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Understanding Television, Part 4

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VOLUME 11
NUMBER 9
APRIL
1958

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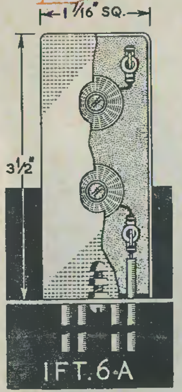

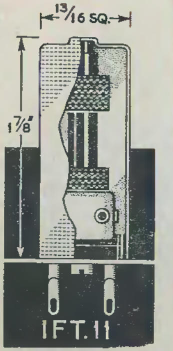

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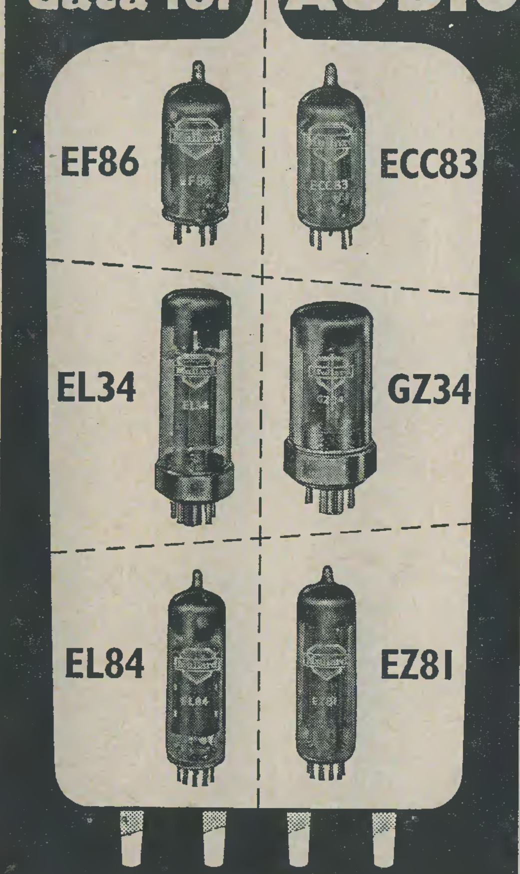

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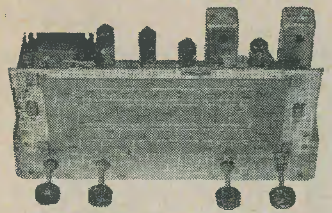

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6BW7	8/6	12AX7	10/6	ECL82	12/6	PY81	10/6
6CH6	10/6	12BE6	10/6	EF39	7/6	PY82	10/6
6D6	7/6	12BH7	10/6	EF41	10/6	SP61	5/6
6F6	7/6	12K7	8/6	EF50	5/6	UBC41	10/6
6H6	3/6	12Q7	8/6	EF80	10/6	UCH42	10/6
6J5	6/6	35Z4	10/6	EF92	5/6	UF41	10/6
6J6	7/6	80	8/6	EL32	5/6	UL41	10/6
6J7	8/6	807	6/6	EL84	10/6	UY41	10/6
6K6	6/6	954	1/6	EY51	11/6	U22	10/6
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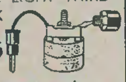

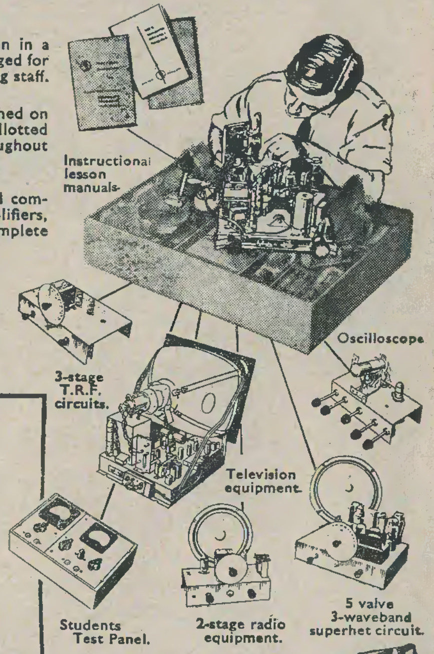
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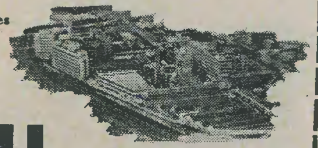


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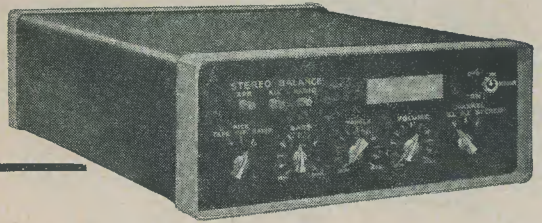

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All parts as above but less 4 valves

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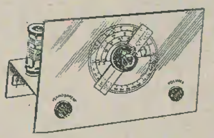

30/-

This **1** valve S.W. receiver can be built for **30/–** from our list of components, which can be purchased separately. It includes valve and 1 coil covering 24-40 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.

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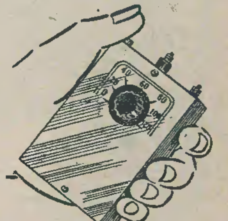

Transistor Pocket Radio, low cost and ideal for the beginner. Using the Variloopstick aerial (see below) and miniature condenser, the whole Medium Wave is covered. Fits the palm of the hand. **30/–**

Variloopstick, specially designed for maximum transistor receiver performance, high 'Q' **4/6**

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R.E.P. 1-VALVE RECEIVER

(Page 653)

Constructor's Envelope	6d.
Complete Kit (less phones and battery)	**£2.15.0**
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(By W.B.)

$1\frac{3}{4}''$ round. Depth 1". Impedance 3Ω ... ... **27/–** tax paid

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Envelope with full directions and parts list 1/6

Complete Kit £13 . 8 . 0

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(*Mullard*)

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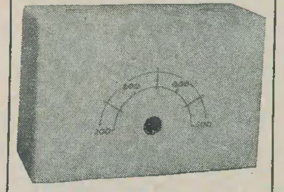
(See review on page 232 Nov)

Trade enquiries invited

THE "AJAX" CRYSTAL RECEIVER

(*See page 558 March*)



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(*See page 568 March*)

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for the constructor

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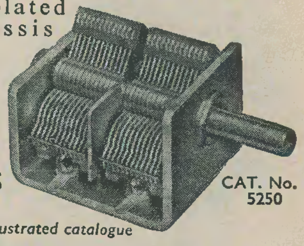

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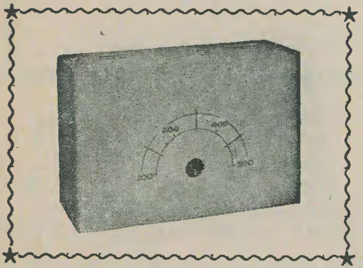

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VOL. 11 NO. 9
APRIL 1958

ANNUAL SUBSCRIPTION 25/– including postage

Editorial and Advertising Offices
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CUNNINGHAM 6141 (2 lines)

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NOTICES

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

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

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

QUERIES. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine; nor can we advise on modifications to the equipment described in these articles.

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Suggested .... Circuits

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No. 89 AN EXPERIMENTAL "LIE DETECTOR"

OVER THE LAST QUARTER CENTURY OR SO, much public interest has been aroused from time to time over the use of what are described in the Press as "lie detectors." So far as can be judged, such instruments appear to have been mainly employed in the United States, with the stipulation that any evidence obtained from their use is inadmissible in a court of law. The devices function on the principle that the subject, when telling a lie, is liable to betray this fact by physiological changes which are detected by suitably coupled instruments. A simple type of "lie detector" may function by measuring the electrical resistance of the body. The subject, if lying, would then be assumed to secrete a greater amount of perspiration than would normally be the case, whereupon the body resistance would drop and would be consequently indicated. More complex instruments, working on cardiograph or encephalograph principles, could also presumably be employed to function as "lie detectors," whereupon altered indications would become evident more quickly.

The value of "lie detectors" is problematic, and a very strong argument which has been made against their reliability is that any feelings of uneasiness—which could be caused by emotions of anxiety or even by physical discomfort—are liable to result in indications similar to those which would presumably be given by the telling of lies. It is, of course, quite possible that the instruments are assumed, cynically, to have little value, and that their impressive technical paraphernalia is liable to impress the more ignorant subject in the desired direction before any test takes place. Fortunately, "lie detectors" are not used at all in Great Britain; nor do we want such instruments.

In this month's contribution a circuit is suggested for an experimental "lie detector" which works on the assumption that bodily resistance drops when a lie is told. The writer wishes to emphasise that he does not want to give any impression that the device is a reliable "lie detector" (mainly for the reasons given above) and that its worth lies in its novelty value alone.

The Circuit

If a "lie detector" which functions on changes of body resistance is to be constructed, there are several methods by which such changes may be detected. The least complicated way consists, quite simply, of measuring the resistance between, say, the two hands of the subject; whereupon all that would at first sight be necessary would be for the subject to hold two electrodes connected to a simple ohmmeter. In practice this arrangement would be unreliable owing to the difficulty of preventing large involuntary changes in the contact resistance between each hand and its electrode. An interesting method of overcoming the effect of varying contact resistance would consist of having the subject clasp one of his hands around an insulating tube containing two tubular electrodes, such as that shown, in section, in Fig. 2. In this case the hand would cause two effective condensers to be connected in series via a resistance, this latter being that provided by the hand itself. Changes in resistance would then cause corresponding changes in the impedance presented between the two terminals of the tube. An advantage of the system is that, since the surface of the hand is now a fixed distance away from the electrodes, changes caused by varying pressures between the hand and the tube are liable to be lower than would be the case if there were a direct electrical contact. There is also the point that the subject does not touch any metal points which might, under faulty conditions, cause shock.

In the circuit shown in Fig. 1, the tube with its two electrodes is depicted as C_2, and it forms one arm of a bridge which is completed by C_3, C_5 and C_6. The variable condenser C_5 is used to balance the bridge against the impedance given by C_2 when this is initially held by the subject. The fact that C_2 presents an impedance which is partly resistive as well as capacitive does not cause any undue trouble in this particular circuit, as the null detector, $V_{1(a)}$ and $V_{1(b)}$, functions on peak a.c. voltages only and is not sensitive to phase differences.

The bridge is powered by the a.c. voltage derived from the oscillator V_2. Assuming that the capacitive component of C_2 is of the order of 50 to 100pF, the oscillator may work at quite a low frequency. In Fig. 1 the oscillator employs a long-wave r.f. coupling coil in the oscillator circuit, this running at a frequency around 160 kc/s. The oscillator valve may be any low-mu triode (or pentode with anode and screen-grid strapped).

The null detector, $V_{1(a)}$ and $V_{1(b)}$, employs a double triode of the ECC82 class. The choice of valve here is, again, not very critical, the main requirement being that each triode has to have a reasonably wide grid base. The r.f. voltages delivered from the bridge to the null detector are shunt detected, whereupon each grid is biased by a negative voltage (with respect to chassis) which is proportional to the peak applied r.f. voltage. The milliammeter in the anode circuits of $V_{1(a)}$ and $V_{1(b)}$ indicates unbalance in the bridge. A centre-zero meter is not needed, incidentally, as readings should, in practice, be all "one-way."

When the device is used, the first step consists of having the subject grasp the insulated two-electrode tube, after which C_5 is set up to provide a zero reading in the milliammeter. If, at some later moment, the resistance of the subject's hand drops, so also does the impedance offered by C_2. This causes the negative voltage at the grid of $V_{1(a)}$ to become lower, whereupon this triode draws more anode current, with the final result that the meter gives a positive indication on its scale.

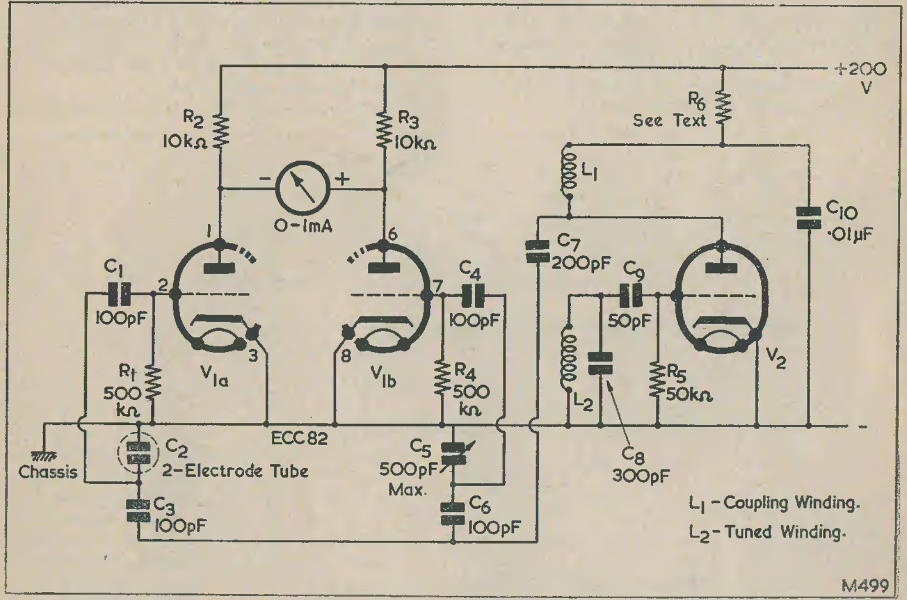


Fig. 1. The circuit of the "lie detector." L_1, L_2, *are the windings of a conventional long-wave r.f. coupling coil.*

Practical Points

There are several practical points concerning the device which require a little amplification. The first of these is concerned with the oscillator, V_2, which provides the r.f. voltage for the bridge. It was stated above that an ordinary long-wave coil of the type intended for r.f. coupling should be employed here. The reason for this is that the coupling windings of r.f. coils usually have markedly fewer turns than the tuned windings, whereupon they may be readily employed for purposes of oscillator feedback. What are described as "aerial coils" frequently have many more turns on the coupling winding than they have on the tuned winding, in which event they become useless for oscillator circuits of the type under consideration. The coupling and tuned windings of the oscillator coil are clearly designated in Fig. 1. The bridge circuit voltage is obtained from the anode of the oscillator via C_7, and the loading incurred here should not affect oscillation provided that the bridge capacities, which are effectively connected across the coupling coil, do not cause it to resonate on or near the frequency to which the grid coil is tuned. The proviso that the coupling winding should have less turns than the tuned winding effectively covers this requirement.

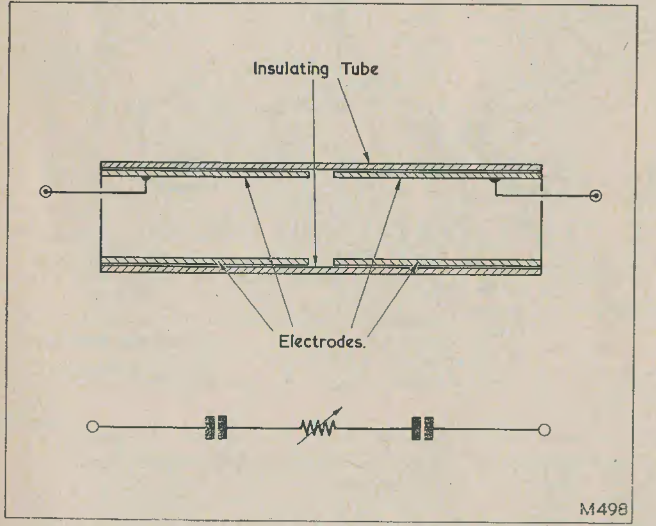


Fig. 2. A cross-section through the two-electrode tube. When the hand is clasped around the tube the resulting circuit consists effectively of two condensers joined by a resistor.

The purpose of the series resistor, R_6, is that of ensuring that oscillator amplitude is suitable for bridge operation. The value of R_6 may be found by experiment after the device has been completed. A resistor of some 5 to $10k\Omega$ should primarily be fitted in the R_6 position and the device set up as described above. Oscillator amplitude should then be varied (by altering the value of R_6) until a meter inserted in series with either R_2 or R_3 gives a reading of approximately 3 to 4mA. (A high resistance voltmeter connected across R_2 or R_3 could be employed instead of the series meter if desired, the voltage reading required being approximately 30 to 40 volts.) The purpose of carrying out a check of this nature is merely that of ensuring that, under normal conditions, $V_{1(a)}$ and $V_{1(b)}$ are biased approximately half-way along their grid base, this giving maximum allowance for grid voltage excursions in either direction when the device is used in practice. With some oscillator coils (or valves) it may be found difficult to achieve sufficient oscillator amplitude to meet the requirements of this check, in which case R_6 may be omitted and the top plate of C_{10} connected direct to the h.t. positive rail. (Assuming good h.t. decoupling, C_{10} could, itself, also be omitted.) So long as there is sufficient oscillator amplitude to cause a marked reduction in anode current in $V_{1(a)}$ or $V_{1(b)}$ when the oscillator is brought into circuit, the device will still be capable of functioning reasonably well.

The two-electrode tube, C_2, requires some further discussion. It would be advisable to ensure that the outside diameter of the tube is of the order of one inch, as this would enable it to be grasped with complete encirclement by the fingers. The insulated wall of the tube should be as thin as is practicable and should, if possible, employ non-hygroscopic material. The two electrodes should be tubular, as solid electrodes would result in a high standing capacity. An alternative method of construction for the two-electrode tube could consist of making up an assembly with two tubular electrodes and of covering this with a good quality p.v.c., or polythene, tape. Whatever method of construction is employed, the tube needs to be mounted close to the bridge circuit to prevent excessive self-capacity in connecting leads.

Should it be found that the instrument possesses too high a degree of sensitivity, this may be reduced by connecting a resistor, whose value is found by experiment, in series with the milliammeter.

As is obvious in equipment of this type, wherein parts are handled by non-technical people, the normal common-sense safety rules apply. The device must *not* be run from any power supply which causes its chassis to have the same potential as one side of the mains supply.

Radio and Electronic
COMPONENT SHOW

FEATURES AND TRENDS IN 1958

Many of the new radio components which will be exhibited at the Radio and Electronic Component Show at Grosvenor House and Park Lane House, London, from 14th to 17th April, will be smaller, more robust and able to withstand higher temperatures than ever before.

The trend to miniaturise components continues, particularly for those to be used with the very small transistors now being manufactured, and also in connection with printed circuitry.

Components for use in guided weapons need to be sub-miniature, of extreme ruggedness and able to operate in high temperatures. Some of the new transformers and chokes are suitable for working in temperatures up to 200° C. and even 250° C., and there is an exploratory design suitable for 500° C.

Certain components have also been designed to withstand the strong vibration and enormous acceleration due to high "G" values in guided missiles.

Improvements are to be found in even the more stereotyped components such as wafer switches and small relays, both sealed and unsealed.

Developments in ferrites and dust iron cores include the introduction of new materials with new properties, especially for memory devices for computers.

Made for the first time in this country are sintered glass preforms for glass-to-metal seals in hermetically sealed components. These are cheaper, less laborious to use and available with closer tolerances than the glass tubing they replace.

