipment has nowadays reached a very high pitch of efficiency, audio enthusiasts find it more and more difficult to evaluate the capabilities of particular amplifiers and loudspeakers by purely subjective listening tests. This comment applies especially, it appears, to those who have never in their lives attended an actual musical performance, and who do not possess, in consequence, a basis for the true appraisal of the sounds which are offered by their audio equipments. The Kilroy Appreciation Meter consists of a microphone coupled to a simplified oscilloscope display unit. The microphone is set up at the listening position whilst a special record, available with the Appreciation Meter, is played over the high-fidelity system being examined. The record provides a continuous succession of square waves having varying repetition frequencies, these being picked up by the microphone and displayed on the oscilloscope screen. A booklet written in simple non-technical language then explains to the user how the oscilloscope displays may be interpolated into "scores" varying from zero (gross distortion) to 100% (perfect reproduction). With the aid of the Kilroy Appreciation Meter it is possible for the enthusiast to discover whether he is obtaining say 97% enjoyment from one set of audio equipment as opposed to a mere 94% enjoyment from an alternative set of equipment; and it completely eliminates haphazard judgment by conventional listening methods, wherein no detectable difference may be apparent at all.

Stereo

As is to be expected in an Audio Show nowadays, stereophonic equipment was much in evidence.

Although stereo reproduction from discs employing the currently accepted system, by means of which both signals are recorded in a single track at 90 degrees to each other and at 45 degrees to the surface of the record, is now considered "standard," attempts are still being made to introduce other means of obtaining disc stereo. A very interesting system was exhibited by the Mezzo-Cut Recording Company. This firm demonstrated records which had the two stereo tracks cut on either side of a single record, the record then being played with the aid of two pick-ups. Fig 2 gives an idea of this arrangement. In Fig. 2 one of the pick-ups rests in normal manner on top of the record, whilst the other is held up against its underside. By suitably weighting the second pick-up, stylus pressure and arm inertia of both pick-ups is kept equal. Mezzo-Cut claim that this method of stereo reproduction completely eradicates cross-talk between the two tracks, and that it enables best use to be made of currently developed high-performance single-track pick-ups.

Another new departure was the introduction of a stereo demonstration disc which displaces the time-honoured record of the passage of a train through a railway station. The new demonstration disc is startling in its

continued on page 702

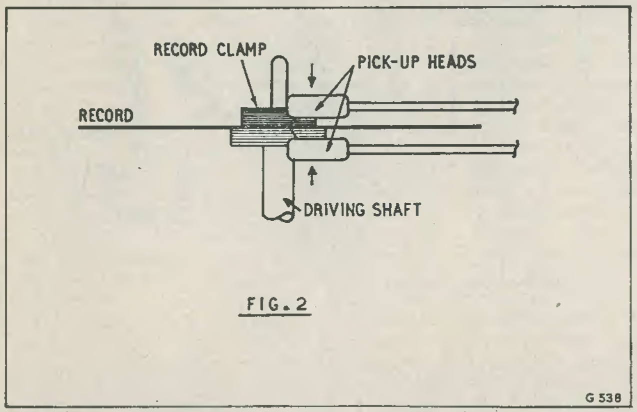

Fig. 2. The Mezzo-Cut stereo system relies basically on having two pick-ups tracking opposite sides of the record. it is claimed that this results in improved fidelity and that it obviates cross-talk

Radio Miscellany

DURING the week-end I had a visit from a couple of fellow enthusiasts of the mid-'twenties era. The three of us, as bright-eyed youths, were regulars at our local radio club. In those good old days, shortly after the birth of broadcasting, more or less every well-populated locality had a "wireless" club of some sort. As anyone who could tinker with a few simple tools became an "experimenter," as they were then known, there was no shortage of members. Our club had nearly 150, and the attendance at the weekly lectures, which took place in the local church hall, usually ran into three figures. In those days there were no commercial sets worth mentioning, although there were a few factory jobs for those with a lot more money than sense. Consequently, there was plenty of scope for enthusiasts who were kept busy making up sets for relatives, friends and neighbours. The component trade was colossal and every main street had two or three shops at which bits and pieces could be bought. Consequently, there was a continual stream of new ideas and gadgets coming into circulation almost daily. Hence radio was a very exciting and fast-moving hobby and there was no difficulty in planning club programmes and getting a packed house every club night. There was lots to talk about, and anyone who with his two-or three-valver claimed to get regular reception from 5IT (Birmingham) was sure of a ready audience clamouring for the circuit.

In the early 'thirties mass-produced factory-built sets began to edge the home-built variety out of existence. Actually it took a long time, and even well in the 'thirties there was probably a fairly equal number of each. When the price of the factory superhet became comparable with that of a home-built "straight," a fast decline set in.

The three of us, my two visitors and I, saw the gradual decline reflected in the club. Moves to smaller premises finished up in a room in which, when a couple of dozen of us were seated together, everyone had to ease up a bit when somebody wanted to straighten their legs. In fact, when we three drifted away for various reasons a couple of years before World War II, the club finally fizzled out after outlasting many others by several years. We had no end of a time yarning about the club when it was in its heyday.

As usual with clubs of this sort, I fell in with a little group made up of those with similar tastes and ideas to my own, and who walked the same way home. We soon fell into the habit of sitting together at meetings and smoking each others' cigarettes, etc.; and, at the end of the meeting, drifting homewards together in a little animated knot, pausing at corners where one of us broke away to follow his lonely path, to chat—about radio and other matters.

I also belonged to a very specialised short-wave club, mostly transmitting amateurs, a bug that bit me deeply, and in later years, when I was persuaded to write "Reflected Waves" (the forerunner of this and other columns), it was urged upon me that I should find it easy possessing, as I did, a long background of club experience. Who, my tempter argued, could know better what enthusiasts loved to talk about when they got together? It seemed very plausible and I suppose I fell for it. However, when I tried to think what enthusiasts *did* talk about when they got together all I could remember them discussing was motor-bikes, cameras and such-like. Surely, during all those hours of conversations before and after meetings, during intervals and on our slow walk journeys homewards, we must have talked of many vitally interesting radio points. Yet if we did, try as I would I could never think of them.

Hence, when my two old-time radio friends were with me I decided to ask them. After so many hours of enjoyable chatting they *must* remember something of what we chatted over. For a minute or two they hummed and ha'd, but I pressed for an answer. Finally, after much profound thought, they said: "Oh! motor-bikes

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Centre Tap talks about items of general interest

cameras and such-like things." Which only goes to show that radio amateurs take a lively interest in most working things and probably explains why this column, whenever it touches upon a "fringe" subject, receives quite a lot of correspondence from readers who dabble in that as well as radio.

Up the Garden Path

True to our youthful habits, we went into a long and enjoyable rag-chew about all sorts of things—many of them topics recently discussed in this column. Both of them read it. Whether they read it for enjoyment or simply because they know the chap who writes it, I am not sure.

"Funnily enough," said one, "about the same time as this garden-shedders business came up we had just moved into our present house. So I have changed from a bleak and draughty attic hobbyist to a garden workshop shiverer right at the onset of winter. As it was the late autumn it was too late to design and build my own, and in any case I have not had much experience in the carpentering line. Didn't even own a saw. Whenever I have had a sawing job on hand, simply bought one from the usual red-fronted store, used it once and cheerfully bought another when the next need turned up years later. So I sent to several firms and like your correspondent received an armful of beautiful catalogues. Finally I selected one that seemed to be the most suitable. The only tools required, according to the brochure, were a hammer, a screwdriver and a spanner. I happened to have all three, so I thought I was pretty well set. The book didn't mention you also needed an assistant, and a strong one at that. In fact, when it came to putting the roof on I found I really needed two or three.

"I said I wasn't much of a carpenter. I wasn't—until I started on that job. In putting the sections together, try as I would I couldn't get the bolt holes to correspond. Naturally, I didn't have a brace and bit so off I went and bought one. Then I found that edges that were supposed to meet only seemed to match up here and there. Off I went again—this time to buy a plane. Thus it went on, and I finished up with as fine a set of tools as most chaps possess when they have ideas about building their own furniture. It was a jolly good job I decided on a shed on the big side. I need all that extra space to store the new tools, and since then I have had to divide my time between making a tool chest to store 'em in, and trying out ideas on keeping the rust from ruining 'em. By the way, some of the dodges your correspondents recommended to prevent rust really worked.

"Before you have a chance to say it, let me tell you my troubles were not due to starting off with an unlevel foundation. In fact, I had to buy a spirit level to start. Thirty-five years of radio and all sorts of other hobbies and I have never felt the need for a spirit level before! And as far as I can see I shall never need it again—but at least I have now got a nice shed to keep it in.

"Seriously though," he added, "once you have succeeded in making a garden workshop really comfortable it's a treat. No one to interfere with you, and you can make as much noise as you like. Previously, if I ever used a file on a chassis I had the whole house running round complaining I was putting their teeth on edge. It's a joy to be able to leave a half-finished job, and go back later and find everything exactly as you left it. Even so it is as well to fit a good strong lock. The Missus has already hinted the place is in need of a good clearing up, so just to be on the safe side I have put up a few DANGER, HIGH VOLTAGE, KEEP OUT signs in strategic positions."

Harmonics and Transients

Then we fell to talking about gramophone records—a subject on which reader-correspondence has been so heavy that it has regularly forced its way into this column for several months. One of them had brought along with him an E.P. record of Offenbach's "Orpheus in the Underworld" for me to hear—or rather to hear it himself on my hi-fi equipment. It is certainly a very pleasant record without any special merit as a test-cum-pleasure disc, except perhaps for one unusual passage. The record is unusual, too, inasmuch as the overture takes up only 1½ sides. The second side consists of the celebrated Can-Can music only, the rest of it being filled up with "The Procession of the Sardar," by Ippolitov-Ivanov. This, too, is a popular piece of music, and I recall the first time I heard it many years ago I mistakenly guessed the composer to be Rimsky Korsakov. However, I later discovered that Ippolitov-Ivanov was a pupil of the said R.K., which perhaps accounts for the similarity of a style in which I find particular pleasure. This recording of it starts as a duet with a piccolo and a bassoon playing three octaves apart. My friend said he had played it with two different makes of pick-up and found a marked difference in the reproduction of each. He then alleged he found it quite different again on mine! Haven't yet heard it myself on a second pick-up, but it seems to have some possibilities as an interesting test for those interested.

This record might also be of interest to F.N. (Derby). Incidentally, many thanks to those readers who were kind enough to send helpful replies to his query. The letters have been forwarded to him and I guess he will have such a busy time answering them all that he won't have much opportunity of listening to all the discs recommended. That is, if he has got that much money to buy even a tenth of them!

Club Records

The Classics Club records fans are certainly enthusiasts. At the first suggestion that C.C. records are in any way inferior to standard recordings out come their fountain pens and, presto, another letter, and I just haven't got the space to squeeze any quotes in. Except, perhaps, that H.W.S. (Gillingham), after advising me to go along to their club-room and hear for myself, says, "It is the high standard reached that forced one leading manufacturer to meet the competition at a slashed price." He refers, of course, to the Ace of Clubs records.

Non-gramo enthusiasts, please be patient with me. I certainly didn't start off all this argument but I seem to be thoroughly caught up in it. There remained nothing for me to do but to buy one for myself. So I sent off for the Classics Club 10in l.p. of Ten Great Works, and while the said friends were with me, I tried it out on them. We finally agreed that any major differences between this particular record and the average standard disc was so slight as to pass unnoticed. Actually the volume level was markedly less, but this was easily compensated for by turning up the volume control a shade. The absence of surface noise was definitely lower than with most makes, and is indeed a matter for congratulation.

While on the subject of records and their cost, I see that the British Phonograph Committee were early in the pre-Budget field with strong arguments in favour of a reduction of Purchase Tax. The current tax on discs is 60%—double the rate it was when it was first introduced in 1940, when the war outlook was very dark. Yet, despite the tax, home sales are still booming. Last year a radio dealer friend of mine opened a special record department, since when it has been his principal line of business! On the export side the annual figures run to some 15 millions, which makes it hard to plead that the heavy tax restricting home sales reacts unfavourably on production costs. Still, a price reduction made possible by a P.T. concession is a nice idea. Does anybody know if the Chancellor is a Hi-Fi fan?

Round and Round

We chatted on about all sorts of things, but whatever the subject it seemed to lead us back to the gramophone. Talking of holidays (visiting Continental amateurs) we gradually veered to foreign languages—and the learning of them from l.p. records. Incidentally, I see that the Editor of the *Linguaphone Magazine* enjoyed my little anecdote of the "second cup" of Austrian tea and reproduces it in his magazine.

Then we got on to greetings cards and one friend mentioned the good quality of reproduction on those of the "record" type. Incidentally, H.W.S. (Gillingham) also mentions that he was greatly impressed when he first heard one of them.

Even when we discussed the difficulties of lone amateurs in learning Morse we had to agree that the gramophone, especially with l.p. records, is an excellent medium. The chief obstacle in learning Morse, or getting the right sort of practice, is the discouragement which grows out of lack of apparent progress. I am sure far more amateurs give up in despair than ever become proficient readers of it. For this reason the unsuccessful ones agree with me that the ability to become quickly proficient is in no way related to one's intelligence. I always console myself with this theory, as even at my best I invariably got jittery when anything faster than about 18 w.p.m. was shot at me and I fell more than seven or eight characters behind. As I once served with several really hot professional operators, perhaps I suffer from a Morse inferiority complex. I've seen chaps take real fast stuff, stop and light a cigarette or sip a cup of tea, and then continue copying 15 or 20 words behind. At first I used to suspect it was a trick. If it was, it deceived far better operators than me. Anyway, these super-Morse men didn't seem particularly good at anything else, so it merely served to reinforce my belief that this strange knack had nothing to do with real brains. In the Army I saw quite a number of fellows who shot through exams with honours reduced almost to desperation by their failure to make progress, while lesser types were taking 12 w.p.m. in cypher in less than a month. But even this interesting discussion failed to get us away from music. Morse aptitude and musical sensibility, we agreed, often go hand in hand. So I am left wondering how many of our gramophile readers are Morse supermen—or would be if they got down to it?

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Technical Forum

A GLANCE AT THE CIRCUIT DIAGRAM OF A television receiver and a look inside the set itself should reveal a complicated mass of wires and components which would dissuade the average do-it-yourself enthusiast from tackling a repair. Yet most of us know of the success which many of these people have in doing their own servicing, sometimes with good advice from a friend "in the know." This led us to reflect the other day just how much technical knowledge is required for servicing work and what is the possible number of faults which could occur. Certainly, if we were to take an average t.v. circuit and work out the combination which could exist if one or two components became faulty the number would run to several hundreds. One might then go on to argue that to learn the effects which all these different faults could produce on the performance of the receiver would require a great deal of learning. This, of course, supposes that the service engineer has to memorise a very long list of causes and effects in parrot fashion, and raises the question of whether or not it would be easier to learn the mode of operation of a circuit and then to apply the fault-finding procedure by purely logical means. This implies a very good knowledge of the operation of quite a large number of different types of circuit if the engineer is to tackle all the various makes and models which can be encountered. Yet it has been repeatedly found that a man with this knowledge will take longer to repair a set than an experienced service man who has little knowledge of the type mentioned but who has spent many years doing repair work. This may seem a little odd at first, but this is possibly one of the few cases where a lot of learning is not necessarily a good thing. Logical fault-tracing based on a thorough circuit understanding may easily involve a detailed series of measurements, whereas an experienced serviceman may point out the fault from past experience.

Success at servicing would therefore appear to depend on a great deal of experience and a little technical training. The experience consists largely of knowing the cures for the defects which are most likely to occur, and this is not as difficult as may at first appear because, of the hundreds of faults which are possible, only a matter of tens are probable. With this in mind, the writer set out to consider those faults which are most likely to be encountered.

Primary Defects

As might perhaps be imagined, the valve constitutes the least reliable of the components found in radio and television sets, but as the average t.v. receiver has sixteen or seventeen the survey requires to be taken a stage further to find which valves are the least reliable. Most multiple valves fall into this category with the frequency-changer at the head of the list and the double triode near the bottom. Of the single structure valves, those in the line and frame output stages come first, with the most reliable being the r.f. pentodes used in the i.f. stages. The valves themselves can suffer from a multiplicity of defects, but by far the most likely are low emission or bad insulation. The former generally shows up as a reduction in gain, that is lack of sensitivity or a reduction in height or width of the picture. Bad insulation will normally cause distortion, either audio or on the picture depending in which stage it exists, or a complete failure of one stage should a complete inter-electrode short have developed.