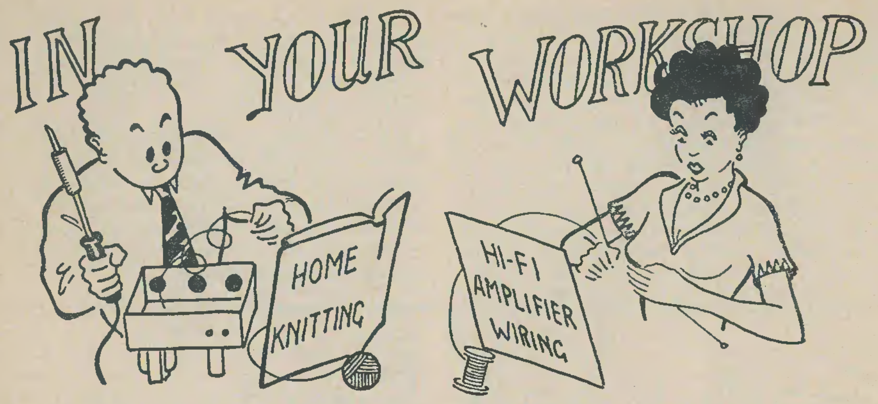
There are 171 stands in the Component Show compared with 164 last year.

Admission to the exhibition (from 10 a.m. to 6 p.m. daily) is by invitation only, applications for tickets to be made to the Secretary, Radio and Electronic Component Manufacturers' Federation, 21 Tothill Street, London, S.W.1.

The Radio Component Show overlaps this time with the Instruments, Electronics and Automation Exhibition (Olympia, London, 16th to 25th April) in which members of the Radio Communication and Electronic Engineering Association will be exhibiting as well as many component manufacturers.

Exports of British electronic components, excluding sound reproducing equipment and valves and cathode ray tubes, were valued at £10.1 million last year compared with £8.7 million in 1956, and represent steady progression from year to year with increasing exports to the dollar countries. The January 1958 figures continue to show an increase.

IN YOUR WORKSHOP



This month Smithy, prompted by his assistant Dick, deals with queries raised in readers' letters.

"YOU KNOW, DICK," SAID SMITHY AS HE settled himself more easily into the only comfortable chair the Workshop possessed, "it looks as though, recently, we haven't been doing our job properly."

"Why's that?" asked Dick, startled.

Smithy's assistant surveyed the array of sets stacked neatly on the "Repaired" rack and frowned perplexedly.

"Surely," he continued, "nobody could have done more than we have today. Not only have we cleared up every faulty set in the place, but we've also overhauled the test gear and cleaned out the spares cupboard. What more can be asked of two keen and competent engineers?"

Smithy glanced out of the window. The deepening dusk of the mid-March late afternoon emphasised the warm cosiness inside the Workshop.

"Well, now," Smithy answered at length. "One of the things we haven't devoted sufficient attention to recently *is* test gear. I'll agree that we've done a good job in the Workshop today and that, for the first time in months, we are in a position to have an idle rag-chew for half an hour or so before we pack up and press on home. However, that's by the way, and the point I want to natter about is this. As you know, quite a few people follow our adventures each month, and some of them think we're getting a little too far ahead of the average home-constructor who only has access to the simplest of test equipment."

Low-Cost Servicing

"I see what you mean," said Dick. "In other words, it's all very well for us to go around using expensive 'scopes and wobblies and things like that, but this sort of work doesn't offer any help to the chap who may only have an inexpensive signal genny and testmeter."

"That's right," remarked Smithy.

"Funnily enough," commented Dick, "I'm rather interested in having a talk on these lines myself. Not," he added hastily, "that I'm contemplating setting up at home in competition to you, but merely because a friend of mine finds himself in the position of having to do occasional servicing without having access to any expensive equipment. He isn't at all interested in servicing as a whole-time occupation, and many of the jobs he has to fix are receivers which he's made himself."

"That's the sort of bloke I'm thinking about," interjected Smithy.

"What do you think is the minimum amount of gear a keen home-constructor requires?" asked Dick.

"That's not an easy question to answer," replied Smithy, "because so much depends on individual cases. Nevertheless, I would say that if the home-constructor was mainly interested, as of course we *have* to be in the Workshop, in receivers or amplifiers he would find himself doing away with a lot of guess-work if he could invest in a simple testmeter. That is the first almost essential piece of gear to aim at. A signal generator would be extremely useful also as a second instrument. With these two items he could, in fact, cover almost all the snags and experimental work he is likely to encounter."

"I see," said Dick interestedly. "What sort of testmeter would you advise?"

"Well, that's *another* rather awkward question," replied Smithy. "The reason being that the choice of meters available is very wide and because each home-constructor presents his own individual case. Taking extreme instances, you can *make* a testmeter quite cheaply if you're prepared to go to the trouble; or, alternatively, you can spend a lot of money on an instrument whose more refined capabilities will only be brought into use once in a blue moon. Basically, I would say that, whatever class of instrument is used, a moving-coil movement is essential, and that the testmeter should have a number of d.c. voltage ranges extending from, say, 1 or 2 volts full scale deflection to 500 volts or more, plus one or two resistance ranges. A minimum resistance on the voltage ranges of 1,000 ohms per volt would be very desirable, although not essential. You may notice that I haven't made any reference to d.c. current ranges or to a.c. ranges. Funnily enough, you'd be surprised how infrequently the d.c. current ranges of a testmeter are employed in run-of-the-mill servicing. Almost always, whenever you want to check a current in a receiver or amplifier, you find that it flows through a resistor (or a component having resistance), whereupon it becomes much quicker to measure the voltage *across* that resistor than it is to insert a meter in series. I think the classic case of this method of working is given when you want to check the cathode current of a valve. If, as usually happens, this has a cathode bias resistor it is a lot easier to shunt a voltmeter across the resistor (Fig. 1 (*a*)) than it is to unsolder one of its ends and insert a current-reading meter (Fig. 1 (*b*)). Mind you, you have to calculate the current when you use the voltmeter, but Ohm's Law doesn't baffle the likes of us.

"So far as a.c. testmeter ranges are concerned, I always feel that, whilst the ability to measure a.c. voltages is useful, you have to make up your mind whether that usefulness is worth the expense incurred. Very often the a.c. ranges of a voltmeter are only used for checking the *presence* of a.c.—as might occur when looking for faults around a mains transformer—in which case you *could*, assuming a very tight budget, detect the presence of high a.c. voltages with a neon lamp, and low a.c. voltages—heater supplies and the like—with a dial lamp. And again, in normal servicing work you will find that a.c. current ranges are usually employed much less frequently than are a.c. voltage ranges."

"Well, that seems to answer my query fairly adequately," said Dick. "I suppose that, when you referred to a sensitivity of 1,000 ohms per volt just now, you were thinking of an instrument having a basic 0–1mA meter movement."

"If the usual string of series resistors were employed, that would be correct," agreed

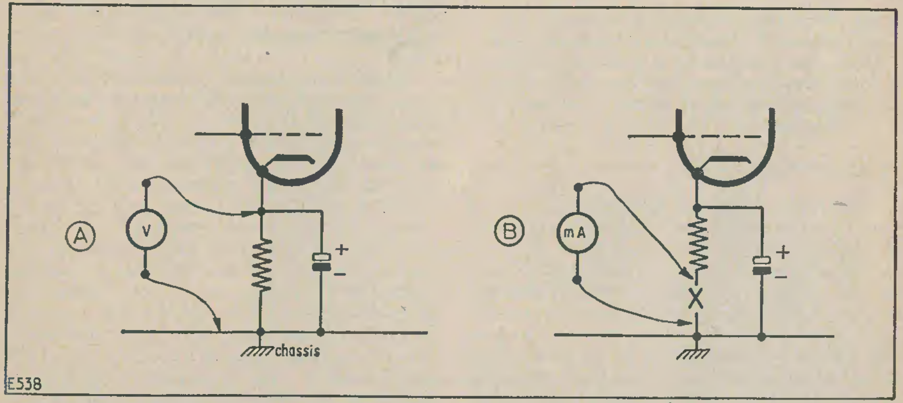


Fig. 1. An illustration of the fact that it is often quicker to determine a current by measuring the voltage it drops when flowing through a resistor. In (a) cathode current is measured by reading the voltage across the cathode bias resistor, a quicker process than that of inserting a meter in series with the resistor, as in (b)

Smithy. "The simplest type of voltage testmeter has a milliammeter connected in series with different resistors for different voltage ranges (Fig. 2). If the basic meter has an f.s.d. of 1mA then, in an arrangement of this type, you find that the resistance offered by the testmeter terminals is 1,000 ohms multiplied by the f.s.d. voltage of the range selected. Thus, if there were a 20 volt range, the resistance offered by the meter on this range would be 20,000 ohms.

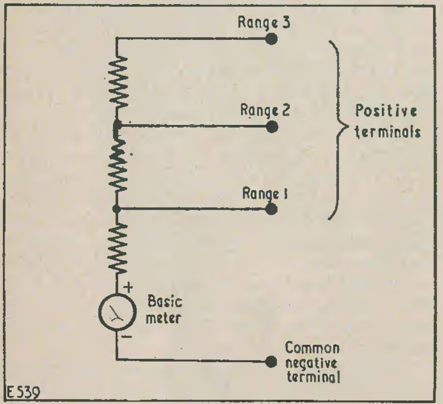


Fig. 2. A typical circuit for a multi-range voltmeter. If the basic meter reads 1*mA f.s.d., the resistance presented by the voltmeter terminals will be* 1,000 *ohms multiplied by the f.s.d. voltage of the range selected* (*i.e.* 1,000 *ohms per volt*).

"Testmeter resistance becomes very important, of course, if you are measuring voltages having high source resistances, such as occur at the anodes of a.f. voltage amplifiers and so on. When you measure anode voltages in these cases (Fig. 3 (*a*)) you have to remember that the resistance of the meter will cause the voltage readings given to be lower than those which are present when no meter is applied. To take an example, if a particular anode load resistor had a value of 500kΩ and the resistance presented by the testmeter were 100kΩ, the meter reading obtained would be only one-sixth of the h.t. value even in the case where the valve itself drew no anode current. Since the resistance presented by the meter increases on higher voltage ranges it sometimes proves helpful to use a proportionately very high range when measuring voltages which have high source resistance. Although the meter needle may only move over a small part of the lower end of the scale, the reading you obtain thereby is probably more accurate than that given on a lower voltage range where the meter presents a lower resistance.

"A rough-and-ready dodge for measuring anode voltage with relatively low resistance testmeters consists of first measuring the anode voltage in the normal way and then, without changing the voltage range, connecting the testmeter across the load resistor (Fig. 3 (*b*)). The correct anode voltage will then lie somewhere between the two indications obtained."

"That's a good idea," said Dick. "I suppose that you have to subtract the second voltage reading from the h.t. voltage?"

"That's the idea," replied Smithy. "Let's assume that the h.t. voltage is 250 and that your first voltage reading, anode-to-chassis, is 100 volts. Your second reading, across the anode load, is 75 volts; which means that, when the meter is connected across the load, the anode potential is 250 minus 75, or 175 volts. You know from these two readings that the true anode voltage must lie somewhere between 100 and 175 volts, and you could make a guess at its being around the 130 to 140 volt region. As I said, the idea is rough and ready, but it does at least enable you to get a better idea of voltages at circuit points such as this with a relatively low resistance meter."

"What about resistance ranges?" queried Dick. "Couldn't a home-constructor make a simple resistance meter quite easily himself?"

"Very easily indeed," said Smithy. "The basic circuit of such a device could be something like this (Fig. 4 (*a*)). Here you have a series resistor which causes the meter to give an f.s.d. reading when the test points are shorted, the small-value variable resistor enabling an accurate zero setting to be obtained under these conditions. A circuit like this assumes that the voltage of the battery remains constant but that its internal resistance increases as it gets older, the increase being taken up by the variable resistor. In practice, this principle holds true for quite a large proportion of the useful life of the battery. The resistance range covered by the circuit depends entirely upon the sensitivity of the meter and the voltage provided by the battery. Increasing battery voltage enables you to read higher values of resistance, whilst decreasing meter sensitivity—say, by connecting shunts across it—enables you to read lower values of resistance. The last two processes necessitate different series resistors in the testmeter, of course. An idea which doesn't appear to be used very frequently, but which is ideal for the home-constructor who wants to make the most of a small amount of equipment, consists of making test connections *across* the meter (Fig. 4(*b*)). In this instance you first of all set up the meter to give f.s.d. with the test terminals open circuit, after which you connect the test terminals to whatever resistance you want to measure. The great advantage of this arrangement is that you can read very low values of resistance quite simply, fractions of an ohm being easily measured with most conventional meter movements around 1mA f.s.d."

"I suppose you calibrate home-made resistance meters of this type by measuring a number of known resistors," volunteered Dick.

"Yes, that's right," agreed Smithy. "The process doesn't take long, and there's no need to mark the actual scale of the meter if you're prepared to work from conversion tables or graphs. The best method of present-

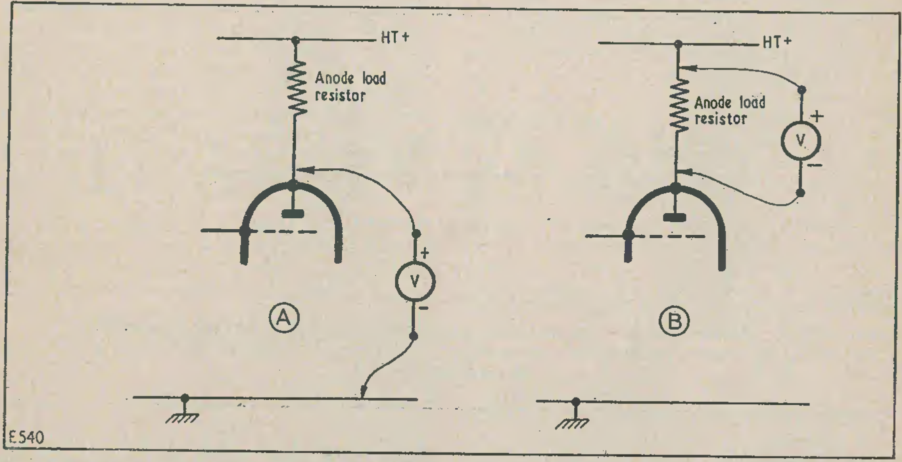


Fig. 3 (*a*). *When an anode load resistor has a high value, a volt-meter connected as shown will give low readings if it draws excessive current.* (*b*) *An approximate idea of anode potential can sometimes be obtained by averaging the figures given by connecting the voltmeter between anode and chassis and then across the anode load* (*see text*)

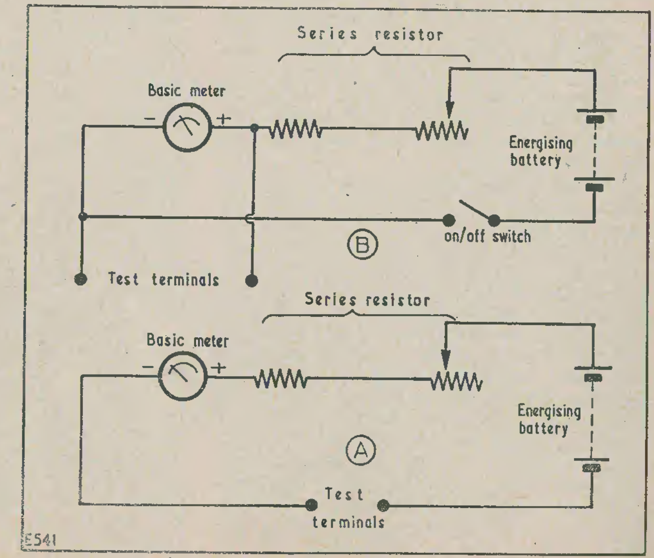


Fig. 4 (*a*). *A simple resistance-measuring circuit.* (*b*) *When circuit* (*a*) *is modified as shown here, the meter is capable of giving indications for very small values of resistance. The on-off switch could be combined in a range-selector switch if desired.*

ing a conversion table consists of marking off resistance and scale readings on either side of a straight line (Fig. 5). It's quite easy to make up a table of this sort with the aid of squared graph paper and it can be mounted close to the meter or on its case. It's much quicker converting from a meter reading to the corresponding resistance with a straight-line table than with a graph."

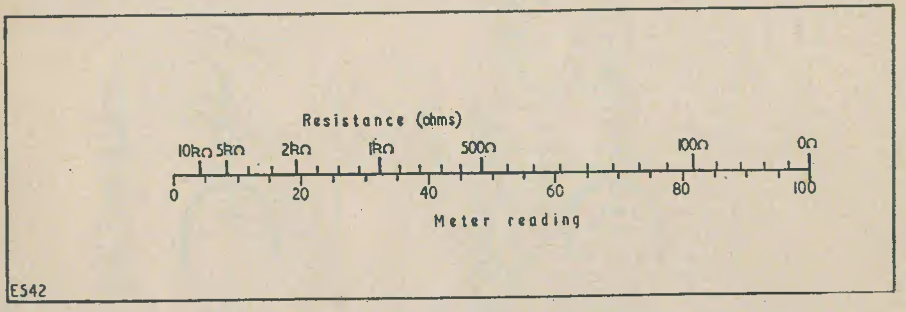


Fig. 5. An example of a straight-line conversion table for indicating resistance in terms of meter calibration. A table of this type is easier to use than is a conventional graph

Signal Generators

"That seems to clear up the testmeter side," started Dick.

"As far as we can," interrupted Smithy, "without giving advice which is too specific. It would be rather dicey to tell a home-constructor that all his difficulties would be overcome if he used the Funftrap 30 Range Supermeter, because advice like that just wouldn't apply in many cases. So I've only been able to give a few hints which, I hope, might be of some value."

"Fair enough," said Dick, "but we're now coming to the second piece of equipment, the signal genny."

"Ah yes," said Smithy. "Now, when we come to think of signal generators we yet again run into the point that it is unwise for anyone to start dishing out advice as to the type of signal generator any individual person should buy. That decision has to be left to the particular home-constructor, who can balance the question of cost against his own peculiar requirements. As a matter of fact, there are a few relatively inexpensive signal generators on the market which have been designed with the express purpose of providing cheap instruments that are quite good for general service work, even though they may not come up to 'laboratory' standards. So long as these instruments have the required frequency range, a low impedance output and a reasonably reliable attenuator system they can prove extremely useful. I've handled one or two of the cheaper signal gennys myself, and the only trouble I've found is that in some cases the attenuators become unreliable above 50 Mc/s or so. I presume that this snag is due to excessive self-capacity in the attenuator layout, because the attenuators are not capable of reducing output to low levels. However, when you want low level output, attenuation trouble of this nature can be largely overcome by loosening the coupling between the signal genny and the circuit point to which it is applied. It's not a very tidy way of doing things, I must admit, but it's good enough for most service work."

Dick looked surprised.

"I should have thought," he remarked, "that if a manufacturer were intending to market an inexpensive signal generator he would at least ensure that he fitted a reliable attenuator into it."

"When you go up to v.h.f.", said Smithy, "attenuator design gets more and more expensive. To be really trouble-free, many of the resistors in attenuators have to be completely screened from each other, with the result that manufacturers have to resort to such things as die-cast metal shells having channels in which individual resistors are fitted, and so on."

"What would you say are the most important features of a signal generator?" queried Dick.