Thus with a very basic knowledge of the function of the different stages of a radio or television receiver it is possible to locate a faulty valve with a good degree of accuracy. The next most likely components to suspect of being faulty are the electrolytic capacitors, particularly those in the h.t. smoothing filter. The actual capacitance of these components usually falls towards the end of their working life whilst the leakage resistance comes down in value. Defective smoothing capacitors, of course, will cause hum on sound stages and one or two horizontal bars on the vision channel. It is worth remembering that a leaking h.t. electrolytic can increase the current in the rectifier to the point where it also may become damaged. Conversely, a faulty rectifier may pass a large 50 cycle component through a filter capacitor to its detriment. Hence when either of these components is found to be faulty the other must also be suspect.

Next on our list comes the variable resistor or potentiometer, the failure rate on these components being highest among those fitted with on/off switches because they require readjustment each time the receiver is switched on. Noise, whether on sound or on vision, is the normal indication that a control is in need of replacement.

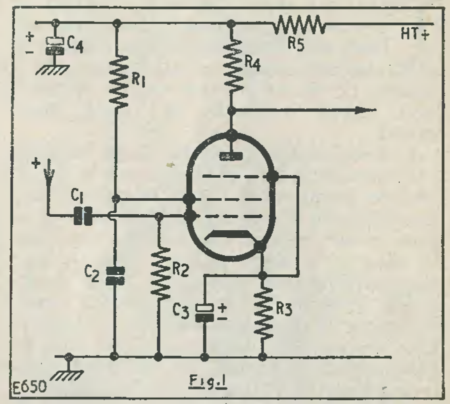
Another source of noise or intermittent operation takes fourth place in the list and is due to faulty valve pin contact. This form of trouble was increased with the miniature range of valves, these having slender wire pins with a greatly reduced contact area. The source of the noise can usually be detected by simply tapping each valve in turn, and then the pins may be cleaned up with a fine grade of emery cloth.

Fixed Capacitors

The next most likely source of trouble is the fixed capacitors, and here the fault tracing procedure becomes rather more complicated. The first step is to narrow down the search to the stage which contains the suspected fault, but even then there is a choice of perhaps a dozen capacitors. A clue can be obtained from the effect which the fault is having on the performance of the receiver and the class of capacitors which are employed in the circuit. For example, waxed paper capacitors are more inclined to develop a resistive leak than the mica or ceramic type, which usually become open circuit at the end of life. It is difficult to generalise on the effect which certain components will have in circuits without taking a specific example, but a first step can be taken by considering Fig. 1.

This is typical of an audio or frame output stage, which will function on low frequencies and will therefore employ a combination of paper and electrolytic capacitors. Any leakage in the paper capacitor C_1 will raise the bias on the valve positively and cause it to pass an excess of cathode current. To save breaking the circuit to read this current simply measure the voltage across the cathode bias resistor R_3 and then calculate the current by Ohms Law. Leakage on C_2 or C_4 will lower the screen or anode voltages of the valve and show up as a reduction in cathode current. When making measurements on such a stage it is worth remembering that the cathode current comprises the anode and screen grid currents and that these divide approximately in the ratio of 5:1. The screen current may be arrived at by reading the voltage across R_1. A leak in C_3 has the same effect as reducing the value of R_3 which will increase the current flowing through the valve, thus increasing the voltage across R_1 and R_4. This procedure has been described as it is indicative of the process employed to locate a defective component; it is, of course, helpful to have the service sheet on hand to indicate the correct values of voltage and current which should be encountered at various points in the circuit. However, if the service data is not available, it is surprising the amount of very useful information which can be gleaned from the valve-maker's published information.

Turning next to the mica or ceramic type of fixed capacitor found in the r.f. or i.f. stages, it has already been stated that these normally go open circuit when at last they do become defective. An open circuit



capacitor can often be located by shunting it with a known good component and noting the improvement in set performance.

To complete the list of most likely component faults comes the fixed resistor, where the locating procedure is similar to that used for capacitors. A faulty resistor is one which has usually become open circuit and will not therefore be passing current. To avoid removing a suspect component for test it is usually possible to shunt any such components with a resistor of similar value to note any improvement in receiver performance. This process of checking components by shunting is quick and effective but is, of course, only applicable to those which are likely to have become open circuit, it being quite useless to hope to find a shorted capacitor by this method.

This concludes the list of most frequently encountered component faults; no mention has been made of transformers, speakers, tuning capacitors and the like, as experience has shown that these items are the least likely to cause trouble.

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MISCELLANEOUS

Circuits for Crystal Diodes

by F. G. RAYER

THERE ARE MANY CIRCUITS IN WHICH A crystal or germanium diode can be used, and the cheap diodes obtainable as surplus will usually be satisfactory. As it requires no heater or other supply, a crystal diode circuit is usually very easily made indeed.

The self-contained crystal diode receiver, a typical circuit for which is shown in Fig. 1, deserves mention because it can give trouble-free reception of one or two local stations, at good phone volume. A dual-wave coil can be used, or a single coil, or separate long wave and medium wave coils, with appropriate switching. An air-spaced tuning condenser is recommended, and medium or high impedance phones of good quality. Low impedance phones are not satisfactory, unless a matching transformer is added.

A reasonably good aerial is required to obtain sufficient volume, but indoor aerials are often sufficient. An earth is usually essential, or volume will be very poor.

Tuner Unit

The crystal diode receiver will act as tuner for an amplifier or tape recorder. Alternatively, it may be wired-up in a more compact form, with pre-set tuning for the local station, as in Fig. 2. Here, a small dust-cored coil is shown, and the circuit can be tuned to the local station by adjusting the core. A small pre-set (500pF or 300pF maximum capacity) can be wired in parallel with the coil, as indicated, or a fixed condenser may be selected to bring the local station within the tuning range of the coil. With a poor aerial, or in cases where volume is too low, the aerial connection can be taken directly to the tuned winding.

With such a tuner, an amplifier can be used to give excellent reception of a local station. The "hot" tuner output lead should be short, or screening may be necessary to avoid hum. This point goes to the grid side of the amplifier input. With amplifiers drawing h.t. directly from the mains (as with a.c./d.c. equipment, and cheap a.c. amplifiers) isolating condensers must be included in output and earth return leads. Reliable condensers of 0.05μF, 750V working, will suffice, and the 0.05μF condenser in Fig. 2 is then unnecessary.

Transistor Set Detector

The crystal diode is very useful as detector in transistor receivers, and a simple 2-transistor set of this kind is shown in Fig. 3. Component values are for a pair of TS2 transistors, but cheap surplus transistors can also give good results, with a change of resistor values if necessary. With this circuit, an output transformer giving a primary impedance of about 680 ohms is recommended.

If a particular diode is to be selected, then the GD5 would be satisfactory. But any crystal diode in good condition can be expected to give good results. The circuit is intended for local station listening, with a reasonably effective aerial.

Following R.F. Stage

When signal strength is poor, or an efficient aerial is not possible, an r.f. stage may be used before the diode, as in Fig. 4. Component values in the r.f. stage are suitable for a 6K7 or similar valve, and may, of course, be modified for other valves. Tuning may be by a 2-gang condenser, and include long wave coils. Or pre-set tuning to a number of local stations may be adopted.

This circuit can be used as a tuner, giving a much better output than that in Fig. 2. Or it may form the early stages of a local-station receiver capable of giving very good reproduction. In conditions of good signal strength, a single stage will allow a speaker to be operated at reasonable volume. In less favourable conditions, or for better volume,

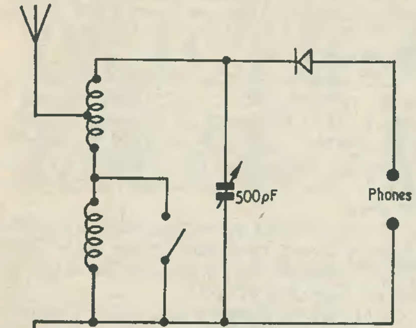

Fig. 1 Crystal diode receiver

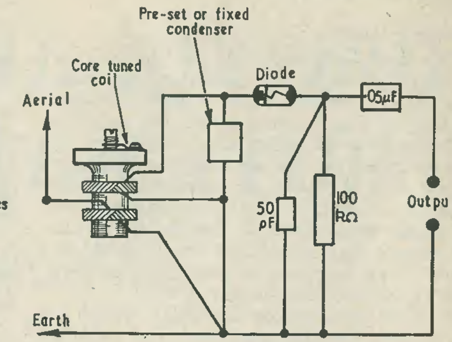

Fig. 2 Tuner for amplifier or tape recorder

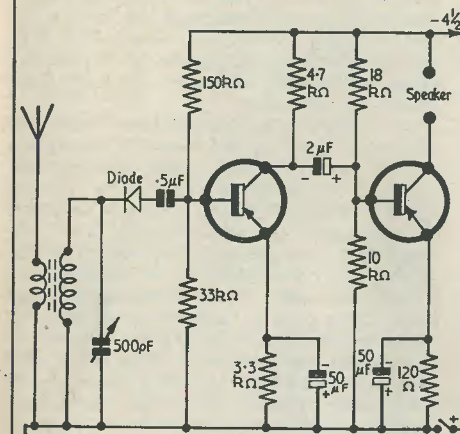

Fig. 3 Detector for transistor set

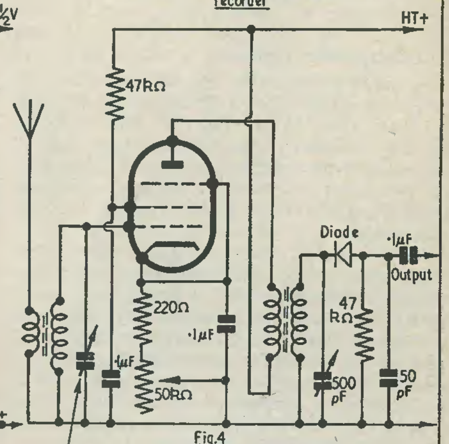

Fig. 4 RF Diode circuit

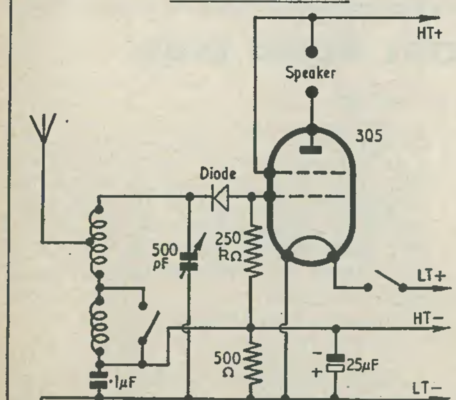

Fig. 5 Loudspeaker 1-valver

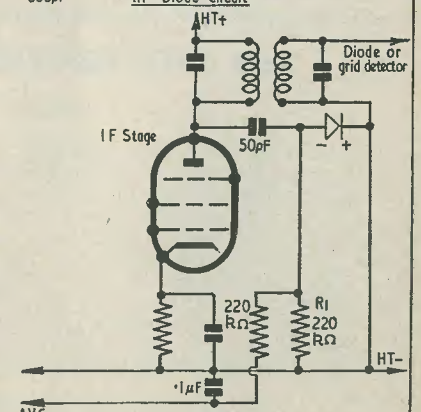

Fig. 6 Crystal diode for AVC

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a 2- or 3-stage amplifier can be adopted, to complete the circuit. This depends on the purpose in view.

Superhet Detector

The crystal diode can be used as detector in battery, mains, or transistor superhets. The detector circuit can be exactly the same as that in Fig. 4, except that the diode is connected to the secondary of the last i.f. transformer. In this application, it is very useful in local station or "quality" superhet tuners or receivers. Frequency-changer and i.f. stages would precede the diode, and the a.f. output from the diode circuit would be taken to an amplifier section in accordance with the volume and quality in view.

A diode such as the GEX45/1 would be satisfactory for this purpose. The GEX34 or OA89 is also satisfactory. Some types of surplus diodes may be overloaded by local stations.

A Loudspeaker 1-valver

A diode of this kind may be used in one of the simplest speaker receivers, employing a circuit like that in Fig. 5. The diode is directly coupled to the output stage, and a high-gain type pentode is best for the latter. In practice, the rectified voltage obtained from the diode is too small to upset the grid bias voltage.

With such a circuit, a good aerial and earth must be used, when reasonable speaker volume can be expected. A sensitive speaker, with correct matching transformer, will help to assure that enough volume is obtained. The 3V4 is of similar characteristics, though usually less cheap to purchase. With a 90V h.t. supply an optimum load of about 10kΩ is required. With a 2/3 ohm speaker, a 65:1 or similar transformer will provide this.

If a very simple circuit, for mains operation, is in view, this can be chosen. In the event of half-wave rectification from the mains, for h.t. current, isolating condensers must be added in the aerial and earth circuits.

Obtaining A.V.C.

A crystal diode may be used to obtain an a.v.c. voltage, one circuit being shown in Fig. 6. It is necessary to connect the diode with correct polarity, so that a negative voltage is obtained. The GEX45/1 is satisfactory, but other germanium diodes may be used.

The degree of a.v.c. action can be modified to some extent by changing the value of the 220kΩ resistor R_1. Reducing its value will reduce the a.v.c. action.

In superhets where a grid type of detector has been adopted, because of its high sensitivity, the crystal diode is very useful to provide a.v.c. When a diode-triode, or double-diode-triode has been provided, a.v.c. will normally be present already. A.V.C. may also be obtained by means of a crystal diode, in this way, when a further such diode is used for detection.

The a.v.c. voltage produced can be applied to the i.f. stage by returning the secondary of the first i.f. transformer, suitably decoupled, to the a.v.c. line. With the frequency changer stage, a.v.c. may similarly be applied to the aerial tuning coils. To avoid back coupling, a resistor of about 100kΩ can be included in the a.v.c. circuit to the coils, with a bypass condenser of about 0.1μF from coils to chassis. An alternative method is to include a 100pF condenser in series with the frequency changer control grid, and take a 0.5MΩ resistor from grid to a.v.c. line. This is sometimes more convenient as coil connections need not then be disturbed.

THE 1959 PROVINCIAL AUDIO SHOW

continued from page 694

realism and it portrays in sound the entry of a train into Platform 1 at Paddington Station; recording also how the train leaves the track just after the Refreshment Rooms and ends up in the Booking Office Hall. As a point of interest, the only jarring note of the Show occurred at the end of a particularly vivid demonstration of this record when, as the final echoes of escaping steam died away, one listener was heard to observe bitterly that "it was about time that blasted train crashed, anyway."

To sum up, it may be said that the 1959 "preview" Audio Show at Cardiff has proved to be a really outstanding success and that exhibits shown offer a good augury for what is to be expected in the future high-fidelity field. The writer should add, of course, that the exhibition was held on the appropriate date of 1st April, and that all ticket-holders were admitted to the Show after the backs of their hands had been stamped with the legend:

APRIL FOOL

NOTE: All names mentioned above are, of course, fictitious, and do not represent any persons, living or dead, or any businesses, past or present.

PRACTICAL RECORD LEVEL INDICATORS

By **A. BARTLETT STILL**

Reference has been made previously to the various types of Level Indicators suitable for home-built Tape Recorders.* At that time, however, the process of recording itself was of primary interest, and the level indicator had to be relegated to its true position, assistant to that process.

Those constructors who have built, or are building, their own recorders may well be looking to a field for experiment. The level indicator will allow such experiment without materially affecting the performance of the complete instrument, and is, in consequence, an ideal start in this direction. The writer therefore proposes to discuss this type of circuit in some detail.

The first step, as with a complete recorder, is to decide exactly what the indicator is required to do; draw up a specification, so to speak. A machine that employs three heads, i.e. a separate playback head and amplifier, allows you to monitor your recording off the tape almost as soon as it is made, keeping an eye, or rather ear, on the volume level and distortion. Under these conditions the record level indicator is not so vital as in the machine that utilises a combined record/playback head. In such a case the recording is being made "blind" and the user relies on the indicator to ensure a good quality recording.

To avoid possible confusion that point must be stressed. The record level indicator is your passport to a *good quality* recording, the volume level being the sole concern of the reproducing amplifier.

Variations in the level at which a recording is made can affect the quality of that recording at either extreme. If the recording level is too low, the playback volume will be low also. This will mean that increased gain is required during playback, bringing up unwanted noise such as hum or tape hiss. In other words, the signal-to-noise ratio will be poor. A recording made at too high a level, on the other hand, may well pass the rather sharp dividing line between acceptable and unpleasant third harmonic distortion.

The term "modulation" is often used in connection with the recording level, though no percentages are quoted. It is usually sufficient to say that a recording is under-, over-, or correctly-modulated. Of the two extremes, there can be no doubt that an over-modulated recording is far worse, and so the simplest form of indicator would be one that gave warning of over-modulations only. A miniature neon lamp forms the basis of such an indicator, coupled to a d.c. voltage that is just insufficient to maintain it. The signal voltage is coupled in through a d.c. blocking condenser, and, adding to the steady voltage, strikes the neon when the correct amplitude is reached. A refinement is the use of two neons, one set to strike at normal modulation levels, while the other is reserved solely for use as an over-modulation indicator. This system was used on early commercial models in this country and, surprisingly, can be found on current American machines.