"There are, I suppose, three basic things," replied Smithy, "and they all need to be reasonably good or the performance of the whole instrument suffers. Firstly, the oscillator frequency should be stable after the generator has been switched on for some five minutes or so. Secondly, amplitude modulation by an a.f. tone is essential. And, finally, the attenuator system, which I have just been talking about, must give a low impedance output and be capable of reducing signal strength to a level low enough for connection to sensitive receivers; with the qualification that this requirement may be difficult to attain at v.h.f. Incidentally, the attenuator calibration in some of the very cheap signal generators is rather a joke sometimes, but this needn't worry you too much. You soon get used to the instrument you have; and you can easily evaluate individual receiver performance from previous experience, even if the microvolts or 'db down' on the attenuator scale seem to be telling a fairy story. I might add that some of the very expensive 'laboratory type' signal generators aren't entirely reliable on output calibration, so there is little point in complaining about vagaries in their cheaper brethren.

"What happens if a signal genny which you already happen to have on hand doesn't go high enough in frequency?" asked Dick. "Is it possible to work on harmonics?"

"You know, working on signal generator harmonics can be rather a dicey business," said Smithy. "This is not because there is anything technically *wrong* in working on harmonics, but because you have to make absolutely certain that you're working with the *right* harmonic. To take an instance, let's imagine that you're servicing the front end of an f.m. receiver and that the signal genny you're using only goes up to 25 Mc/s. The receiver front end has packed in completely and you can't receive any broadcast signals, even with a good aerial. You will already have applied your signal generator to the mixer grid and established that the 10.7 Mc/s i.f.'s (or whatever frequency they happen to have) are O.K., and you will have already swapped bottles (if spares are available) and checked their potentials. If you're working on a commercial set and if nobody has messed the trimmers around too much you may then, should you wish to follow this line of attack, apply your signal generator to the aerial terminal and, with full output, swing it around 22 to 25 Mc/s in the hope that its fourth harmonic will turn up in Band II. If you're lucky you should get some sort of signal through and you *could* then check your trimmers to see that the tuned circuits are working correctly. Unfortunately, this process is, in itself, more than a little risky because you are making the assumption that the receiver oscillator is tuned to the correct frequency and is thereby selecting the correct signal generator harmonic for you. You shouldn't forget also that the *receiver oscillator* is sitting at the bottom of its own little family tree of harmonics, so, before you wrench away too enthusiastically at the trimmers with your King Dick, it's a good plan to reduce signal generator output and ensure that the receiver is only responding to one signal generator harmonic from the quarter-Band II frequency range you're forced to use. You will then, at least, have the comforting feeling that you are working with the receiver oscillator fundamental, even if you aren't too sure about the signal generator harmonic!"

"What about second channel responses?" asked Dick.

"Well, you have to avoid lining up on the second channel when using harmonics just as much as when you use a signal generator whose fundamental covers the frequency range you require," replied Smithy. "The only snag is that the second channel in an f.m. set is usually 21.4 Mc/s—that is, twice the 10.7 Mc/s i.f.—away from the signal frequency; with the result that, assuming the receiver oscillator is above signal frequency, the fifth harmonic of your signal generator working in the 22 to 25 Mc/s range is perilously close to it. If the receiver oscillator were below signal frequency the same remark applies to the third harmonic of the signal generator. Your only hope here is to keep your fingers crossed and hope that, with a sufficiently weak signal from the signal generator, the receiver second channel sensitivity will be too low for the unwanted harmonic to be picked up."

"You said just now that you have to assume that the receiver oscillator is on correct frequency," remarked Dick. "What happens if it isn't?"

Smithy looked at his watch.

"Oh well," he commented, "I think it's time we thought of packing up to go home."

"Come off it," cut in Dick, remorselessly, "I'm not going to let you off that question as easily as that!"

"Well," replied Smithy, "the best answer I can give is that, if the receiver oscillator is off frequency or if it isn't working at all, you're in dead trouble. I would say that the only course you could follow is to forget about your signal generator altogether and start following your nose through the oscillator circuit, checking for o/c condensers and so on. Incidentally, and if you'll excuse me straying off the subject for a moment, so far as oscillators not working are concerned you can often check for this point by applying a testmeter across the grid leak via a small r.f. choke (Fig. 6 (*a*)). If you get a negative voltage reading from the grid then you know the oscillator is running at *some* frequency. Frequently, you may get a negative reading without having to use the choke at all, the testmeter lead being applied direct to the grid. Unfortunately, this method of checking an oscillator *might* cause it to stop working when the testmeter prod is applied; and a better idea, which takes a little longer, consists of checking whether the anode current of the oscillator increases when its grid leak is shorted. Thus, if an h.t. decoupling circuit were used (Fig. 6 (*b*)) you can start such a check by applying a voltmeter between the decoupling condenser and chassis. When the grid leak is shorted a drop in voltage reading—caused by increased anode current—indicates that the oscillator is running.

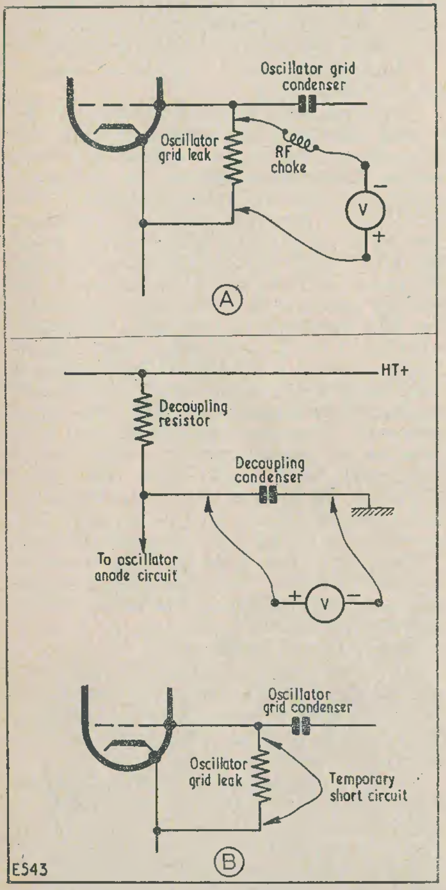


Fig. 6 (a). It is often possible to connect a voltmeter across a receiver oscillator grid leak without stopping the oscillator running. A voltage reading in the meter indicates the presence of oscillations. The r.f. choke is mounted in the test prod, and may often be dispensed with. (b) When a leaky-grid oscillator is running correctly, short-circuiting its grid leak causes an increase in anode current. Such an increase may be checked in the typical set-up illustrated here. (When carrying out the checks shown here and in (a) it should be remembered that the grid leak may not necessarily be returned to chassis.)

"Another little dodge for checking oscillator circuits is worth passing on. This consists of injecting the highest output you can get from your signal generator into the mixer grid via, say, a 50pF condenser, and swinging the signal generator across the frequency band the oscillator should cover. If, with the receiver tuning dial set, as far as you can judge, to a station you can then tune in a signal you know that the receiver oscillator isn't doing its job properly. Unfortunately, this is only a 'one way test' because inability to pick up a signal in this manner may not be due to a faulty receiver oscillator but merely to the fact that the signal generator output is much lower than that given by the oscillator. When you're in a strong signal area with a good aerial the dodge should work with most receivers, and it should even work when you are using signal generator harmonics.

"Incidentally, you haven't been quite as observant as you normally are because, apart from mentioning the receiver oscillator, I made another assumption just now which you've missed altogether."

Home-Constructed Receivers

"What was that?" asked Dick.

"I said," replied Smithy, "that working with signal generator harmonics could possibly be successful if the receiver was a commercial model. The reason I made that particular point was because such a receiver would have tuned circuits which would have been designed for, and which had at some time worked satisfactorily on, Band II. Even if one of these tuned circuits were faulty the others would help to ensure that you found the correct signal generator harmonic. The same wouldn't apply if you were lining up a just completed home-constructed set in which you had wound your own coils; although you would be fairly safe here if the coils had been supplied by a coil manufacturer. I think I should point out also that you should never rely blindly on the frequency calibration of your signal generator for final alignment at v.h.f. You should either align finally on received signals or, perhaps better, beat your signal generator against a known signal and apply a correction, if it is needed, to its frequency reading. The same applies, incidentally, to signal generators having a v.h.f. output at fundamental frequency. It's quite easy for an instrument which gets as much use as does the average service generator to start a little long-term wandering at these high frequencies."

"There's another point that puzzles me," said Dick. "I've just realised that we're talking about aligning an f.m. set with an a.m. signal genny!"

"That's an easy one to answer," laughed Smithy. "This is because you'll almost certainly find that, even when the receiver has perfect a.m. rejection, the v.h.f. output of the signal generator—especially if it is a cheap version—is likely to be partly frequency modulated as well as amplitude modulated whereupon you should be able to hear it at reasonable strength from the receiver. Since most receivers have ratio detectors you can, in any event, make them respond to a.m. by temporarily disconnecting the stabilising electrolytic."

"Well, that seems to clear up the question of inexpensive signal generators and Band II receivers," remarked Dick. "Now, what about Band III televisors?"

"If you're working on signal generator harmonics," said Smithy, "even greater precautions against using the wrong harmonic are required at Band III. However, in practice the difficulties aren't too bad here because you can do most of your receiver snag clearing at a Band I frequency. If you have to line up a Band III converter, or something like that, I think you would be well advised to work on a received signal as far as you possibly can. By the way, even when a signal generator gives a Band III output at fundamental you would be well advised to check its frequency calibration by beating it with a known signal before using it too extensively for final circuit alignment. Which is, of course, a repetition of the same warning I gave concerning Band II."

"What about using Government surplus wavemeters—such as the BC221—as signal generators?" asked Dick.

"Instruments like the BC221 are ideal for checking frequencies," replied Smithy, "but I would never use one myself as a service signal generator. The snag is that their fundamental frequency range is not great and you would have to work on harmonics nearly all the time. Also, their output is usually at high impedance, without attenuators."

Packing-up Time

Dick remained quiet for some moments.

"What's up?" asked Smithy, impressed by this unwonted silence.

"I just can't think of any more questions," replied Dick, frowning.

"Thank goodness for that," commented Smithy, whereupon he stood up and struggled into his mackintosh.

Both he and Dick prepared to leave, after which Smithy switched out the lights, leaving the Workshop lit only by the evening dusk which strained through the windows. As Smithy and Dick walked away, Dick's voice could be heard raising yet another question which had just occurred to him, but this must remain unrecorded. At any event, it was followed so quickly by the slamming of Smithy's car door that it is doubtful if, in this case, Dick received a really satisfactory answer at all.

New Battery Booklet

A new booklet for the "boffin," manufacturer and designer of light electrical and electronic equipment has been introduced by Chloride Batteries Ltd., Clifton Junction, Manchester. It provides a complete and easy reference to the comprehensive range of Exide batteries and Drydex power units for electronic and transistorised equipment.

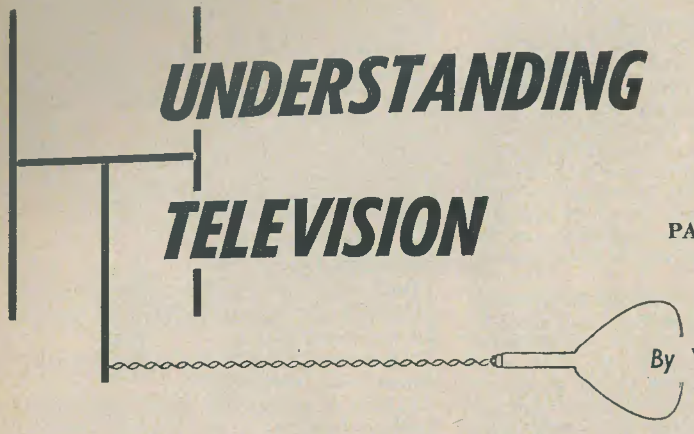
The "Dale" Banner Aerial

We feel that our readers will be interested in details of a completely new development in aerial design, using "printed circuit" technique, i.e. the elements are thin foil mounted on a tough Kraft paper support. It is a full 5-element array, having reflector, folded dipole aerial, and three directors. Performance characteristics are equal in sensitivity and directivity to a conventional 5-element array.

Despatched as a roll 2in diameter by 30in long, the aerial is ready for immediate use when unrolled. The size when extended is 45in by 30in. It is intended for inside use only, and can be suspended on cords in a loft, when its full directional properties can be exploited, or it can be used as a temporary or portable aerial for use in a sick-room, or a room not wired for television. In flats or tenements where outside aerials are not permitted it can be pasted to a wall and papered over.

The instructions show how to obtain best results in such circumstances. Large eyelet holes pierced along one edge of the aerial act as a cord-grip to prevent the weight of the cable hanging on the connections.

Under test in very adverse conditions of humidity the aerial has shown no deterioration. The price is 12s. 6d. retail, and the makers are Meadow-Dale Manufacturing Co. Ltd., The Dale, Willenhall, Staffs.



UNDERSTANDING TELEVISION

PART 4

By **W. G. MORLEY**

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

In the third article in the present series we commenced to discuss the television standards and waveforms employed in the major television systems throughout the world. The 405 line system was described in some detail, as also was the question of thinking of video information in terms of units of time. The concept of horizontal versus vertical resolution was introduced and, in this month's article, we will note some interesting aspects of horizontal resolution when the Continental and American television standards are compared to our own.

Table 1
Details of Television Systems

	405	525	"C.C.I.R. 625"	819
Video bandwidth (Mc/s)	3	4	5	10.4
Channel width (Mc/s)	5	6	7	14
Sound carrier relative to vision carrier (Mc/s)	−3.5	+4.5	+5.5	−11.15
Sound carrier relative to edge of channel (Mc/s)	+0.25	−0.25	−0.25	+0.10
Line frequency (c/s)	10,125	15,750	15,625 ±0.1%	20,475
Frame Frequency	50	60	50	50
Picture frequency	25	30	25	25
Line period (µs)	98.7	63.5	64	48.84
Aspect ratio	4/3	4/3	4/3	4/3
Sense of vision mod.	Positive	Negative	Negative	Positive
Sound mod.	A.M.	F.M. ±25 kc/s 75 µs pre-emphasis	F.M. ±50 kc/s 50 µs pre-emphasis	A.M.

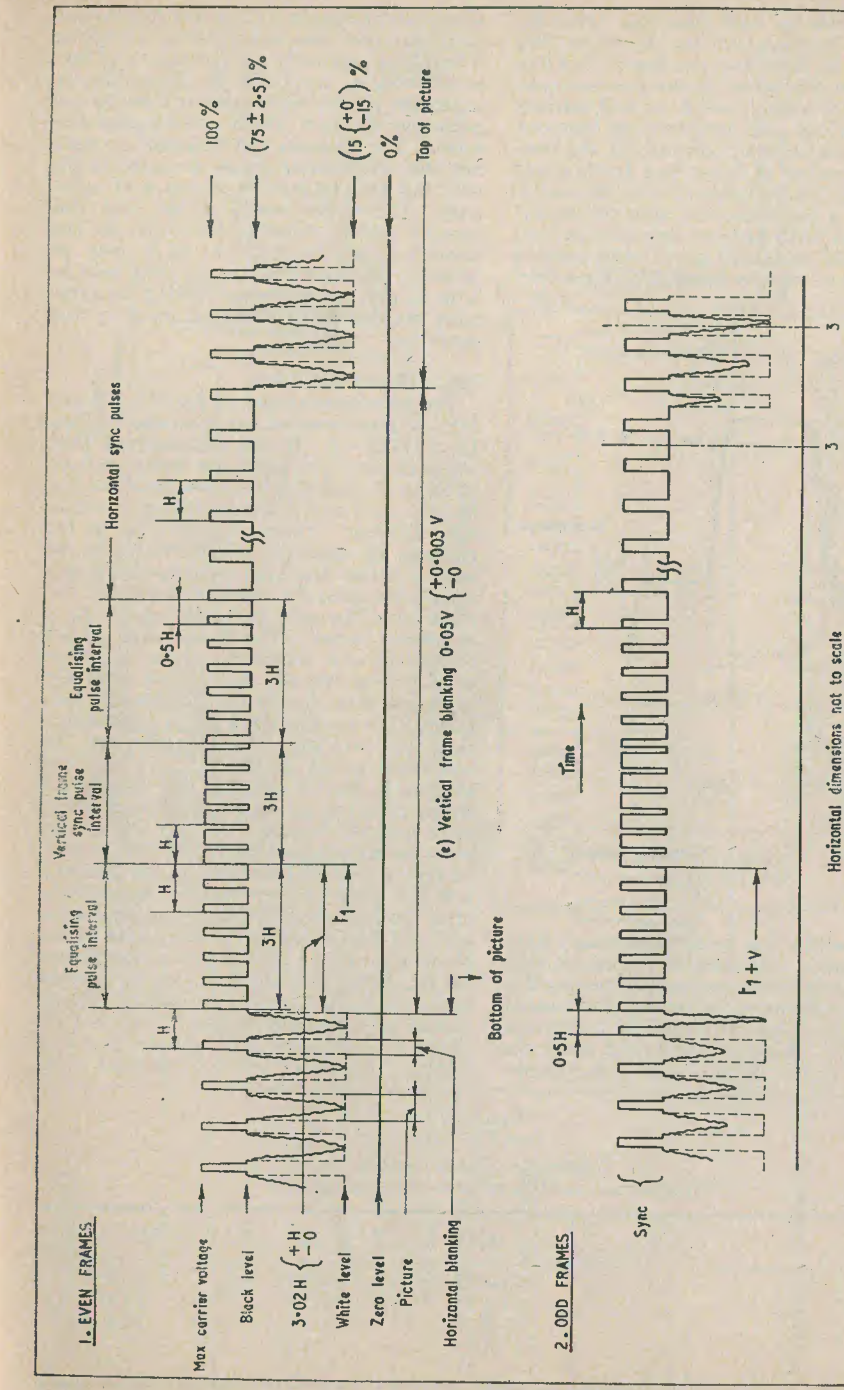


Fig. 17a. Synchronising waveform of the 525 line system. The dimension H refers to the duration of 1 line and is equal to 63.5 µs. The dimension V refers to the duration of 1 frame and is equal to 16,667 µs

This month we shall also deal with the waveforms employed for the American 525, the "C.C.I.R. 625," and the French 819 line systems. As was stated in the previous contribution, the reader would be well advised to keep in touch with systems other than our own 405 line standard because of the considerable amount of design and development work which is in progress all over the world. Too great a preoccupation with the British system is liable to narrow one's outlook, and it is most definitely well worth while keeping an interest in what is being done elsewhere.

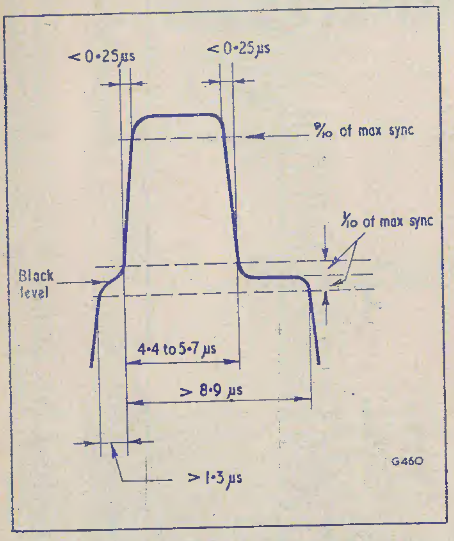


Fig. 17b. The line sync waveform of the 525 line system

It is possible that some readers may have the impression that some of the information presented in the diagrams accompanying this article is rather more "advanced" than would be expected at an early stage in a series of this nature. However, this is not really the case, the reason being that it is impossible, at any later stage, to refer to any feature in a particular television system without having information available on that signal. There is, of course, no point in attempting to remember all the information relating to any particular diagram which accompanies this article. The diagrams and tables are intended not only to illustrate points discussed in the text, but also to provide a source of *reference*. The writer would advise that this month's article (together with that in last month's issue) be retained; as it may be necessary from time to time to refer back to it in future articles when dealing with the more detailed parts of receiver circuitry and operation.

525, 625 and 819 Lines

The waveforms employed for 525, 625 and 819 line transmissions are illustrated in Figs. 17, 18 and 19. It will be observed that, whilst the line sync pulses are similar in form to those of the 405 line system described last month, the frame blanking period is markedly different. This is mainly due to the presence of *equalising pulses*, those in the section before the sync pulse period being sometimes called the *pre-equalising pulses* and those after the sync pulse period the *post-equalising pulses*. The frame sync pulses themselves are similar in shape to those employed in the 405 line system with the exception that, due to the fact that the 525 and 625 line systems use negative modulation, they are inverted. The function of the equalising pulses in the 525 and 625 line systems is that of ensuring that the overall frame blanking period is the same on both even and odd frames. The 405 line system does not have equalising pulses and, as may be seen if Fig. 13 (published in last month's issue) is examined, the section immediately after the frame sync pulse period differs for odd and even frames. The equalising pulses assist in providing good interlace; the reason for this being that, since they cause the odd and even frame blanking periods to become similar to each other, frame flyback is then initiated at the same point relative to either frame. This factor will be discussed more

TABLE II
(see Fig. 20)
Transmitter Characteristics
(frequencies in Mc/s relative to vision carrier)

	405	525	625	819
f1	−3.75	+4.75	+5.75	−11.25
f2	−3.5	+4.5	+5.5	−11.15
f3	−3	+4	+5	−10.4
f4	+0.75	−0.75	−0.75	+ 2
f5	+1.25	−1.25	−1.25	+ 2.75

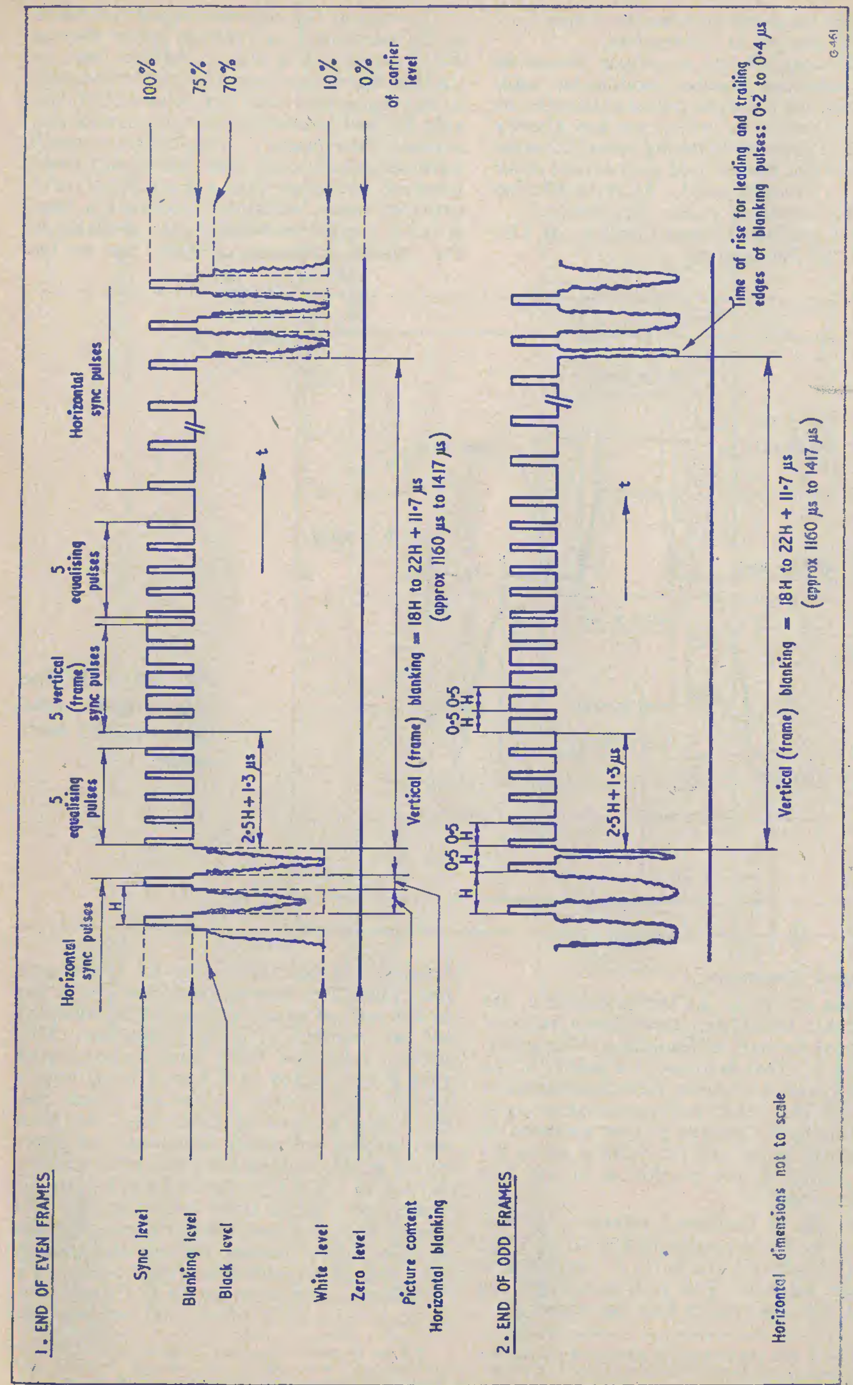


Fig. 18a. Synchronising waveform of the "C.C.I.R. 625 line" system. (Actually "625 line system for 7 Mc/s channel width.") The dimension H refers to the duration of 1 line and is equal to 64 µs. Amplitude level tolerances are given in Fig. 18b

fully when we come to consider frame synchronising circuits in the receiver.

The French 819 line waveform shown in Fig. 19 employs positive modulation and, once again, the line sync pulses are similar in shape to those with which we are already familiar. The frame blanking period is somewhat dissimilar to that used by the three other systems we have discussed. As in the 405 line system no equalising pulses are radiated.

Table 1 provides information for the 525, 625 and 819 line systems.

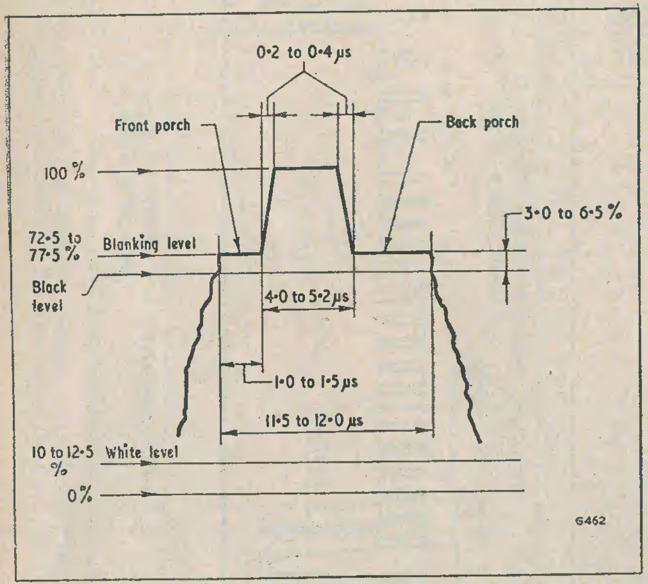


Fig. 18b. The line sync waveform of the "C.C.I.R. 625 line" system

Horizontal Resolution

As was shown in the previous article, the British 405 line system provides a ratio of horizontal to vertical resolution of approximately 1:1. That is to say, the ability of the British system to resolve picture elements in the horizontal sense is approximately equal to its ability to resolve picture elements in the vertical sense. In the vertical sense the factor which limits resolution is the line structure itself.

The ratio of horizontal resolution to vertical resolution is popularly known as "Kell Factor,"* wherein the ratio is expressed as a single number. The Kell factor for the British 405 line system then becomes 1.

The reason for choosing equal resolution in the horizontal and vertical senses for the 405 line systems is due to the fact that, at the time this system was originally introduced, it was considered that this ratio would provide the best balance between horizontal and vertical "sharpness." Investigations which have since been made into this subject have, however, indicated that a Kell factor of 1 provides more horizontal information than is really needed to balance that available in the vertical direction. Largely due to the break-up of the picture by its constituent lines, there is an impression of less resolution in the vertical sense than would be indicated by the number of lines themselves; and, indeed, subjective tests† have demonstrated that a Kell factor of 0.7 only is all that is needed to provide a picture which has equivalent degrees of "sharpness" in both vertical and horizontal directions. An interesting point resulting from this reduced ratio is that, in a 525 line picture having approximately 495 active lines (assuming 30 lines "lost" in the frame blanking periods) the number of horizontal picture elements in each line is actually lower than occurs in a line having the same length in the 405 line system. The ratio of picture elements per

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* A recent, and informative, reference on this subject is *Horizontal versus Vertical Resolution*, by L. C. Jesty, *Wireless World*, July 1957.

† Tests in which observers, judging from their own impressions, were asked to evaluate vertical and horizontal "sharpness" for different Kell factors.

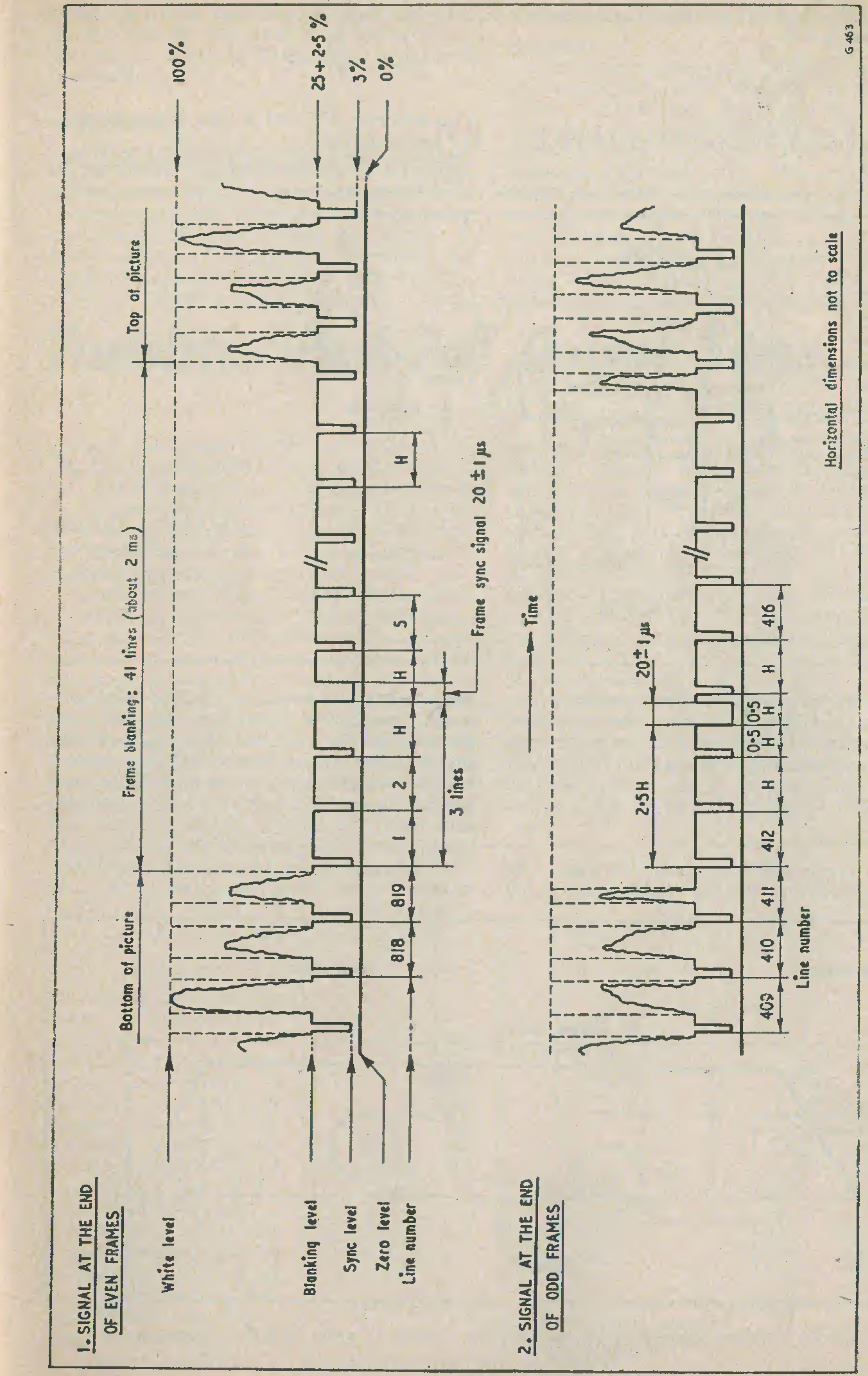


Fig. 19a. Synchronising waveform for the 819 system. The dimension H refers to the duration of 1 line and is equal to 48.84 µs

unit width in the 525 to the 405 line system is approximately:

$$\frac{495}{377}\times 0.7 : 1$$

$$\simeq 0.9 : 1$$

(This assumes 377 active lines in the 405 line picture.)

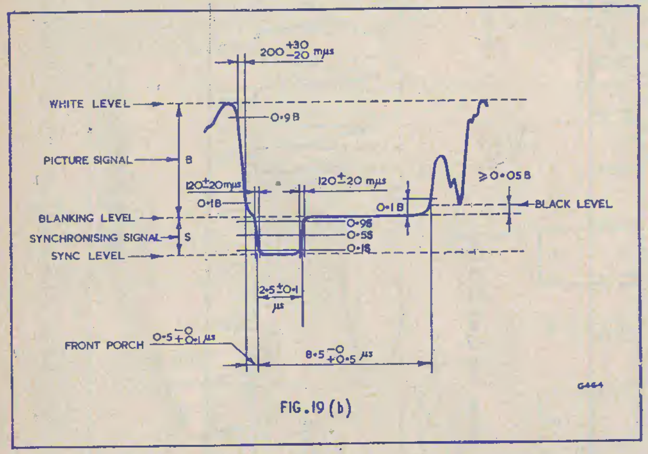


FIG. 19 (b)

Fig. 19b. The line sync waveform of the 819 line system

The ratio of picture elements per unit width between the 625 and 405 line systems (assuming 575 active lines in the 625 line picture) is slightly higher, being approximately:

$$\frac{575}{377}\times 0.7 : 1$$

$$\simeq 1.07 : 1$$

The corresponding ratio between the French 819 line system (Kell factor 0.85) and 405 line systems is approximately:

$$\frac{737}{377}\times 0.85 : 1$$

$$\simeq 1.7 : 1$$

(This assumes 737 active lines in the French 819 line system.)

As may be seen, the American 525 line picture has, in practice, slightly less horizontal resolution than has the 405 line picture, whilst the 625 line picture has slightly more. The French 819 line system which, incidentally, was based initially on a greater ratio of horizontal to vertical resolution than that chosen for the 525 and 625 line systems, has considerably higher horizontal resolution, being nearly one and three-quarters times better than the other three systems. These facts are worth bearing in mind whenever the question of the optimum number of lines in a television system is discussed.

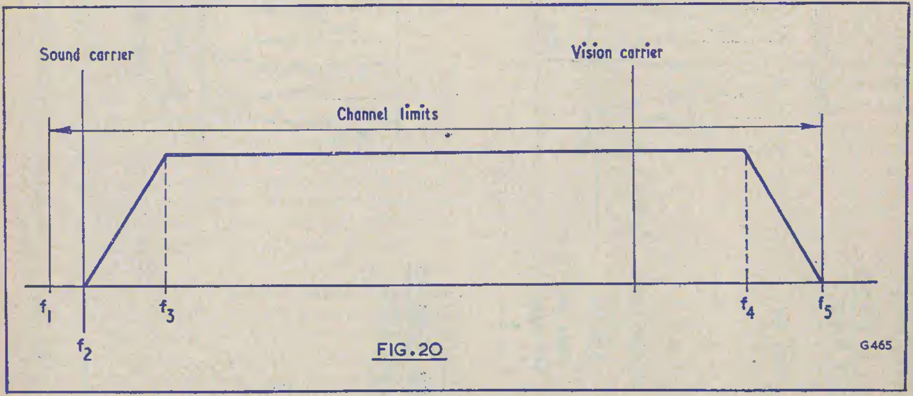


FIG. 20

Fig. 20. Ideal transmitter characteristic. Table II gives details of frequencies relative to the vision carrier

Next Month

Having covered the basic form taken up by the major television standards employed at the present time, we now become able to concentrate on the processes of transmission and reception (especially the latter) in greater detail. Next month, therefore, we shall carry on to the television receiver itself, commencing with the cathode ray tube.

Reference

The information given in the table and waveforms included in this and last month's article was obtained from Report No. 83, Television Systems; Extract from the documents of the C.C.I.R. VIIIth Plenary Assembly, Warsaw, 1956. The term "field," where it appears in extracts from the report, has been changed to "frame." "Ideal" transmitter characteristics for the various systems are given in Fig. 20, the information here also being taken from the C.C.I.R. Report.

RADIO

Transistor Push-Pull Output Stage

By **P. THORNTON**

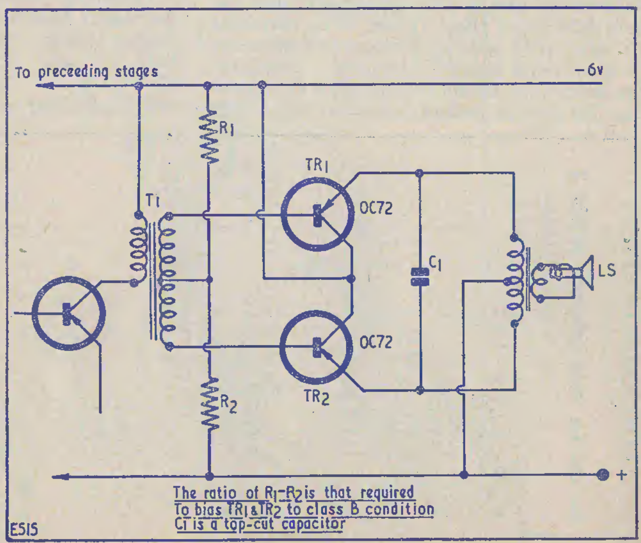
SINCE THE INTRODUCTION OF TRANSISTORS, the circuitry in which they have been used has followed closely the pattern already set by their valve counterparts. That is, as far as audio circuits are concerned. The output stage shown in Fig. 1 does not appear to have received much attention in print.

It must be emphasised that the author takes no credit for the design of this output stage as, in fact, it has been produced by a commercial firm, and is at present in use in one of their transistorised record players.