A simple and, indeed, cheap arrangement, but something better is really required.

The electron beam tube, more generally known as a magic eye, has proved its worth many times. These indicators usually incorporate a d.c. amplifier triode, and, taking a modern example, the EM81 requires a grid voltage of about −15V to produce zero shadow angle. The maximum shadow angle of about 80° requires a steady level of $-\frac{1}{2}$V, normally obtained by grounding the cathode and producing grid current bias. A practical circuit is shown in Fig. 1. The condenser C_1

* "Some Design Considerations for the Home Constructor," Part 2, December 1956.

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couples from any point in the amplifier at which a suitable signal is available, though this will normally be the anode of the valve that feeds the record head. The indicator feed network will, in consequence, be in parallel with the head circuit. It is in view of this that R_1 is included, and it should be noted that the value given, 33kΩ, is very nearly the minimum that can be entertained. Were R_1 omitted, the "front-to-back" ratio of the rectifier MR_1 would allow negative-going half-cycles of the audio signal to be severely shunted, resulting in distortion of the head current.

The audio signal at C_1 is likely to be about 20V r.m.s. for full modulation. Rectified, nearly the peak voltage will appear across C_2, giving about 27.5V d.c. As only 15V d.c. are required, we have plenty in hand and could, in this instance, increase R_1. C_2 and R_2 are chosen to have a long time constant, so that the "eye" will not fall off too quickly. Too great an increase of R_1 will tend to prevent the quick "rise time" that is required unless C_2 is reduced (with a corresponding increase in R_2).

Fig. 2 shows a variation of the same circuit, using an Osram valve. The extra condenser, 220pF, might be needed on either circuit to get rid of the last trace of bias.

The rectifiers quoted are both crystal types, but a signal-type metal rectifier is, of course, equally suitable. Those who have no small rectifier available, or who like to experiment, may be interested in Fig. 3. Here the amplifier triode of the indicator itself functions as a leaky grid detector. The writer has had success with this arrangement, but cannot guarantee it to work every time, without some component juggling. Variations of characteristics between one valve and another seem to be more critical.

Let us now turn our attention to a third form of indicator, one that utilises a meter movement. Without expressing any opinion as to whether a meter is more efficient than a magic eye, there can be no doubt that the addition of a meter to your equipment does make it look more "professional."

The simplest form of meter circuit of a practical nature is shown in Fig. 4, and immediately proves to be less economical than is apparent at first sight because of the high sensitivity meter that is required, together with a bridge rectifier. Referring to the recording amplifier circuit shown in the December 1956 issue (Fig. 8, page 322), the record head network and the indicator are fed from the anode circuit of the second half of a double triode (ECC81 or ECC83). In order to cater for a head current of up to 200 microamperes, the anode load resistor was kept down to 33kΩ. To allow an additional 500μA through a meter may mean

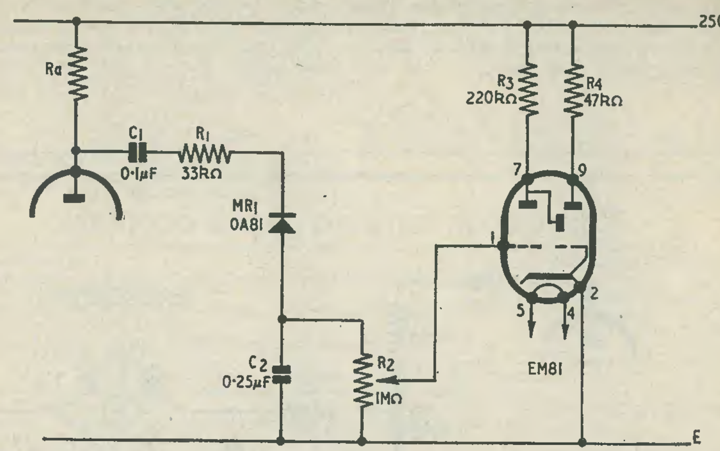

Fig.1

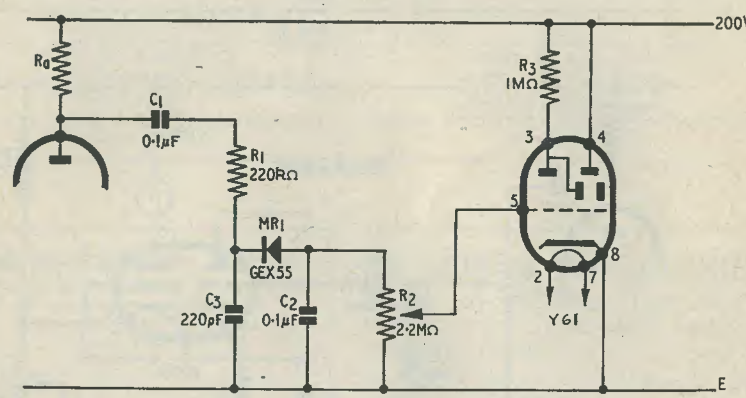

Fig.2

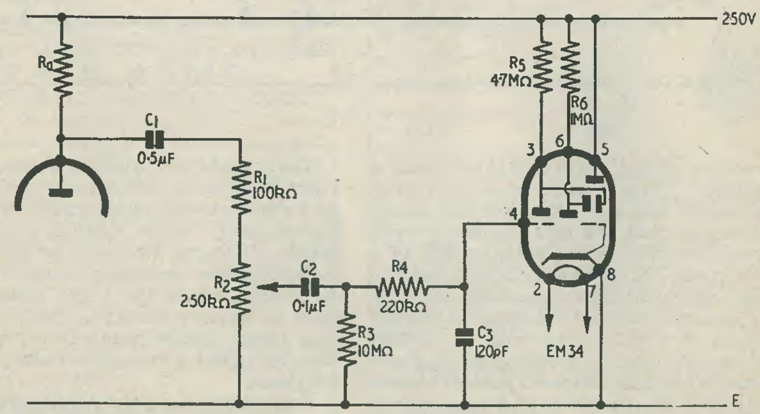

Fig.3

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reducing this resistor to an extent whereby the maximum cathode current of the valve would be exceeded. (The two a.c. current values involved are not simply 200 and 700μA, but the comparison will serve.)

will depend on the meter current; up to 5mA f.s.d. can be used successfully with suitable adjustment. R_6 is made variable in order that the electrical zero of the meter may be set.

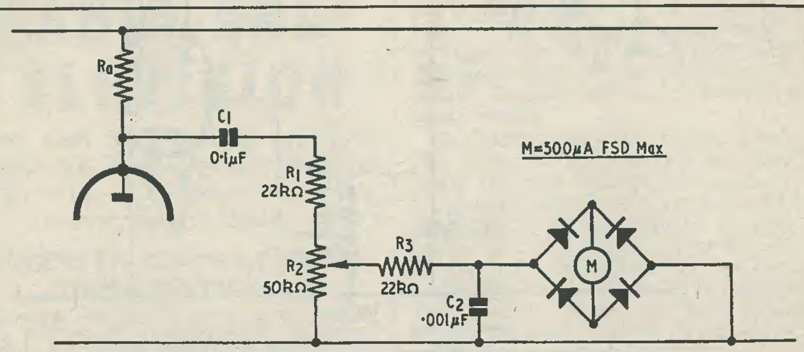

Fig. 4

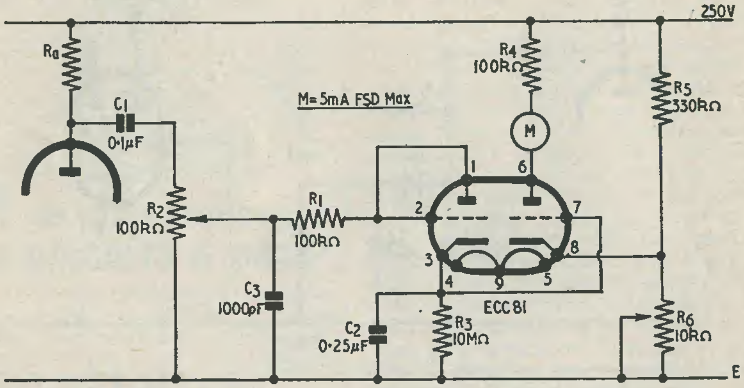

Fig. 5

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A second glance at the magic eye gives us the answer. These devices incorporate a d.c. amplifier whereas our meter does not, so one must be provided. As with the magic eye, a triode is suitable, which may be half of a double triode. Strapping the anode and grid on the other half does away with the need for a separate rectifier. A practical circuit is shown in Fig. 5, which may be usefully compared with Fig. 1, in respect to the signal network. C_2 now forms a time constant circuit with R_3, however, and to overcome the effects of meter inertia this constant is made considerably longer. The value of R_4

The arrangement outlined above, using the circuit of Fig. 5, though extremely efficient as a record level indicator may seem to be a rather costly device to fulfil that function alone. It forms the basis, however, of the comprehensive metering used on studio apparatus, where the single meter may be used to monitor recording level, erase, bias, and audio currents during recording, serving also as a peak programme meter (PPM) on playback.