A glance at Fig. 1 will show that the unusual points in this circuit are, firstly, no output transformer is used; secondly, the transistors are operated in the common collector mode instead of the common emitter usually employed; and thirdly, a centre tapped loudspeaker is employed. Besides being centre tapped, the loudspeaker is of somewhat higher impedance than usual, 55 ohms at 400 c/s across each half. The transistors are two OC72's or equivalents, and the operation of the circuit is as follows.

T_1 is the phase splitter transformer, which is preceded by two a.f. stages in cascode. The anti-phase signals appear across the secondary of T_1 and are fed to the bases of TR_1 and TR_2, together with a d.c. bias from the voltage divider R_1 and R_2. The output stage operates in Class B condition and, therefore, R_1 and R_2 should be chosen to give the necessary bias. TR_1 and TR_2, as already stated, operate with common collectors similar to a cathode follower in ordinary valve practice. There is consequently no voltage gain, but an appreciable power gain results. The emitter loads are the two halves of the loudspeaker windings, so that the emitter current fluctuations operate the loudspeaker directly. D.C. current through the two halves of the loudspeaker winding cancels itself out, so the voice coil is not shifted out of the magnetic gap.

In practice, the loudspeaker volume given by this circuit is more than is comfortable, though not so much as may be obtained in the common emitter mode. The frequency response is better, however, and there is also greater safety from thermal "run-away."



The ratio of R_1-R_2 is that required
To bias TR_1 & TR_2 to class B condition
C_1 is a top-cut capacitor

One for One Superhet Receiver

By **A. S. CARPENTER**

VARIOUS SUPERHET CIRCUITS APPEAR IN these pages from time to time, and no apology is given for offering yet another.

As is well known, the conventional "Four plus One" is fairly standard in commercial designs. It is reasonably efficient and trouble free.

Periodically we come across constructors' designs in which economy is effected by omitting the i.f. amplifier stage, so saving a valve and its associated components, including an i.f. transformer. Regeneration is then usually employed in conjunction with a leaky-grid type of demodulator to compensate for the loss of gain which inevitably follows when an i.f. valve is not included.

This is all very well up to a point.

It can be truly said that most of the gain in a superhet takes place in the i.f. amplifier, and regeneration can never quite make up for this loss if one is not included. Further, the secondary of the i.f. transformer must be coupled to the demodulator grid which follows by means of a condenser, and the grid leak (load resistor) has to be across or in series with it also. The secondary therefore becomes heavily "damped." Feedback (regeneration) assists considerably in lightening this damping effect, but selectivity is still poor unless one is prepared to advance the regeneration control to such a point that sidebands become non-existent.

Consider now the statement made earlier that most of the gain takes place in the i.f. amplifier. What gain?

It means, of course, that the signal selected from the aerial receives most amplification when it passes through the i.f. amplifier, having been converted to a different frequency by the frequency changer (usually the first valve). All very nice—if it happens to be a strong signal which has been selected. What happens to a weak one? More than likely it gets "lost" on its way through the i.f. transformer, especially if the coupling is loose. In this case the i.f. amplifier has nothing to amplify, and turning up the volume control gives us a nice lot of hiss for our trouble. Even if the signal *has* managed to creep through it sounds distorted, as not many demodulating devices can produce an undistorted l.f. from a small input.

The thing to do, therefore, is to amplify the signal before it is presented to the frequency changer, and a receiver incorporating both r.f. and i.f. amplifiers is extremely efficient.

To construct such a receiver can be an

COMPONENTS LIST

Set out for easy reference to Fig. 1

Resistors

R_1, R_5, R_6, R_7	47kΩ
R_2	500kΩ
R_3	100kΩ
R_4	2MΩ
R_8, R_9, R_{13}	1MΩ
R_{10}	100kΩ
R_{11}	22kΩ
R_{12}	1MΩ pot and switch

Capacitors

C_1, C_3, C_4, C_6, C_{12}, C_{14}, C_{15}	0.01μF
C_2	500pF twin-gang
C_5	50pF mica
C_7	500pF variable (see text)
C_8, C_{10}	100 pF mica
C_9	500pF (see text)
C_{11}	100pF trimmer
C_{13}	470pF
C_{16}	300pF
Ct	50pF trimmers

Valves

V_1	EF39
V_2	6K8
V_3	6J5

4-pole, 2-way Yaxley type switch

Coils

L_1	QA8	Osmor
L_2	QA9	
L_3	QA5	
L_4	QO8	

HFC—Osmor all-wave choke

T_1 465 kc/s I.F.T., Teletron, type N/R

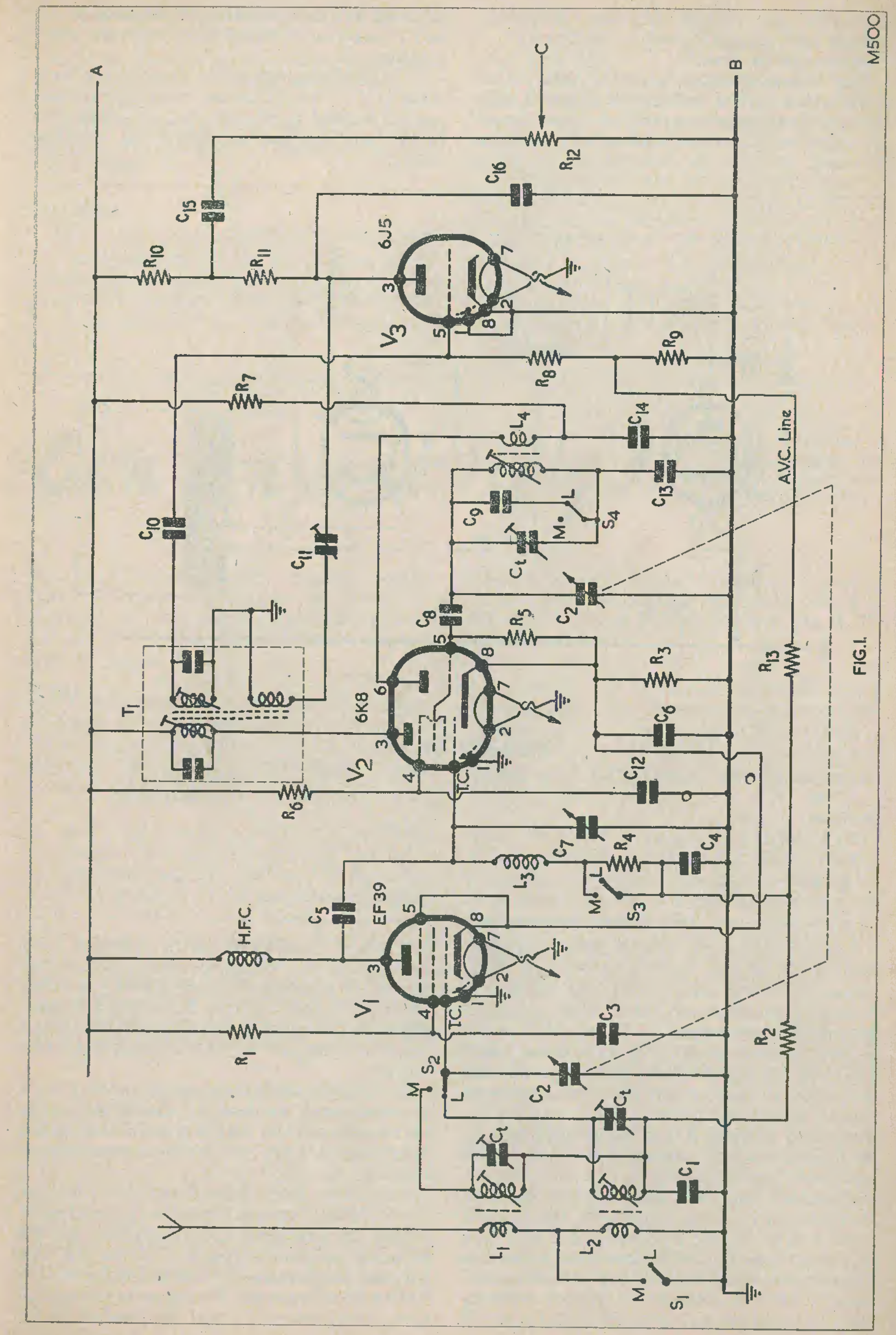


FIG.1

expensive and tedious business, and final "lining up" something of a nightmare.

What can be done?

The following design presents an arrangement which is not difficult to align, is efficient, and not unduly expensive. The normal i.f. amplifier is omitted and an r.f. amplifier included.

solid dielectric reaction type condenser. It acts more as a "peaking" trimmer than anything else.

It is hardly worth while including a long wave coil as amplification is sufficient without it; instead a resistor, R_4, is used, this being switched out of circuit on medium waves.

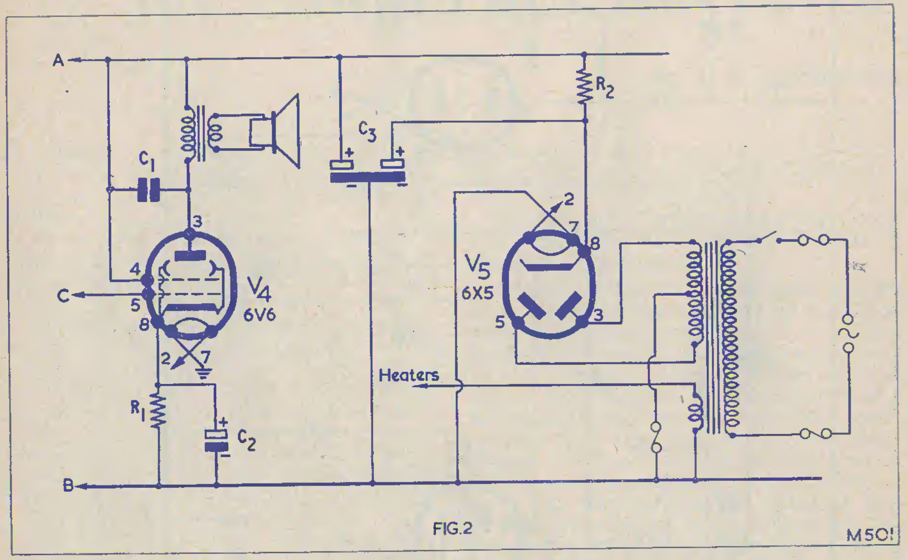


FIG.2

Parts List for Fig. 2

Mains transformer	250–0–250V 80mA, 6.3V 2.5A
Resistors	
R_1	470Ω
R_2	1,000Ω, 3 watt
Capacitors	
C_1	5,000pF
C_2	50μF, 25V electrolytic
C_3	16+16μF 350V electrolytic
Valves	
V_4	6V6
V_5	6X5
Output transformer	80–1

Certain valve types are shown, but others will work equally as well—perhaps even better in some cases—and the design is presented more as an "idea" than a not to be varied arrangement.

The circuit diagram (Fig. 1) is shown only as far as the demodulator valve, but all that is needed to make a complete receiver is an output stage and power supply coupled to the points marked A and B on the diagram. In the interests of tidiness a suitable circuit to follow is given in Fig. 2.

Consider Fig. 1. The first valve is a variable-mu r.f. type, amplifying the r.f. and feeding it to V_2, the frequency changer. The signal grid of this valve contains a tunable circuit (for medium waves) consisting of L_3–C_7, the latter not being ganged with C_2 but, in the prototype, consisting of a small

A single oscillator coil (L_4) covers both wavebands, C_9 being switched across the secondary winding for long waves. A value of 500pF is given for C_9, but slight variation might be necessary depending upon the exact frequency chosen as the intermediate frequency.

An intermediate frequency of 465 kc/s appears at the anode of V_2 and is fed to the i.f. transformer T_1, which is a product of the Teletron Co. Ltd., and carries a regeneration winding.

The i.f. is demodulated and amplified by V_3, feedback being taken from its anode and passed to the grid and controlled by the capacitor, a preset type, C_{11}. Once set, this trimmer requires no further adjustment.

The load resistor in the grid circuit is split, comprising R_8 and R_9, and a.v.c. is taken from their junction and fed back to the grids of the two preceding valves.

L.F. for feeding direct to an output valve grid is available at the slider of R_{12}, the volume control.

In the prototype there are four controls: Tuning, Wavechange, Volume/on/off, and the peaking tuner, C_7.

Operation

The main tuning control is the twin-gang, C_2, and irrespective of the setting of C_7 signals are available at fair strength. One tunes to a signal by means of C_2, then peaks it up to maximum (on medium waves) with C_7.

Does it work well?

Yes! Radio Luxemburg can be received loud and clear at 7 p.m. on a July evening; a fair test, I think, especially in the Bristol area where the West Home Service is radiating strongly on 206 metres (Luxemburg 208 metres). Both can be received free from each other. This is given as just one example.

Lining up will not be dealt with here, as constructors capable of building something like this from a circuit diagram are not likely to be handicapped. In any case it follows standard practice and has been dealt with in detail many times before.

Concluding words for this somewhat rhetorical article could be, are—in fact—"Try it and see."

Can Anyone Help?

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

D. M. BELDING, 207 Stanley Street, Grimsby, Lincs, is anxious to obtain the circuitry of the mains energised speaker wiring in the a.c. mains Philco domestic receiver model A.637.

* * *

M. J. MONTGOMERY, 16 Alexandra Drive, Surbiton, Surrey, would like any information about, and if possible the circuit of, the timebase unit type 42 (10DB/1815); any expenses gladly paid.

* * *

G. BURT, 38 Parkside, Jedburgh, Scotland, is willing to pay for the supply of any information regarding the Collins T.C.S.-12 and the 1392 receivers.

* * *

J. D. LOADER, "The Caravan," Buckley Barn Farm, Castleton, Rochdale, Lancs, would like some information on the 18 Set Mk. III transmitter/receiver, in particular the voltages to be applied to the 5-pin battery plug and where a suitable battery may be obtained.

* * *

C. J. MORRISON, 10 Hillside, Roe Green Estate, Hatfield, Herts, is a keen beginner and would like to obtain circuits of a guitar amplifier using miniature valves and transistors, a v.h.f. and an ordinary superhet receiver—push-pull output or otherwise—with valves selected from EL80, EL84, 6BW6, 6BW7, 6BR7, EF95, EF91, 6BA6, 12AT7, 12AX7, 12AU7, ECH42, ECH35, EBC33, EB91 and EF39—and using an FR1 ferrite aerial and oscillator coils RO1 and RO2 (Repanco).

Master JOHN PAYTON, 9 Brigfield Crescent, Birmingham 14, asks if any reader can give him the working instructions for the R.107 receiver, Z.A.3050.

* * *

M. IVINGS, 359 Rocky Lane, Great Barr, Birmingham 22A, wishes to obtain, preferably on loan, any information concerning the No. 18 Mk. III transmitter/receiver and particularly the connections to the 5-pin battery plugs.

* * *

4176552 S.A.C. Poole, P. J., J.A.T.C.C., R.A.F. Seletar, Singapore, 28, urgently requires information on the combined transformer used in the B.2 transmitter unit. In return information can be given on the H.R.O. receiver model M.X. for which the authentic service sheet is held by the writer. All postal expenses will be reimbursed.

* * *

R. A. JACKSON, 58 Rodney Street, Edinburgh, wishes to buy or borrow the manual, circuit or any data on the Canadian VRL.250 receiver.

* * *

J. O. ROBERTSON, 132 Hatton Gardens, Glasgow, S.W.2, would like to hear from anyone who has successfully built the Transistor-8 Superhet described in the August 1957 issue.

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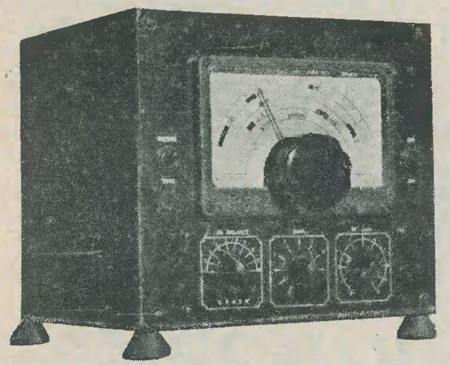
F. BEE, 60 Caer Saint, Caernarvon, N. Wales, would like to purchase or borrow the manual, circuit, or any data on the Triplett Cathode Ray Oscilloscope model No. 1690.



The "Communications" Pre-Selector

by **N. MARSH**

This article describes a high-gain preselector covering both short and medium wavebands, and designed especially for the "communications" enthusiast and the amateur transmitter. The preselector may also be used to provide improved medium wave reception in "difficult" parts of the country.

DUE TO THE PRESENT EXCESSIVELY crowded condition of the amateur and a.m. broadcast bands, it frequently happens that anything approaching adequate reception of weak medium or short wave signals becomes virtually impossible. This condition is accentuated when the receiver used by the listener has insufficient sensitivity, or if it is subject to i.f. breakthrough or image (second channel) interference. A further worsening influence may be given when the receiver employed does not have an r.f. stage, since its signal-to-noise ratio may then become undesirably low. This low ratio is due to the higher noise level given at the frequency changer as compared with that given at the input circuit of a tuned r.f. amplifier.

An excellent method of improving reception performance with any given receiver, even when this is already a communications-type model, consists of fitting a preselector between the aerial and its own aerial input terminal. A preselector is a high-gain tuned r.f. amplifier, preferably having a low noise input circuit, whose purpose it is to apply an amplified version of the aerial signal to the input circuit of the receiver. A number of advantages are thereby conferred. Firstly, the required signal is raised well above the strength of any interfering signal on the image frequency, and heterodynes and breakthrough are consequently eliminated. Secondly, and for similar reasons, i.f. breakthrough is removed, again resulting in the elimination of heterodynes. Thirdly, if the preselector has a carefully designed aerial input stage, a high signal-to-noise ratio can be obtained, this permitting clear reception of signals which might otherwise be lost in background noise. And, fourthly, there is the fact that a preselector is inherently an "add-on" item of equipment, with the result that it provides a considerable amount of r.f. gain at far less expenditure than might be required by the purchase or construction of a new receiver with commensurate pre-mixer amplification.

It must also be stated that a preselector presents the disadvantage that it has to be tuned in step with the receiver which it serves. However, this does not cause any unsurmountable difficulties as an approximate setting of the preselector tuning dial is quite sufficient for initial reception of the desired signal. A preselector is not normally intended to provide a large amount of assistance so far as adjacent channel interference is concerned, although it may still prove quite helpful in this respect on the lower frequencies. The provision of adequate adjacent channel rejection is really the job of the i.f. stages in the receiver: the preselector then plays its part by ensuring that the required signal is applied to these stages at good strength.

The Circuit

Whilst the advantages detailed above can be given by any preselector which gives some gain at the signal frequency, it is obvious that a more searching specification is needed if the preselector is to be of real and practical use. In the unit to be described in this article care has been taken to ensure that a high degree of gain is provided on all bands covered, and that the maximum transfer of energy is given from the preselector output stage to the aerial input circuit of the associated receiver. This latter point is most important, and is not always given the full attention it deserves.

The circuit of the preselector is given in Fig. 1. In this diagram it may be seen that four valves are employed in the unit, three of these being concerned with the r.f. circuits and the fourth being the h.t. rectifier. Four coil ranges are provided.