Space does not permit description of this more complex circuit here, but perhaps the Editor will be indulgent at a later date!

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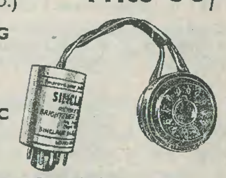

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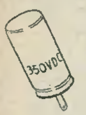

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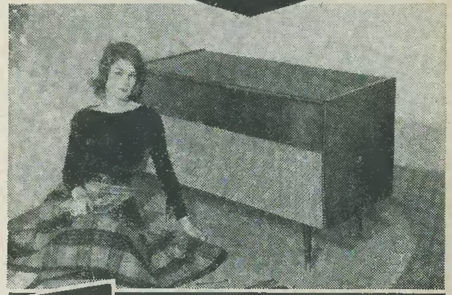

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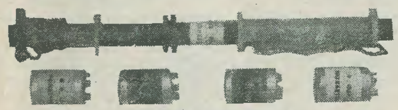

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EB34	1/6	PL83	10/6	1C5GT	12/–	6AT6	7/6	6J5M	4/11	6U4GT	11/6	12AT7	6/–	956	2/11
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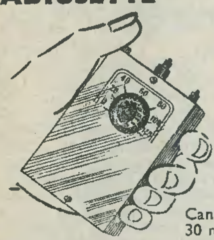
EF37	4/6	PZ30	12/–	1T4	5/6	6C6	4/6	6K8G	6/11	7B7	8/–	25A6G	9/6		
EF50	2/9	TDD4	12/6	3Q5GT	9/–	6CH6	10/6	6L6G	6/11	7C5	8/–	25L6GT	9/6		

Any parcel insured against damage in transit for only 6d. extra per order. All uninsured parcels at customer's risk.

C.O.D. or C.W.O. only. S.A.E. with all enquiries. Postage and packing 6d. per valve extra. Over £3 FREE. *Trade enquiries invited*

RADIOSETTE

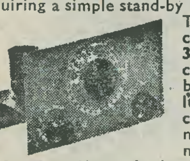


The ideal low cost transistor pocket radio for the beginner. The circuit utilises the new R.C.S. VARILOOP-STICK transistor coil. A specially designed miniature .0004 tuning condenser permits the set to be in a case which fits the palm of your hand.
Can be built in 30 minu es **30/-**

All components are sold separately, full construction da a including plan of parts, 2/–

ALL-WAVE RADIO 35/-

Ideal for the beginner or for those requiring a simple stand-by receiver



This 1 valve S.W. receiver can be built for 35/– from our list of components, which can be purchased separately. It includes valve and 1 coil covering 20-40 metres. Provision is made to increase to 2 or 3 valves if required, and all components are colour-coded so that the beginner can build this set quite easily. *Send 2/– for specification, wiring diagram, layout and price list.*

Postage: Under 10/–, 9d. Under 40/–, 1/6 Over 40/–, post free

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The Teletron TRANSIDYNE

Portable 6-Transistor Superhet Receiver with printed circuit

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

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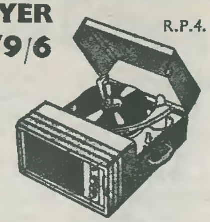
Sole Distributors to the Trade

RECORD PLAYER CABINET 79/6

R.P.4.



Stylish cabinet by famous manufacturer. Cloth covered in contrasting colours (red and grey). Grilled front controls panel. Size 15" x 19" x 8¾" deep. Beautifully made—a cabinet of which you can be really proud. Takes 4-speed B.S.R. Autochanger. 6½" round or elliptical speaker. Room for any amplifier of your own choice. Carr. and ins. 4/6.

B.S.R. Monarch 4-speed Autochanger £6.19.6 Incorporating auto and manual control complete with turnover crystal p.u. and sapphire stylus.

Collaro 4-speed Autochangers £7.19.6
U.A.12 Latest B.S.R. Monarch 4-speed Mixer £8.9.6
T.U.9 B.S.R. 4-speed Single Player £4.9.6
Postage and packing on autochangers 5/6

PORTABLE AMPLIFIER MARK D.2 79/6
12 months guarantee. Printed circuit. Latest design. Dimensions 7" x 2¼" x 5". A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume and tone controls. Knobs 2/6 extra P. & P. 3/6.

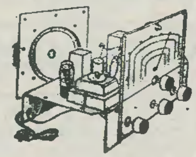
★ STEREOPHONIC SOUND ★

EXTENSION SPEAKERS 19/9

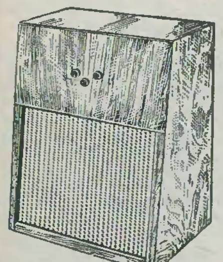
Polished oak cabinet of attractive appearance. Fitted with 8" p.m. speaker, W.B. or Goodmans, of the highest quality. Standard matching to any receiver (2-5 ohms). Switch and flex included. Ins. carr. 3/6.

8" p.m. Speakers 8/9. With o.p transformer fitted, 10/–.
6½" p.m. Speakers 12/6. 4" x 7" Elliptical Speakers 19/6. 8" x 5" Elliptical Speakers 22/–. Postage 2/9.

SUPER CHASSIS 99/6



5-valve superhet chassis including 8" p.m. speaker and valves. Four control knobs (tone, volume, tuning, wave/change switch). Four wavebands with position for gram. p.u. and extension speaker. A.C. Ins. carr. 5/6.



CONTEMPORARY EXTENSION SPEAKER 32/6

18" x 7" x 15". Dark veneered walnut cabinet. Attractive speaker fret. High quality 8" p.m. speaker. On and off switch and volume control. P. & P. 3/6.

TV AERIALS 25/6. For all I.T.A. channels. Outdoor or loft. 3 elements. P. & P. 2/6.
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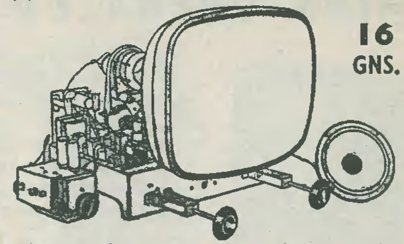
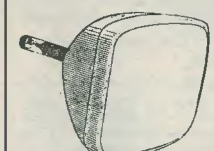
★ 17" TV CHASSIS, TUBE & SPEAKER

16 GNS.



17" Rectangular Tube on modified chassis. Supplied as single channel chassis covering B.B.C. channels 1-5, or incorporating Turret Tuner which can be added as an extra, at our special price to chassis purchasers of 50/–, giving choice of any 2 channels (B.B.C. and I.T.A.). Extra channels can be supplied at 7/6 each. Chassis size 12" x 14½" x 11" less valves. Similar chassis are used by well-known companies because of their stability and reliability. With tube and speaker (less valves), **16 guineas.** Complete and working with valves and turret tuner, **24 guineas.** 12 months guarantee on the tubes, 3 months guarantee on the valves and chassis. Ins. carr. 25/–.

EXPRESS DESPATCH SERVICE
Please phone to confirm Tube in stock. Send Telegraph Money Order. Tube despatched passenger train same day. This service only available with remittance by a Telegraph Money Order.



REGETTERED IMPROVED VACUUM TV TUBES

12 months guarantee

17" RECT. £7.10.0 14" RECT. £5.10.0

Our 12 months guarantee (6 months full replacement, 6 months progressive) illustrates our whole-hearted confidence in the Tubes we offer. We sell many hundreds a week throughout the country and have done so for the past 8 years. Many of them go to the Trade, i.e. to Insurance Companies, Renters and Retailers, who are thoroughly satisfied with our supplies. Remember, they also hold a 10 days money back guarantee.
9", 10", 14", 15" and 16" Round Tubes. Our special offer of these sizes **£5.** 12" TV Tubes **£6.** Three months guarantee on round tubes. Ins. carr. 15/6.

TV MASKS 17" White 9/9. Grey 10/9. P.P. 2/–.
TV MASKS 12" Soiled, 1/9, post 1/6.
REELS OF SOLDER 1/6. On plastic spools. 60/40 3-core Ersin, 20ft. Post 4d.
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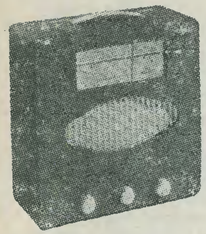


GUARANTEED BRAND NEW AND IN PERFECT WORKING ORDER

- ★ FIVE VALVE SUPERHET
- ★ BUILT IN FRAME AERIAL
- ★ ALL MARCONI VALVES
- ★ SLOW MOTION TUNING
- ★ 7" x 4" ELLIPTICAL SPEAKER
- ★ GRAM. PICK-UP SOCKETS
- ★ CHASSIS SIZE 10" x 10" x 4"
- ★ MAINS 200/240V A.C./D.C.

£7.12.6 Post 5/- (BOTH MODELS)

PORTABLE POLISHED WOOD CABINET, 27/6 EXTRA

SUPER REXINE PORTABLE CABINET (Illustrated) 37/6 EXTRA

The ideal unit for a radiogram or portable radio

Models available:

Type C

Medium wave, 180 to 550 metres
Short wave, 10 to 90 metres (3 to 30 Mc/s) in two wavebands

Type D

Medium wave, 180 to 550 metres
Long wave, 800 to 2,000 metres
Short wave, 15 to 50 metres (6 to 20 Mc/s)

NEW RECORD PLAYERS

Collaro Conquest. The latest 4-speed autochanger with lightweight turnover crystal pick-up. Brand new and guaranteed **£7.19.6** P.P 4/6

Garrard 4-speed single player with latest turnover crystal pick-up. Brand new and guaranteed. **£6.19.6** P.P 3/6

B.S.R. Monarch. The latest version of this well-known 4-speed autochanger with turnover crystal pick-up **£6.19.6** P.P. 4/-

AC/DC 200/250V PORTABLE-GRAM AMPLIFIER

Completely assembled on baffle board size 12½" x 4⅔", depth 3". Containing two Mullard valves type UL84 and UY85. Elac 7" x 4" elliptical speaker, volume control, tone control. Nothing else to buy, just plug in to mains and connect your pick-up to amplifier.

67/6 Carr. 2/6

CRYSTAL MIC. INSERTS

¾" square	3/6	1½" round (Acos)	7/6
¾" round (Acos)	5/-	2" round (Acos)	12/6

Each item p.p. 6d.
Suitable moulded plastic hand mic. case 2/6 p.p. 1/-

TRANSMITTER/RECEIVER Army Type 17 Mk. II

Complete with Valves, High Resistance Headphones, Handmike and Instruction Book and circuit. Frequency Range 44.0 to 61 Mc/s. Range approximately 3 to 8 miles. Power requirements: Standard 120V h.t. and 2V l.t. Ideal for Civil Defence and communications BRAND NEW **45/-**

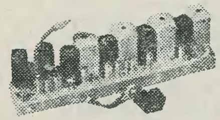
44–61 Mc/s calibrated wavemeter for same, 10/- extra

WALKIE/TALKIE TYPE 38 TRANSMITTER/RECEIVER

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

Headphones 7/6 pair, Junction Box 2/6, Throat Mike 4/6, Canvas Bag 4/-, Aerial Rod 2/6

373 MINIATURE I.F. STRIPS 9.72 MC/S



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

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

Postage and packing 2/6 (either type)

VIBRATOR PACKS. Input 6V d.c. Output approx. 100V d.c. at 30mA, fully smoothed and r.f. filtered. Size 6½" x 5" x 2". Fitted with Mallory 629C vibrator. BRAND NEW. Boxed. 12/6, p.p. 1/6

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

RCA 6½" 3-ohm P.M. SPEAKER in Cabinet. With volume control and 600 ohm line trans. **27/6** P.P. 2/6

RF UNITS

TYPE 25 Switched. Tuning 30 to 40 Mc/s. includes 3 SP61s Carriage 2/6 **10/-**

TYPE 26. Variable tuning, 50 to 65 Mc/s. including 2 EF54s and EC52. Carr. 2/6 **25/-**

(Circuits in stock for both types **9d.**)

ROTARY CONVERTER

24V d.c. to 230V a.c. 50 cycles. 100 watts. Brand new and unused. **£5.10.0** Carr. 7/6

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A large range of frequencies in stock from 100 kc/s upwards. Fundamentals: 54th and 72nd harmonics, etc. **Send for NEW free complete list.**

RADIO AND TV VALVES, ETC.

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Opposite Edgware Road Tube Station (DEPT. RCA) *Telephone* **PADdington 1008/9**

NEW BARGAIN PARCEL

★ Perdio style moulded cabinet with gold trimmings (red, blue or cream)	12/6
★ J.B. 208+176pF screened gang	10/6
★ Miniature 2½" 3 ohm speaker	21/6
★ 20:1 output transformer	10/-
★ 5-transistor printed circuit	5/6
★ 5-transistor circuit diagram	1/-
★ Cabinet size 5½" x 3¼" x 1¼"	

SPECIAL INCLUSIVE PRICE 55/- P.P. 2/-

All the above components are made to fit the cabinet and printed circuit. Other components for the radio available.

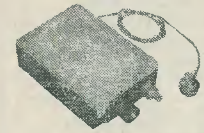
CAR RADIO 2-watt Amplifier

A permanent power transistor stage complete with 7" x 4" speaker. May be used with any battery portable using a 3 ohm speaker.

Complete set of parts	65/-	P.P. 2/6
Unit built up and tested	77/6	P.P. 2/6

Free diagrams and list

MAJOR—2 *(two-transistor pocket radio)*



- ★ 4-stage reflex circuit
- ★ Tunable over medium waves
- ★ No aerial or earth
- ★ Over 6 months on one battery
- ★ Size 4½" x 3" x 1¼"
- ★ Weight under 4 oz.
- ★ Layout diagrams

Complete set of components including 2 **Ediswan** transistors, **72/6** post free. All components sold separately. **FREE LIST**

NEW MAJOR—3 *(three-transistor radio)*

As the Major-2 but with a third **Ediswan** transistor and fitted with a volume control. Fantastic output! **90/-** post free. **FREE LIST**

NOW IN ITS THIRD YEAR!

"THE TRANSISTOR—8"

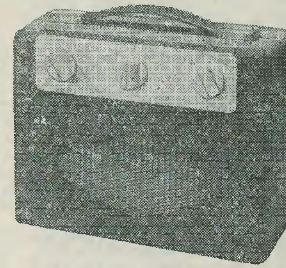
Combined Portable/Car Radio Push-Pull Portable Superhet

- ★ Tunable over medium and long wavebands
- ★ 250mW output push-pull
- ★ Internal Ferrite aerial
- ★ High y sensitive and selective
- ★ 7" x 4" speaker
- ★ All components identified and carded
- ★ **Ediswan** transistors throughout
- ★ Easy-to-follow layout diagrams

Car radio components **8/-**; A.V.C. **4/3**; 325mW version **£13.10.0.** P. & P. 2/6

Size 9" x 7" x 3½". Weight 4 lb

Complete set of parts including cabinet and all components **£11.10.0** P. & P. 2/6 All parts sold separately. FREE BOOKLET



TRANSISTORS (ALL GUARANTEED)

Junction Type P.N.P.

Ediswan XA104 6 Mc/s osc./mixer, r.f. amplifier	18/-
Ediswan XA103 4 Mc/s i.f. and r.f. amplifier	15/-
Ediswan XB104 1 Mc/s audio output and driver	10/-
(A pair in push-pull will give up to 250mW audio output)	
Continental OC44 12 Mc/s osc./mixer, r.f. amp.	30/-
Continental OC45 6 Mc/s i.f. and r.f. amp.	25/-
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Red Spot 800 kc/s audio amplifier	7/6
White Spot 2 to 5 Mc/s r.f. and i.f amp.	12/6
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NEWMARKET POWER TRANSISTORS IN STOCK

Free transistor data and equivalents sheet

MINOR—I *(one-transistor radio)*

- ★ Three-stage reflex circuit
- ★ Economical
- ★ Fully tunable
- ★ Layout diagram
- ★ Size 3" x 2" x ¾"
- ★ Weight 2 oz.
- ★ Unbelievable!

Complete set of components **52/6** post free

All parts sold separately **FREE LIST**

TELETRON TRANSIDYNE

6-TRANSISTOR MEDIUM AND LONG-WAVE POCKET RADIO USING LATEST EDISWAN TRANSISTORS. 150 mW. PRINTED CIRCUIT, ETC. **£11.19.6** P. & P. 2/6. LIST FREE.