Commencing at the aerial input socket, the first circuit encountered is that of the aerial coil. Four aerial coils are used—one for each range—these being switched by $S_{1(a)}$ and $S_{1(b)}$. The positions of these switches are designated with the suffixes of the Teletron coils employed in the unit. Thus, switch position 7 causes the Teletron HFA7 coil to be brought into circuit. A table showing the wave-ranges provided by each of the coils is given in Fig. 2, wherein it will be noted that coverage is continuous from 400 kc/s to 30 Mc/s. Fig. 3 indicates the method of numbering the tags on individual coils, these numbers being illustrated also in Fig. 1. In order to maintain clarity, only one aerial coil is shown in the circuit diagram, the other coils being connected to the appropriate switch contacts in the same manner as that illustrated.

The aerial circuit uses a coaxial input socket. A coaxial input is not necessary, however, and any aerial may be applied to the preselector merely by connecting it to the centre receptacle of the socket. When a coaxial input is used good matching will be provided at 75 ohms. An earth connection is at all times desirable, and this will normally be that employed by the associated receiver.

The secondary of the aerial coil is tuned by the two condensers C_1 and $C_{2(a)}$ in parallel. $C_{2(a)}$ is half of the two-gang tuning condenser, whilst C_1 is an "aerial trimmer" which is mounted at the front panel. A panel-mounted aerial trimmer is very desirable in any communication equipment owing to the difficulty of obtaining accurate tracking when reasonably tight coupling is employed. Tracking discrepancies are caused by the differing aerial impedances which are "reflected" into the tuned coil. The aerial trimmer takes up these discrepancies and ensures optimum tuning at whatever frequency is selected.

A simple send-receive switch, S_2, is also connected across the aerial tuned circuit. This switch is needed if the preselector is to be used in conjunction with a transmitter. When S_2 is closed—as it is intended to be in the "send" position—the preselector circuits are protected from excessive r.f. voltages.

The signal voltage appearing across the aerial tuned circuit is applied to the grid of V_1, this being a miniature high-slope r.f. amplifier. V_1 functions in normal fashion, its anode being connected to the coupling winding of whichever coil is selected by $S_{1(c)}$ and $S_{1(d)}$. The coils switched in by $S_{1(c)}$ and $S_{1(d)}$ are similar to those in the aerial circuit, and the switch positions are, once again, designated with the suffix number of the particular coil which they bring into circuit. As in the aerial section, only one coil is illustrated in the diagram. The remaining coils are connected to the appropriate switch contacts in the same manner as is that shown.

The tuned windings of the inter-stage coils in the preselector are tuned by condensers $C_{2(b)}$ and C_6. $C_{2(b)}$ is the remaining half of the preselector two-gang condenser, whilst C_6 is a trimmer. A Philips 3–30pF concentric trimmer is recommended here. It is important to ensure that losses in the inter-stage tuned circuit are kept as low as possible, as this circuit suffers least damping from external causes. It will be found that the inter-stage circuit is that which provides greatest selectivity in the unit.

Buffer Stage

The second valve V_2, like V_1, is a high-gain r.f. amplifier. Its purpose is that of providing a high input resistance for the tuned circuit connected to its grid and of providing a certain amount of amplification on its own account as well. It works, in consequence, as a buffer amplifier providing a useful degree of gain, despite its untuned anode load.

The anode of V_2 is connected to the h.t. rail via an r.f. choke and then couples, through the condenser C_8, to the cathode follower V_3. It is the function of V_3 to provide maximum transference of energy to the aerial coil in the associated receiver, this being achieved by making the receiver coupling coil itself complete the cathode circuit. Fig. 4 shows the coupling arrangement resulting, and it will be seen that a d.c. path between the aerial and earth ter-

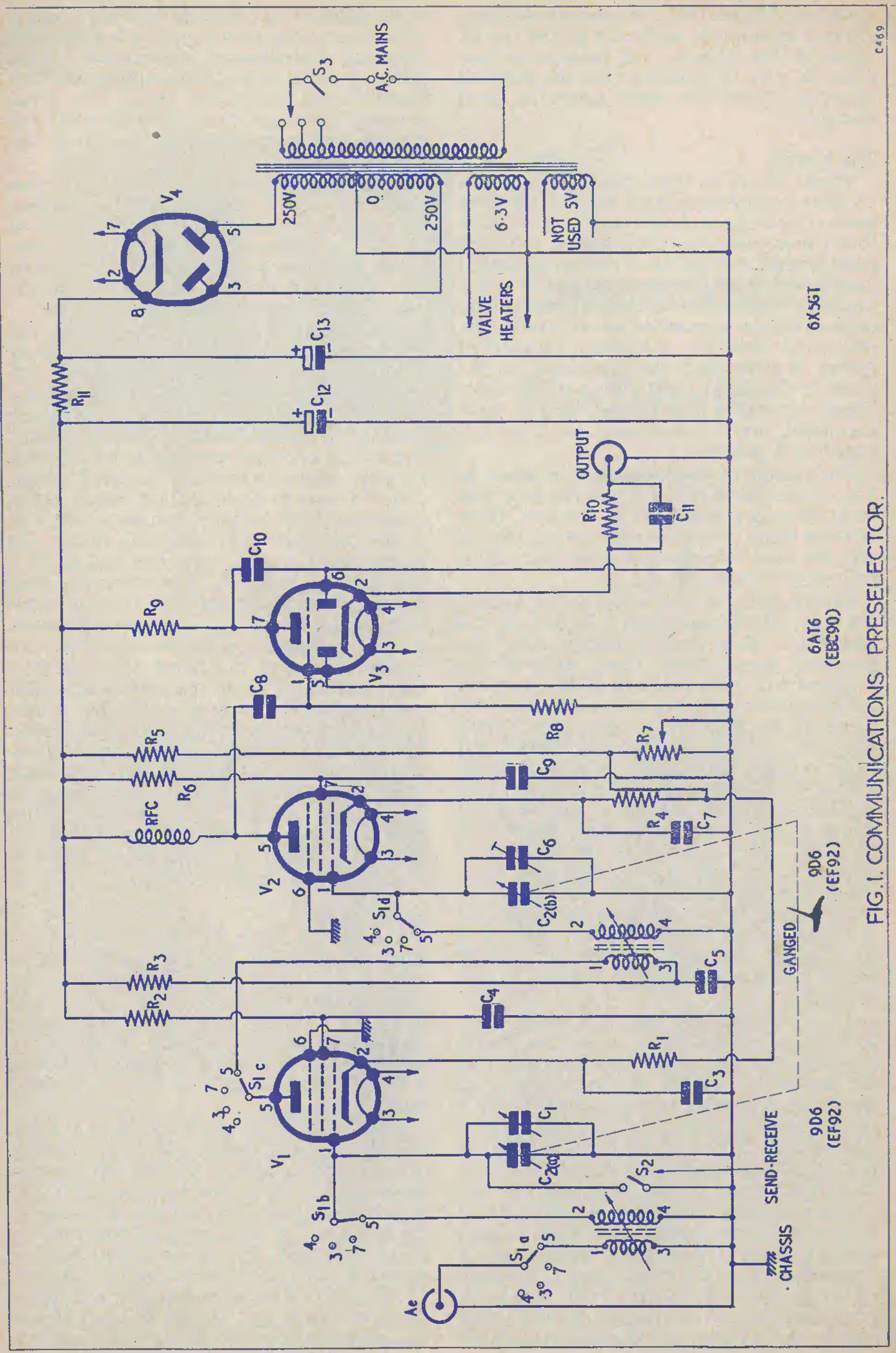


FIG. 1. COMMUNICATIONS PRESELECTOR.

minals of the receiver is essential. Such a d.c. path will almost inevitably be given by a communications receiver as well as by the better-class type of broadcast receiver.

Analysing the arrangement of Fig. 4, it can be stated that maximum r.f. current flows through the coupling winding of the receiver aerial coil, and that maximum r.f. voltage appears across its grid coil as a result. The condenser C_{11} is, of course, virtually a short-circuit at the frequencies being considered. Cathode bias for V_3 is provided by the resistor R_{10}. Whilst the value chosen for this resistor is a little lower than might be indicated by the valve literature, it was found that it gave best results in practice. The current flowing through the aerial coupling coil in the receiver is approximately 4mA, using the value quoted for R_{10}, and this should not cause any difficulties with normal coils. As the receiver is almost certain to have aerial coupling coil switching, the d.c. path between its aerial and earth input terminals will very probably be broken momentarily when it is switched from one range to the next. This momentary effect should cause no trouble as, even when the output circuit of the preselector is open, the cathode

Coil No.		*Wave Range*
HFA4	..	10–30 metres (30–10 Mc/s)
HFA3	..	15–50 metres (20–6 Mc/s)
HFA7	..	50–200 metres (6–1.5 Mc/s)
HFA5	..	200–750 metres (1.5 Mc/s–400 kc/s)

Fig. 2. Table showing the coverage provided by the coils in the preselector.

COMPONENTS LIST

set out for easy reference to Fig. 1

Resistors

R_1	150Ω ¼W
R_2	22kΩ ¼W
R_3	5kΩ ¼W
R_4	150Ω ¼W
R_5	100kΩ ½W
R_6	22kΩ ¼W
R_7	5kΩ pot, linear
R_8	1MΩ ¼W
R_9	4.7kΩ ¼W
R_{10}	390Ω ¼W
R_{11}	2kΩ 2W

Condensers

C_1	27.5pF variable, Eddystone 588; or 25pF variable, J.B. C804
C_2	500+500pF variable, J.B.
C_3	0.02μF paper
C_4	0.02μF paper
C_5	0.02μF paper
C_6	3–30pF, Philips concentric trimmer
C_7	0.02μF paper
C_8	100pF ceramic or silvered mica
C_9	0.02μF paper
C_{10}	0.02μF paper
C_{11}	0.01μF paper
C_{12}	32μF electrolytic, 350V wkg
C_{13}	16μF electrolytic, 350V wkg

Valves

V_1, V_2	9D6 Brimar, EF92 Mullard
V_3	6AT6 Brimar, EBC90 Mullard
V_4	6X5GT Brimar, 6X5GT Mullard

Coils, 2 of each

HFA3	Teletron
HFA4	Teletron
HFA5	Teletron
HFA7	Teletron

Mains Transformer
Secondaries: 250–0–250V 60mA; 6.3V 3A; 5V 2A Elstone MT.162 (or Ellison MT161)

Cabinet
As prototype, Kendall and Mousley, type 9, 9in by 8in by 8in deep

Chassis
As prototype, Kendall and Mousley, 8in by 7in by 2½in

Panel
As prototype, Kendall and Mousley, 9in by 8in

Tuning Drive
Fitted scale and escutcheon, as prototype, Eddystone 598

Flexible Coupler
Eddystone 529, or equivalent

R.F. Choke
Eddystone 1066, or equivalent

Miscellaneous
3 B7G valveholders
1 int. oct. valveholder
2 Coaxial plugs and sockets
1 4-pole, 4-way, Yaxley switch
2 1-pole on-off toggle switches
Panel-Signs, Set No. 1
3 Pointer knobs
Tag-strips, wire, sleeving, etc.

of V_3 cannot rise above its cut-off voltage (at 250 volts h.t.) of approximately 5.

A further point to consider is that the connection between the preselector and the associated receiver is made by means of screened cable. This type of cable is essential in order to prevent feedback to the aerial input circuit of the preselector, with consequent risk of instability. An excellent choice for the screened cable would be given by the use of television coaxial cable; but it must be emphasised that the impedance at which the preselector feeds into the receiver may not be exactly 75 ohms, differences being given partly by the varying impedances of different receiver input circuits. Fortunately, however, provided that its length is kept reasonably short, the risk of a high standing wave ratio on the coaxial cable is negligible at the frequencies employed here. It would probably be best to look upon the cable purely as a screened wire in which it is advisable to keep the capacity between conductors to a low figure. In practice, therefore, good results should be given by any coaxial cable of reasonable quality whose length is not greater than 4 feet or so.

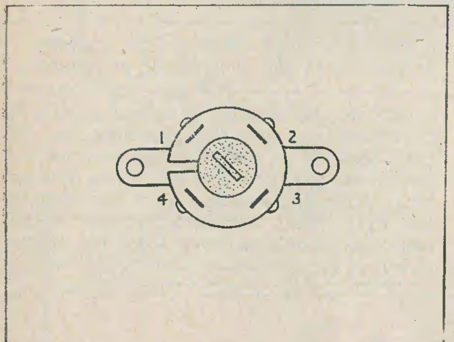


FIG.3.

Fig. 3. View looking down on coil, showing tag numbering.

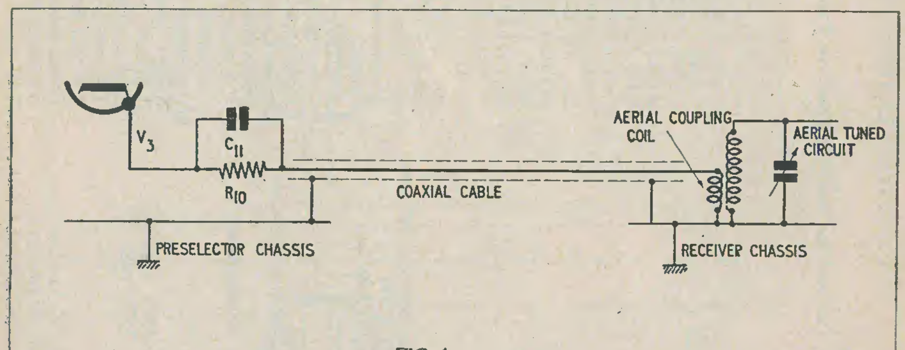


FIG.4.

Fig. 4. Illustrating how the output valve of the preselector couples into the associated receiver

The power supply employed in the preselector is perfectly conventional and straightforward, and requires little further comment here. It is doubtful if any trouble will be experienced due to mains modulation but, if this occurs, it may be cleared by connecting a 0.01μF condenser having a working voltage of 300 a.c. or 750 d.c. between one side of the mains input supply and chassis. If such a condenser is fitted, S_3 will need to be a two-pole switch inserted in both mains leads, and the condenser should be fitted after the switch. No trouble on this score was evident in the prototype, and it is doubtful if the condenser would be needed in other models. It is only due to the fact that the preselector works on very small signal inputs that it is felt necessary to draw attention to this possible requirement.

The Layout

In the layout of a unit of this type it is important to pay attention to two points. The first of these is the prevention of feedback between the two sets of tuned circuits, and the second is the maintenance of short wiring in the r.f. tuned circuits.

As will be seen from the photographs and layout diagrams which accompany this article, the problem of preventing feedback is solved by fitting a screen below the chassis between the two sets of coils. This screen also prevents capacitive couplings between the aerial and r.f. switching circuits, the switch wafers controlling the aerial circuits being mounted on the forward side.

V_1 and V_2 are mounted in conventional fashion on the chassis, but V_3 is fitted below. This particular method of mounting enables short connections to be obtained between V_2 and V_3, and also helps towards over-all compactness. The heat generated by V_3 is quite low and does not cause any excessive temperature rise below the chassis. All valves, with the exception of the rectifier, are fitted with screening cans.

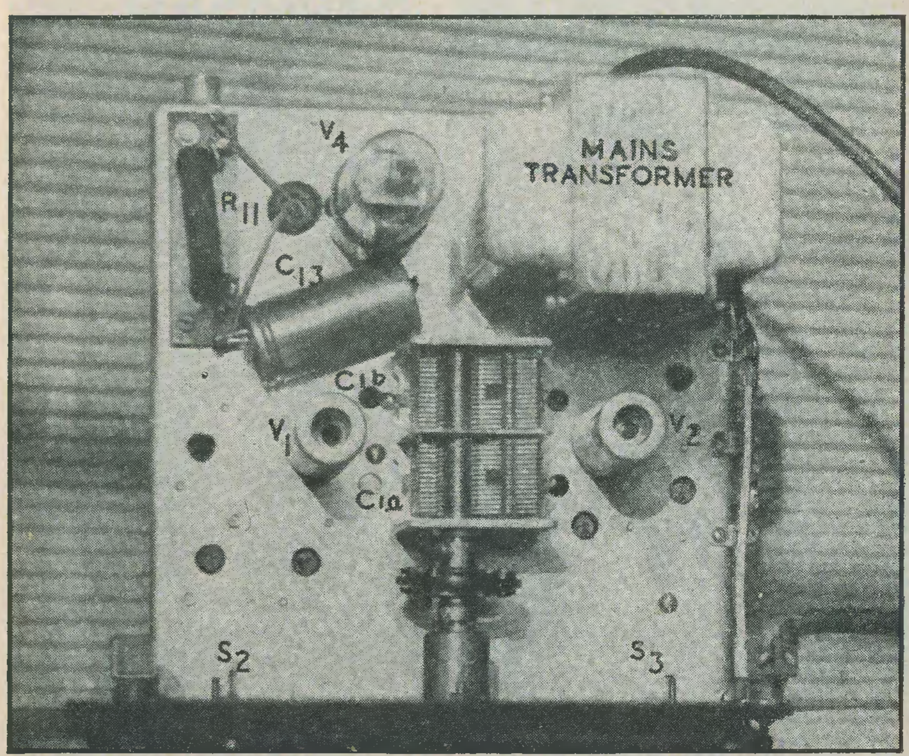


Fig. 5. Layout of the principal components above the chassis

With the exception of C_{12}, the components associated with the power supply circuit are mounted above the chassis, R_{11}, the smoothing resistor, being provided with its own tag-strip. The two-gang tuning condenser is also, of course, mounted above the chassis, its position being governed by the slow-motion drive.

Two views of the layout of the major components are illustrated in Figs. 5 and 6. The chassis employed in the prototype was 8in by 7in (front to back), and had a depth of 2½in; whilst the front panel was 9in by 8in. The prototype chassis assembly is fitted into its own metal cabinet, the latter being finished in crackle black. The two toggle switches to left and right of the tuning scale in the photograph of this cabinet are the Send-Receive and On-Off switches respectively. A final, and quite "professional," appearance was given to the unit by the use of Panel-Signs transfers, these being employed for the scales behind the three lower controls, and for the lettering at these controls and at the switches.

Alignment

The alignment of the preselector may be carried out either with or without a signal generator. The process is extremely simple and takes up very little time.

The preselector is connected to the receiver with which it is to be used, and its gain control, R_7, is set to the maximum gain position. Maximum gain is given when the slider of R_7 is at the uppermost end (as shown in Fig. 1) of its track. The associated receiver should, preferably, have its a.g.c.

line switched out. Alternatively, if an S-meter or similar tuning indicator is provided, a.g.c. may be left switched in, the S-meter being employed to indicate signal level at the aerial terminal of the receiver.

Alignment should commence on the lowest frequency band and proceed to the highest frequency band. Since the aerial circuit is provided with its own parallel trimmer it is necessary only to ensure that the setting of C_6 is such that optimum aerial trimming can be obtained for a reasonably central setting of C_1 on each band. It will be found that the inter-stage tuned circuit is the more selective, whereupon the procedure on each band consists quite simply of setting the core of the inter-stage coil to provide the frequency desired at the low frequency end of the band selected, and of adjusting the core of the aerial coil to give maximum sensitivity at this frequency. After adjustment of the cores, a check should then be made to ensure that optimum aerial trimming is obtainable, at all points of the band being aligned, within the range of C_1. It is advisable to commence initial alignment with the r.f. trimmer C_6 set to give approximately half its total capacity. Adjustments to this trimmer may then be made as alignment proceeds to ensure adequate control by C_1 on all bands.