LARGEST RANGE OF TRANSISTOR COMPONENTS FOR THE HOME CONSTRUCTOR IN THE COUNTRY. FREE LISTS BY RETURN OF POST

SIX TRANSISTOR POCKET SUPERHET

Recommended for Value

★ SENSITIVE! ★ SELECTIVE! ★ LATEST FEATURES!

- ★ Size 5¾" x 3½" x 1¼"
- ★ Weight 15 oz.
- ★ EASY TO BUILD
- ★ TERRIFIC PERFORMANCE
- ★ Medium and long wave tuning
- ★ 6 selected transistors
- ★ Built in Ferrite aerial
- ★ Easy printed circuit
- ★ Red, blue or cream cabinet
- ★ Long life battery
- ★ 100mW output
- ★ Comprehensive booklet

All items supplied at special inclusive price of **£9.19.6** P.P. 2/6
All components sold separately. BOOKLET 5/6 FREE LIST

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The Transidyne Receiver

This proved 6-transistor circuit now supplied with
NEW EDISWAN TRANSISTORS
Complete Kit **£11.19.6** or less transistors **£8.15.6**
FREE—Special printed circuit solder with each kit
Only genuine Teletron parts. Full details and price list **1/-** post free

Heavy duty 500pF differential condensers 3/-. Small solid dielectric variables, 0.0001μF **3/-**; 0.0003μF **3/9**; 0.0005μF **4/-**. **Resistors** from **3d.** each. Asstd. carbon (many 5%) 25 for **3/11**, 50 for **7/6**. Hi-Stabs 10% ½ watt **6d.**; 10% 1 watt **9d.**; 1% ½ watt **2/-**. Many odd values available at lower prices. Send requirements for quotation. **Ajax Crystal Set** complete, **14/6**; L.W. **15/-**. Case and chassis **5/9**. **Teletron HAX coil 3/-. REP Dual Wave Xtal Coil 2/6. Headphones,** lightweight, **14/-** and **16/-**. **Nuts, bolts, washers, tags.** Well assorted: 25 **1/-**, 72 **2/9**, 144 **5/-**. **Miniature Neons 1/10. "Litesold" Miniature Soldering Iron,** battery or mains, **21/6. Multi-core Solder 4d.** yd, 19ft reel **2/6**, 1lb reel **14/9**. **Fine gauge** for printed circuits, 40ft reel **2/6**. **Switches,** s/p from **2/3**, d/p from **3/6**. **Ferrite Rods** 8" x ⅜" diam., **2/-**. **Mains neon indicators** with built-in resistor. Domed top, chrome bezel, 1" long ½" diam. Opal, red, amber, **3/10**; green **4/7**.

CONNECTING WIRE p.v.c. 50ft coil, 5 colours, **1/9. Sleeving,** 15ft, asstd. colours and thicknesses, **8d. Tinned Copper Wire** 24 s.w.g., 15ft **8d. Combined pack** (3 above items) **2/9**.

TRANSMITTING KEYS—Last Few Only! Heavy duty with 27" twin rubber cable, fitted robust jack plug. Ideal also for Morse practice. The plug alone is worth the price! **Limited number at 1/6 each,** postage **1/-**.

SENSITIVE TRANSISTOR RECEIVER

(Page 298 Nov, '58)
All parts now available for this excellent receiver.
Complete Kit (less speaker) **£4.18.9**, or less speaker and transistors, **£3.10.0** *(S.A.E. for price list)*

Sub-miniature Electrolytics 8μF 6V, 16μF 12.5V, 32μF 3V, 5μF 12.5V, 5μF 40V, 2.5μF 40V, 1.6μF 6V, 25μF 6V. **All 3/- each.** 100μF 6V, **3/-**. Paper 0.01, 0.001, 0.002, 0.005μF, **all 8d. each. Transitor holders 1/-** each, 6 for **5/9**, **11/-** doz. **Ardente T.1065** transformers (page 911—July), **12/-**. **Sub-miniature Speakers** 1¾" round, **27/-**; 2" x 3" elliptical, **33/-**. **Sub-miniature Output Transformers,** single-ended or p/p, **12/6. Volume Controls,** button type (totally enclosed), 47k and 1MΩ, **2/6**; preset skeleton type 5k, **2/6**; spindle type, ½M, 1M, 2M, **4/3** (page 705—May, '58). **Ardente Deaf Aid Earpieces** E.R.100, with cord and plug. Limited number at **13/9. Ardente Catalogue 6d. Transistors:** Yellow/Red **15/-**; White Spot **14/-**; Yellow/Green **7/6**; Red Spot **7/-**.

THE "AMPLIFONE"

(Page 611—March)
Complete Kit including 2½" speaker and wire for pick-up coil **£4.19.6**
All parts available separately (S.A.E. for list)

QUOTATIONS gladly given (S.A.E. please)
R. FAGELSTON (MAIL ORDER)
Please add Postage to above prices
46 HARDWICKE ROAD · LONDON N13

★ VALVES NEW TESTED AND GUARANTEED

1R5	7/6	6X4	7/6	DK91	7/6	EF92	5/6
1S5	7/6	6X5G	6/-	DK92	9/-	EL41	10/-
1T4	6/-	12AH8	9/6	DK96	9/-	EL84	9/-
3S4	7/6	12AT7	7/6	DL92	7/6	EL91	7/6
3V4	8/-	12AU7	7/6	DL94	8/-	EY51	10/6
5U4G	6/-	12AX7	9/-	DL96	9/-	EZ35	8/-
5Z4G	9/-	12K8GT	13/6	EB91	5/6	EZ40	8/-
6AM6	6/9	12K7GT	8/6	EBC41	8/-	EZ80	8/-
6AL5	5/6	12Q7GT	7/-	EBF80	9/6	EZ81	8/6
6AT6	7/6	25A6G	10/6	ECC81	7/6	PCF82	11/-
6BA6	8/6	25L6GT	7/6	ECC82	7/6	PL81	13/6
6BE6	7/6	35Z4GT	8/6	ECC83	7/6	PL82	10/6
6BR7	10/6	35L6GT	9/6	ECC84	8/6	PY81	8/-
6BW6	8/6	53KU	11/6	ECF82	11/-	PCC84	9/-
6J5G	5/6	807	6/9	ECH81	10/6	PCF80	9/6
6J7GT	8/6	5763	10/6	ECH42	10/-	U76	8/6
6K7G	2/6	DAF91	7/6	ECL80	12/6	UBC41	10/-
6K8G	7/6	DAF96	9/-	EF36	7/6	UCH42	9/-
6Q7GT	8/6	DF91	7/6	EF39	5/6	UF41	10/-
6SL7GT	8/-	DG96	9/-	EF41	9/-	UL41	9/6
6SN7GT	8/6	DH76	8/6	EF80	8/-	UY41	8/-
6V6G	7/6	DH77	7/6	EF91	6/9	W76	8/6

Matched Pairs. EL84, **23/-**; 6V6G, **17/-**; 6BW6, **18/-**; KT33C, **19/6**; KT66, **27/6**; 807 **14/6** pair

1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DK92, DL92, DL94, any four, **27/6** per set
P.P. Op. Transformers. MR 3-15 ohms for EL84, 6V6, 6BW6, etc., **18/6**; Op. Pen. 50mA, **5/6**; 30mA, **4/6**
Volume Controls. All values, long spindle. L/S **3/-**, s.p. **4/-**, d.p. **4/9**, ext. spkr. control **3/-**
W.W. Pots. Pre-set **3/-**; 3W long spindle **5/6**, s.p. **6/6**
P.M. Speakers. 3 ohm. 5" **16/6**, 6½" **17/6**, 8" **21/-**, 10" **25/-**, 12" **30/-**, Bakers 12" 15 ohm 15W, **90/-**
Coaxial Cable. 75 ohm ¼" stranded, **8d.** yd; semi-air spaced, **9d.** yd; screen cable single and twin, **9d.** yd
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continued on page 719

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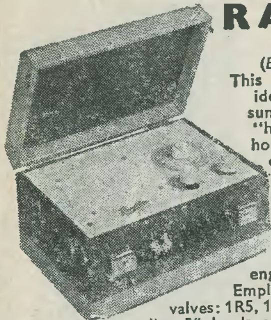

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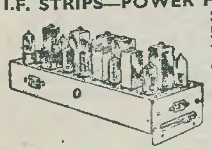

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continued from page 717

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continued on page 720

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6K8G	7/–	ECC81	7/–	EZ80	8/6	UCH42	9/–
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