If a signal generator is not available, the preselector may be aligned quite successfully on aerial signals of weak amplitude. Align-

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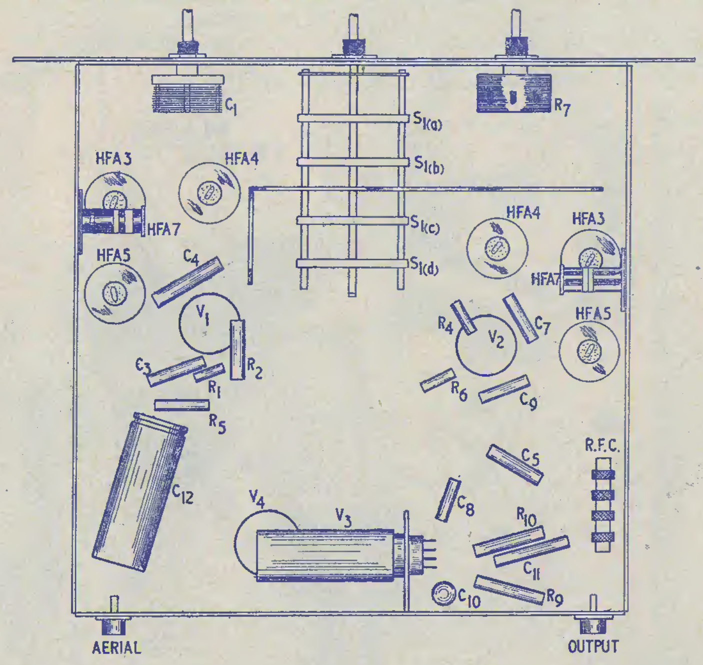
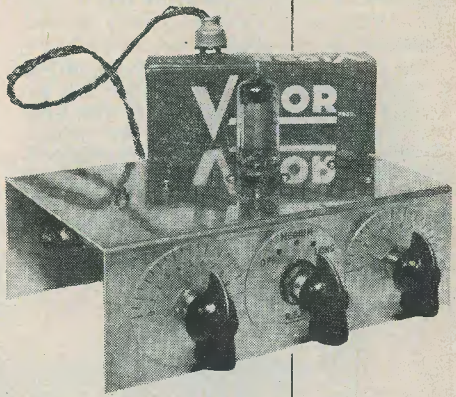


FIG. 6.

Fig. 6. The components below the chassis are positioned as shown here

The R·E·P one-valve Receiver for the Beginner



Described by **E. GOVIER**

OVER THE PAST YEAR OR SO, MANY requests have been received by the writer from readers who would like to see published a design of a simple receiver, battery operated, and tuning effectively over both the medium and the long wavebands. Such a receiver should be comparatively simple to construct, reasonably cheap to purchase, inexpensive to run and efficient in operation. To fill the above stipulations, the writer has chosen to describe the R.E.P. one-valve receiver, it being one of the most popular designs that has appeared in recent years.

For the beginner, probably the most important factor when constructing any kind of radio equipment is to ensure that all soldered joints are absolutely perfect. Without any doubt whatsoever, the prime cause of failure in most beginner-constructed receivers, etc., is the prevalence of badly soldered or "dry" joints. This being so, a few words about this important subject may not come amiss.

Soldering

The beginner must, first of all, try to curb the natural desire to hurry and complete the receiver. This eagerness can, and often does, cause many bad joints to be made with the consequent frustration of having to find out why "it doesn't work." Dry joints being notoriously difficult to locate, it is as well to solder properly and avoid them from the outset.

The best type of soldering iron for radio purposes is of the pencil bit variety. Having obtained one of these, the working surface of the actual bit must be coated with solder, this being important if the efficient transfer of heat from the bit to the required joint is to be achieved with any degree of success. Should the iron be a new one, the bit must first of all be tinned. This is done by first allowing the iron to reach its working temperature, when cored solder should be quickly applied to the working surface before the copper has had time to oxidise, the solder being spread over the surface with a cloth if necessary.

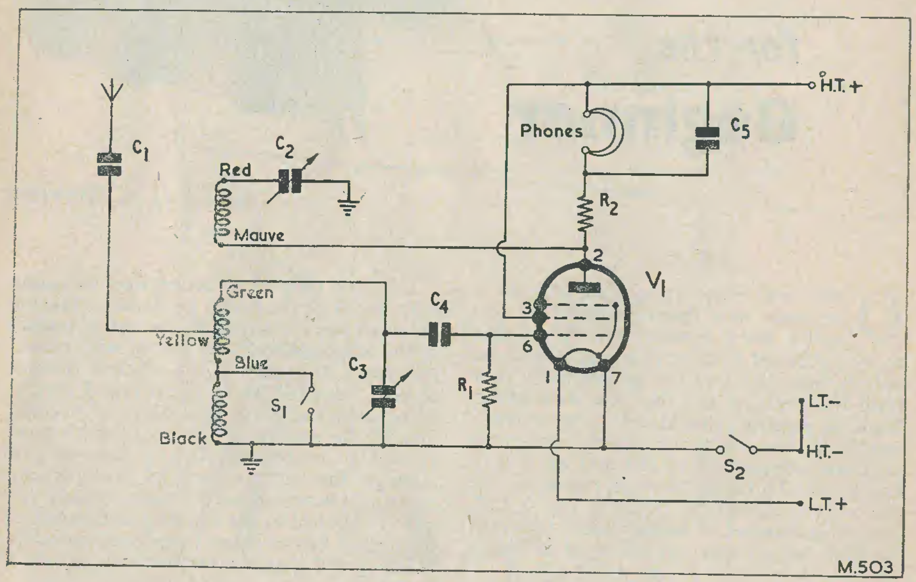
Before soldering any joint, a good mechanical connection must be made. Before doing so, however, the constructor must ensure that the parts to be joined are absolutely free from dirt, or other covering materials, and are bright and clean. Tarnished or dirty surfaces may be cleaned with emery cloth or a small file. The success of soldering largely depends on ensuring that the parts to be soldered are absolutely clean. Having then made the mechanical joint by securely fastening the wire ends to tags, etc., and by pinching them with a pair of pliers, the joint may now be soldered.

To solder correctly, hold one end of a length of flux-cored solder on to the joint and apply the iron—removing the solder as soon as sufficient has been melted. Hold the iron in position on the joint to allow the solder to run freely all over. Remove the iron, ensuring at the same time that the wire or wires composing the joint do not move until the solder has completely solidified. Should they move prior to solidification of the solder, then a bad joint will result.

Circuit

The circuit of the receiver is shown in Fig. 1, from which it will be seen that it is extremely simple and composed of the minimum components necessary to achieve efficient operation over the wavebands covered. The circuit itself is constructed around the 1T4 miniature variable-mu r.f. pentode; this type is well screened internally and functions extremely well as a detector and a.f. amplifier. The switches S_1 and S_2, shown in the circuit as separate components are, in fact, incorporated on the Yaxley type switch, this functioning both as the on/off and the wave change control.

The aerial series condenser C_1 is fed into the medium wave winding, this being tapped down in order to avoid unduly dampening the tuned circuit. Closure of S_1 changes the frequency coverage to long waves by placing both the windings in series with the tuning condenser C_3. Both C_4 and R_1 are the grid components necessary for rectification purposes. The variable condenser C_2 is the reaction throttle control. R_2 together with the headphones forms the anode load with C_5 acting as a tone correction component.



Components List

R_1 1MΩ ¼W
R_2 2kΩ ¼W
C_1 100pF silver mica
C_2 300pF variable
C_3 500pF variable
C_4 100pF silver mica
C_5 0.005μF tubular paper
Connecting wire
Screws and nuts
Battery, Vidor type L5504

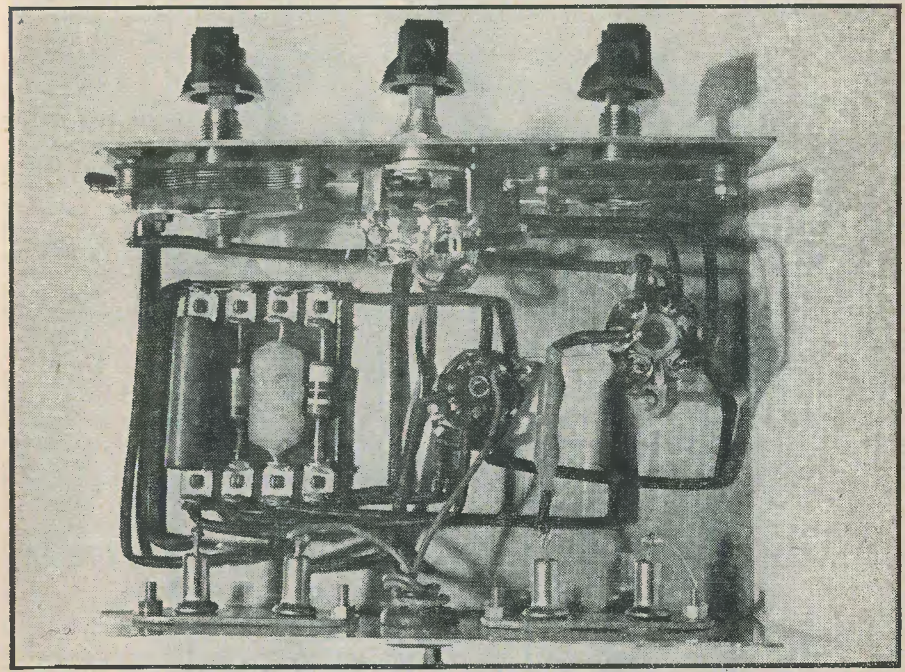
V_1 1T4 Brimar or Mullard DF92
S_1, S_2 3-pole, 3-way Yaxley
Coil R.E.P. Dual-Range
Chassis Repanco Ltd.
Tag board Repanco Ltd.
Knobs
Dial plates Repanco Ltd.
Phone, Aerial/Earth panels
Headphones

Assembly and Wiring Instructions

The assembly instructions are both simple and easy to follow—frequent references should be made both to the illustrations and the point-to-point diagram of Fig. 2.

Taking the four-way tag board, insert two 4BA screws into the outside holes, the heads of these screws being on the same side as the metal tags, fit two nuts (one on each screw) and tighten them to the underside of the tag board. The purpose of these nuts is to keep the tag board clear of the chassis so that no possible short circuits to the metal occur.

Fit and solder R_1, C_4, R_2 and C_5 to the tag board as shown in both Fig. 2 and the photograph. Note here that the wire ends of these components should be as short as possible, the actual ends being passed through the tag holes, twisted around the tag and then soldered. Cut the wire ends of these components to length before soldering so that the wires are short and rigid, holding the components firmly into position as shown.



Underneath of R.E.P. One-Valve Receiver—compare with wiring diagram

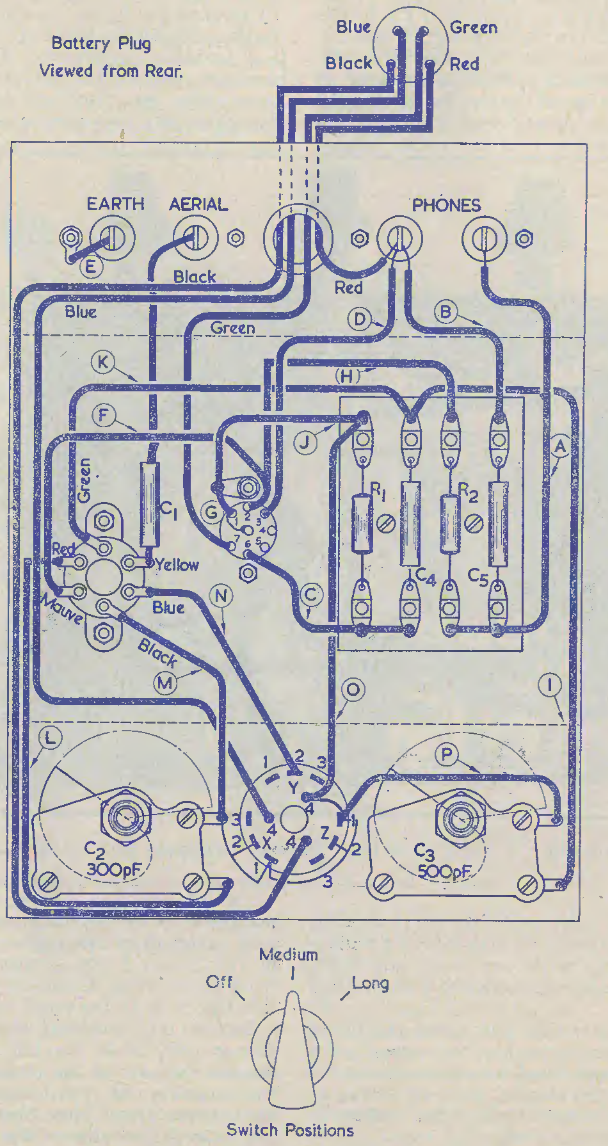
Secure the partially completed tag board to the chassis underside by means of a further two nuts fitted into position on the upper side of the chassis, ensuring before so doing that C_5 (0.005μF) is placed nearest to the outer edge of the chassis.

Having completed the above, next fit the B7G valveholder to the chassis by means of two 6BA screws and nuts, fitting a solder tag to that screw nearest to the rear of the chassis. The valveholder should be so positioned that pins 1 and 7 face the coil that will be inserted later (see photograph). Pins 1 and 7 are those with the wide gap between them. The pins are counted clockwise looking at the *underside* of the valveholder.

Continue by fitting to the front-drop of the chassis both the 300pF (C_2) and the 500pF (C_3) variable condensers. Fit the former condenser nearest the coil position. Before fixing into position and tightening the respective securing nuts, place a dial plate marked 0 to 10 over each spindle threadway and, having done this, tighten the nuts. Next, fit the 3-pole 3-way Yaxley switch on the front drop in the remaining aperture, fitting the dial plate in the same manner as above.

Secure into position the R.E.P. Dual-Range coil, with the tag coloured green nearest the rear of the chassis. Follow this by mounting the twin socket panels on the chassis rear drop. Note here that under that nut nearest the edge of the chassis and the coil should be fitted a soldering tag.

Solder into position C_1, one end being connected to the yellow tag of the coil and the other to the aerial input socket. We



R.E.P. ONE VALVE BATTERY SET.
WIRING DIAGRAM

M504

must now deal with the wiring of the 3-pole 3-way switch. This is shown clearly in Fig. 2, and we commence by connecting together, by means of bare wire, tags Y_4, Z_1, Z_2, X_1, X_2, and joining these to the upper large tag of C_2. To X_4 should be connected one end of the blue length of wire, the other end of which should now be fed through the rubber grommet on the rear chassis drop. This end should now be connected to the battery plug as shown in Fig. 2, this lead being the l.t. – connection. To Y_2 solder one end of a short length of p.v.c. wire, the other end of which is connected to the blue tag of the coil. Similarly, connect tag Y_4 to the far end of R_1 on the tag board; following this by wiring in Z_1 to the upper and larger tag of C_3. Taking a length of black p.v.c. wire, connect one end to Z_4, the other end being fed through the grommet and terminated in the battery connection plug as shown in Fig. 2, this being the h.t.— lead. The red and green flexible wires should now be soldered to the battery plug, as shown in Fig. 2, the red being also soldered to one of the phone sockets and the green to pin 7 of the valveholder. Note that when soldering these leads to the battery plug, the bare wire ends should be passed through the pins and soldered at the tips of each.

Dealing with the remainder of the wiring, this should now be carried out by following closely Fig. 2 and wiring in the connections marked A to L respectively, and in alphabetical order. It should be noted, however, that the drawing of Fig. 2 is shown in "exploded" form for the purposes of clarity. In reality, all the leads should be reasonably short and direct—a glance at the photograph of the underside of the chassis shows quite clearly how this should be carried out.

With this carried out, all the wiring and assembly is now completed. The beginner-constructor should now carefully check that all of the foregoing instructions have been correctly followed and that all soldered connections have been made to the correct tags, etc.

The receiver is now ready for use after fitting the valve, and plugging into the correct sockets the aerial, earth, the phones, and the battery. In order to obtain the best results with a simple receiver of this type, a really good aerial and earth are necessary. Generally speaking, the higher and longer the aerial, particularly where the actual aerial "top" is clear from metal gutterings, etc., the better will be the reception. The earth should preferably be direct to ground, a copper or other metal rod being driven in the earth as deep as possible and the earth wire connected to the top of the rod—a soldered joint suitably covered against weather corrosion being the best method.

A little practice with the controls will soon familiarise the user with the receiver, excellent results being obtained from all the local stations. The left-hand control C_3 should be used for tuning and the right-hand control C_2 as the reaction control—this also having some control on the volume.

As an introduction to radio and the hobby of home construction, this little receiver is ideal for the beginner; simple to construct, relatively inexpensive to purchase, and instructive in itself.

THE BOY SCOUT INTERNATIONAL JAMBOREE ON THE AIR

GILWELL PARK 1958

In connection with the forthcoming Boy Scout Jamboree to be held at Gilwell Park during the week-end of 10th-11th May, the Wanstead, Woodford and District Radio Club have been asked to instal and operate an Amateur radio station. By arrangement with the G.P.O. this station has been licensed under the call-sign GB3BP and will be on the air continuously throughout the Jamboree.

There will be two operating positions available, one for 160 and 80 metres, and the other for the higher frequency bands, and in order to minimise congestion it is proposed that all "G" calls be confined to the 160 and 80 metre transmissions, and all other calls to the remaining h.f. bands. There will also be several extra receivers for those visitors who would like to listen and tune-in for themselves. Further details may be obtained from the Hon. Organiser, The Boy Scout International Jamboree on the Air, 965 Oxford Road, Tilehurst-on-Thames, Reading, Berks, or from the Organising Secretary, G3AAJ.

NORTHERN POLYTECHNIC LECTURE DEMONSTRATIONS

For the past two years the Department of Telecommunications of the Northern Polytechnic has held very successful courses on high quality sound reproduction.

This year another series of 10 lecture-demonstrations has been arranged. The lectures, followed by discussion, will be given each Tuesday commencing on the 29th April at 6.30 p.m. until 8.30 p.m.

Ten outstanding specialists in various aspects of high quality reproduction have accepted invitations to give the lectures.

Full details of the course are available from J. C. G. Gilbert, ASSOC.I.E.E., M.BRIT.I.R.E., Head of Department of Telecommunications, Northern Polytechnic, Holloway, N.7.

Early application is advised as the Polytechnic is only able to accept 150.

Radio Miscellany

A couple of correspondents have recently mentioned the difficulties besetting constructors whose only workshop facilities are limited to a shed in the garden. Apparently my occasional loose use of the word "shack" has suggested that I may have at some time suffered this handicap with its consequent problems of preventing equipment, components and tools becoming rusty or corroded. Despite the fact that dozens of readers have run up against this problem no one, as far as I know, has found the complete answer. After all, one can't keep everything lightly smeared with oil!

Nor is the covering of things with closely-woven or moisture proof materials any answer. The first sunny day results in a warm dampness under the covers which is unable to escape, only to make matters worse. In this respect materials which are supposed to be able to "breathe" usually prove a disappointment. In theory they are impervious to moisture but able to allow vapour and steam to escape. Like a tent, they also leak at any point where they are touched on the inside. Warm-feeling materials seem to be less prone to give trouble from condensation, and with a couple of carefully situated ventilation slits prove of considerable help. Even this is not an effective answer to damp vapours rising from soggy ground—often for days after the rain has ceased! Under such conditions flaps at each end of the shed to allow a current of drying air to pass right through are almost essential, especially in warm spells following wet periods. In any case, a roof is far more important than walls which keep in the damp more than they let it out.

In the war years radio gear was often stored under all sorts of conditions of heat and humidity all over the globe, when the cases were lined with lead-foil and packed with small bags of hygroscopic chemicals. Such an idea is applicable only to items required for very occasional use.

These few hints are a far from satisfying answer to our queries but if any reader has any useful hint to pass on to our Garden Shed Hobbyists they would undoubtedly be most grateful to hear of them. In the hope of picking up a new idea I sought the advice of a friend who has both a garage and a workshop at the bottom of his garden. He was no help. In fact, he said, he even has to take his battery charger in the house to dry it out before using it if by chance he failed to remember to take it out of the garage when he last charged the car battery!

Gay Sparks

I should like to say thank you to readers who, in writing, sent their good wishes for an early recovery from my recent illness. Unfortunately since then, I have landed up in hospital, bringing with me a rather puzzling problem. Just before I came in, a neighbour took delivery of a new car and I helped him transfer the radio from the old to the new one. A couple of days later he came round to complain that it was "building up electric shocks all over the bodywork." Sure enough, as soon as I touched the door-handle a distinct shock was felt.

Of course it wasn't the fitting of the radio, but static, which was responsible. The owner was still a bit doubtful of this explanation, having once heard of a motorist who after mucking about with the wiring found that every time he pressed the horn button the headlamps came on. So he removed the radio, but after the next short run a shock could again be felt. He then decided to fit a trailing chain—despite the fact that I told him it would probably be valueless. Trailing chains on dry road surfaces, invariably highly insulating, do not leak the charge away.

Investigation often traces car static to unsuspected causes and frequently it is the occupants who build up the voltage, and when they step out making a good "earth" the shock is felt. Years ago it was found some types of tyres generated quite a charge. Indeed, so-called non-static tyres were marketed—tyres so marked were often to be seen on public transport vehicles. The people dismounting were usually all right. It was those who touched an exposed metal part when getting on who "caught a packet." Toll-gate keepers on being handed money by a driver seated in a private car occasionally receive quite a jolt—the first few times no doubt suspecting the motorist, resentful at having to pay a toll, was taking it out of them! The common cause, as I have already mentioned, is produced by interaction between the occupants' clothing and the upholstery, especially in dry weather conditions and where the materials are highly insulating. True, the shocks are not physically dangerous, although they sometimes build up to well over 10,000 volts—happily at only the tiniest fraction of a milliamp. Like the sparks from children's sparklers, although they are white hot they don't burn because there is so little of them.

I have had no opportunity of investigating the cause in this particular case, but if it is building up like that after a couple of dry spring days he ought to be able to draw off a pretty display of sparks if we have a dry, hot summer. Or he can, if he alights carefully without touching anything, pass some playful little shocks on to his unsuspecting friends when he touches them.

Centre Tap talks about Items of General Interest

Dialling TROuble

I hear the G.P.O. are trying out a new idea in trouble-shooting. If it proves successful, all the servicing engineer will need to do will be to dial a secret number to receive a diagnosis of the trouble. This will be given, with remedial formula if necessary, from a recorded tape. With ever-increasing automation and book of rule faultfinding for radio and t.v. service engineers perhaps the day is not far distant when even the professional will have to turn to amateur methods to develop his natural wit and deductive power for successful unassisted fault location.

Points from Letters

Mr. J. Crockford, of 33 Waldo Road, Bromley, Kent, adds to the suggestions *re* the use of the prefix letters PM in the nomenclature of the early type Mullard valves. Generally believed to denote "Philips Mullard" or "Pure Music," he puts forward an alternative. He recalls 'phoning them in the mid-twenties when they were at Nightingale Lane, Balham, the operator answering "Paternoster Mullard. Can I help you?" He would also like to have any post-war news of John Scott-Taggart, a well-known name in pre-war radio journalism who formerly resided at Sidcup.

* * * *

My recent half-flippant suggestion that inventors might well turn their attention to a T.V.-selected-area-magnifier prompted Mr. W. Moore, a dispensing optician of Collompton, Devon, to write on the difficulties confronting the inventive mind even after his brain child has been brought to successful completion. He was granted Provisional Patent 37829/4/12/57 for a device to be worn as a pair of spectacles, hand held *à la* lorgnettes, or clipped on to existing glasses. The device enabled the image of the normal t.v. receiver, without any modification, to be seen with a 3-D effect. Two or three national newspapers sent reporters, several of whom admitted they were greatly impressed. Yet not one word of encouragement appeared in print! No wonder he felt that my phrase "What an opportunity for inventors" sounded ironical.

* * * *

Again this month we have more Old Timer news—a feature which seems to be so thoroughly enjoyed by the Old Faithfuls themselves as well as numerous other readers. Surely no other hobby can boast of so many lifetime adherents? This month the news is of Mr. Eric J. Phillips, of Ewell, Surrey, who vividly recalls "Two Emma Tock"—at Wr-r-r-r-ittle—calling CQ, and the still earlier spark transmitters; one working on 8,750 metres producing strong harmonics with a rasping, mushy note right down to the medium waves. He is still very active in the hobby and is currently chairman of one of the G.P.O. radio and t.v. societies. Indeed, his work in the club side of radio goes right back to the early 'twenties when he was secretary of the G.P.O. Radio Society. He nostalgically recalls early adventures in short waves—when 80 metres was considered "short" and twenty-four-inch extension handles were a must for all controls. Then came the thrill of the early transmissions from KDKA—but this soon became so easy that the keen types were not long in searching round for the smaller fry of the s.w. spectrum. E.J.P. well remembers a Philips soft detector which he owned. It blue-glowed at 11 volts h.t. and performed miracles of detection—but not for long! Also shiny ebonite panels which often proved excellent conductors, the craze for glass panels and the fun and games to be had from drilling them. What a pity the modern hard-tipped tile points weren't then available—nor the handyman electric drills. A couple of small holes meant hours of work—and sweat. As he built his first receiver in 1919 (with home-made tuning condensers, of course) he is fully qualified for membership of the Vintagers.

Mention of the home-made tuning capacitors will revive many amusing recollections in this column's circle of Old Timers. True, we sometimes used tapped coils, coils with sliders, elaborate loose couplers and variometers, but before long every enthusiast, to retain his self-respect, was expected to tune interchangeable coils by a "tuning condenser." At first we had to cut the vanes ourselves, but by about 1922-23 one could buy them ready stamped out, complete with spindles, 2BA rodding and spacing washers. Nothing with less than $0.001\mu F$ capacity was considered suitable for the main tuning, which meant a length of at least five or six inches. Then for the next few weeks you had no time for anything else. Cutting and drilling the ebonite end-plates and the preliminary assembly were quite straightforward, but somehow the plates would never be quite parallel. They were bound to touch at some points however carefully you adjusted them, and however judiciously you bent them they were sure to touch somewhere else. At the stage where one was in danger of becoming permanently cross-eyed as a result of peering between the vanes, the only possibility of getting the wretched thing to work properly seemed to be to remove the vanes and flatten them under pressure. While you were doing it any that looked a bit thicker than the average were "rubbed down."

Eventually, having got it more or less O.K., it went into the set—only to find it noisy in operation because of poor rubbing contact on the spindle bearing. Tightening up the end plates only made it stiff to turn; so stiff in places that exact tuning was a matter of luck. Even the mounting in position on the panel was sometimes tricky. A little bit out of true and the distortion caused the vanes to touch again at some point or the other, demanding a lot more fiddly adjustment. And, believe it or not, it wasn't until some years after that some bright lad thought of one-hole fixing!

P.S.—Sorry my "hospitalisation" makes it impossible to reply to all letters, but I do assure readers that I really enjoy hearing from them and will try to catch up with replies later. I am afraid that will be some time yet. Thanks also to the Bedfast Club for their monthly "Radial"—most appropriate at the moment. Despite my admiration for their excellent and lively organisation, I'm doing my best NOT to qualify for membership.

The "VERSATILE" 2-Valve Pre-Amplifier

Regarding last month's article on the above, the following further information has come to hand and the modifications given below should be incorporated in the unit by all constructors.

In the feedback network R_{10} should be deleted and R_{15} reduced to $220k\Omega$, C_3 changed from 680pF to 2,200pF, and C_5 changed from 82pF to 220pF. In the series grid resistor network, R_8 is deleted with no changes to any resistor values. The shorting link must be retained between switch contacts E and F on the same switch bank as that to which R_8 is attached. R_8 and R_{10} should also be deleted from the parts list and layout (Fig. 3) and values of R_{15}, C_3 and C_5 amended.

The reason for these changes is that optimum results can only be obtained with crystal pick-ups using the revised values quoted above.

A further piece of information received from Mullard Limited is to the effect that, unfortunately, their numbering of the resistors will differ from our article in their technical publication TP339 on the 2-valve Pre-Amplifier (TP339, March 1958 supersedes TP331, August 1957). Provided the modifications listed above are made, the circuit and values of resistors and capacitors are as intended by the designer.

TRANSISTOR CAR RADIO

Henry's Radio Ltd. inform us that their Transistor-8 Portable Superhet Receiver may be quite simply modified for use as a car radio. A 2in length of ferrite rod fitted with a medium wave winding, such as is used in their "Mini-Two" receiver, is fitted a half-inch below the existing ferrite rod aerial. One end, it does not matter which, is connected to chassis (h.t.+) and the other end to a socket fitted to the panel, into which the car aerial may be plugged.

The outer screening of the car aerial coax. may not be connected to the car body—it might prove necessary to do this. The receiver is run from its normal battery, and is in no way connected to the car battery, so that ignition interference should not be experienced.

The use of a normal car aerial overcomes the directional effect of the ferrite rod aerial, and being detachable means that the receiver can still be used outside the car as a normal portable. The aerial socket is also of assistance in areas of poor signal strength, as it provides a ready means of attaching an external aerial.

Before modifications are made, it is essential that the receiver should be in good working condition.

The . . .

"HALF-BANDWIDTH" TRANSMISSION SYSTEM

Important basic research in the field of Information Theory has revealed that wide-band t.v. signals may in future be successfully transmitted over narrow-band circuits.

By **S. Shennerman, Grad. A.P.L.A.**

What is almost certainly the most difficult problem facing the modern communications engineer is that of transmission system bandwidth. When information has to be transmitted from one point to another, the system by which the information is carried must possess bandwidth of a finite order; whereupon, in a system having fixed efficiency, bandwidth becomes directly proportional to the complexity of the information itself.

Typical examples of the relationship between bandwidth and information complexity in modern communications systems are presented by the radio and television broadcasting channels with which we are all familiar. We know that the amount of information conveyed by human speech is relatively low, and that it is possible to achieve quite intelligible speech communication over the very limited frequency range of 300–3,400 c/s.* If it is desired to transmit over a given channel all the information given by, say, a symphony orchestra, a much wider frequency range is required—this extending from some 30 c/s to 20 kc/s.†

Television Bandwidth

When we come to the transmission of television signals the question of system bandwidth becomes considerably more important. In Britain we employ a 405 line transmission standard which is capable of picture reproduction whose definition is acceptable for purposes of domestic viewing. However, the bandwidth needed in a system carrying this signal is excessively large, it being no less than 3 Mc/s. This bandwidth is more than 150 times greater than that required for the transmission of high fidelity sound, and it places a most embarrassing responsibility on the communications engineer, who has not only to design equipment capable of handling it, but, in the case of broadcast transmissions, has also to assist in fitting the system into the limited range of broadcast frequencies available. As is well known, the number of 405 line channels currently available in Britain for domestic television transmissions is thirteen only, this small quantity being occasioned entirely by the excessive bandwidth required in each channel. Apart from the points just mentioned, it hardly needs to be added that the expense incurred in designing, developing and manufacturing television equipment, both at the transmitting and receiving ends, is made notably greater by the necessity of handling this proportionately very large range of information frequencies; some of this additional cost being occasioned by the simple fact that increased bandwidth causes decreased gain in amplifying circuits. There is the further point that increased costs are, again, occasioned by the need to employ land lines which do not cause attenuation or phase shift to any of the frequencies in the band.

Some escape from the present impasse is obviously overdue, and concentrated research into the basics of Information Theory has, at last, enabled a partial solution to be obtained. Although it is usually assumed that a bandwidth of 3 Mc/s is required for a 405 line television signal, it may be shown that at no instant in time does the television signal itself occupy *all* frequencies in this bandwidth. At one particular moment a television transmitter may be handling a video signal which forms part, or all, of a 3 Mc/s cycle; at another moment the signal may constitute part, or all, of a cycle whose frequency is of the order of 200 kc/s. The fact that the 3 Mc/s television system is not fully occupied by the information it carries

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* This is the frequency range associated with telephone circuits.

† These figures are typical of the range offered by a high fidelity a.f. amplifier.

is amply borne out by the fact that colour transmissions are feasible wherein a colour information sub-carrier is inserted *inside* the black and white frequency range. Although the process of compressing a "3 Mc/s" signal into a smaller bandwidth without loss of definition raises many technical difficulties, it can now be said that these have been at least partially overcome.

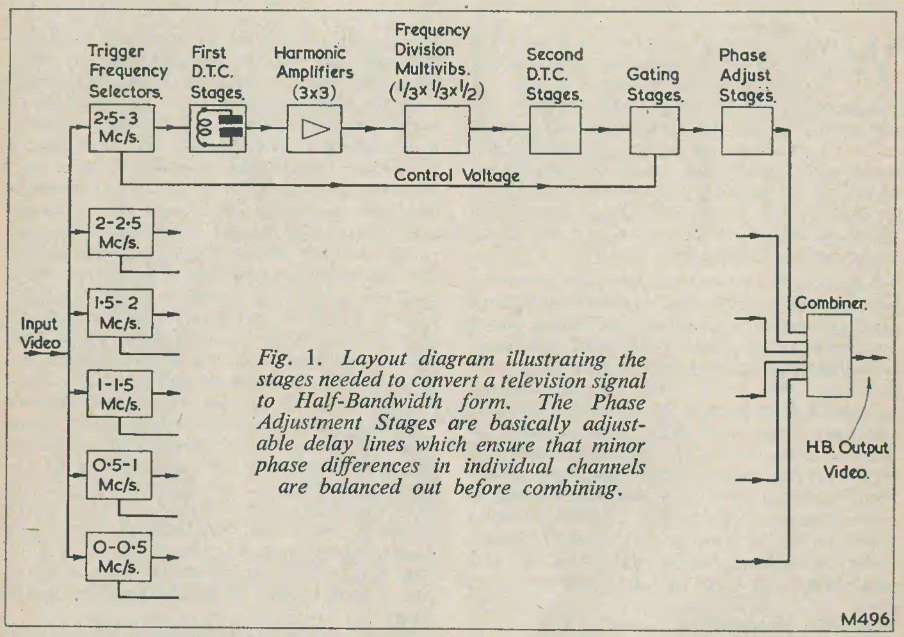

Fig. 1. Layout diagram illustrating the stages needed to convert a television signal to Half-Bandwidth form. The Phase Adjustment Stages are basically adjustable delay lines which ensure that minor phase differences in individual channels are balanced out before combining.

The Half-Bandwidth System

In summing up progress in bandwidth compression to the present date, it may be quite dogmatically stated that it is possible to show mathematically (see Appendix) that a "3 Mc/s" signal may be transmitted, without loss of resolution, inside a band whose frequency range is 0–1.5 Mc/s only. What, from the practical point of view, is much more important is that such a system has already been constructed and is actually in operation in the laboratories of a well-known firm of electronic equipment manufacturers (to whose Press Officer the writer is indebted for much of the material in this article). As a historic note, it is interesting to record the almost fortuitous manner in which development of the Half-Bandwidth system, as it is called, has entered the domestic television field. The initial design terms of reference for the team carrying out the research project were that methods of compressing the bandwidth of *any* information system should be investigated. The engineer in charge of the team decided to commence with a conventional 405 line television signal, as this represented what he considered to be one of the most wasteful transmission processes currently in use. Initial work, therefore, began with a monoscope signal source presenting exactly the same 405 line Test Card "C" which we all know so well. When the Half-Bandwidth process gave evidence of some practicability, more complex signals, in addition to the Test Card, were fed through the system.

As it stands at the time of writing, the Half-Bandwidth system does *not* offer any saving in receiver cost to the domestic viewer. This is due to the fact that, although Half-Bandwidth would enable the average television receiver to be cheapened by the use of a narrower bandwidth i.f. strip employing fewer stages and simpler tuned circuits, the ancillary equipment needed to convert the Half-Bandwidth signal back to full bandwidth would well outweigh the savings incurred. Nevertheless, a strictly limited amount of work is proceeding on simplified converter circuits which might enable practicable domestic receivers employing the Half-Bandwidth system to be made in mass-production. The fact that development work along this particular avenue is of a limited nature only is due to the following very good reason. *If it is possible to halve the bandwidth of a given signal, then the resulting Half-Bandwidth signal can be halved again, and so on.* Experimental "Double Half-Bandwidth" (i.e. quarter-bandwidth) systems have not proved successful to date for reasons which are not entirely understood, but it is hoped eventually not only to achieve reduction of this order but also to obtain as much as one-sixteenth division of bandwidth before the complexity of the conversion terminal equipment becomes so excessive as to cancel out the consequent economies in the system itself. So far as public t.v. broadcasting is concerned, it is considered that it would be better to wait until this greater reduction in bandwidth is attained rather than to take immediate advantage of the simple Half-Bandwidth process currently available.

The situation in the immediate future is complicated by the fact that the Half-Bandwidth system presents the promise of considerable savings to the telecommunications industry (both message-handling radio and line) and development by this industry of practicable Half-Bandwidth terminal converters is already well in hand. Because of this development offshoot, test transmissions of a 405 line Half-Bandwidth system are already being made in the London area on u.h.f. at 725.3 Mc/s, the transmitter being sited such that reception should be possible in most parts of the Home Counties. The writer, who has himself picked up these signals at his home in Ponders End, can pass on the information that the Half-Bandwidth signal, without conversion to full bandwidth, can still be synchronised on most receivers having line flywheel sync circuits, but that there may be evidence of apparent phase modulation or "line jitter." Without a Half-Bandwidth converter at the receiver, the picture itself is very fuzzy and indistinct, although simple captions, etc., can usually be picked out. Due to the relatively long length of the frame sync pulse, even in the Half-Bandwidth signal, frame synchronising appears to be feasible with most sets, although occasional adjustments to the frame hold control might be needed from time to time. All these shortcomings would, of course, be absent if the receiver were fitted with a Half-Bandwidth terminal converter.

Principles

The principle of operation of the Half-Bandwidth system is fairly simple, and can be readily understood by anyone who is familiar with the basics of radio theory.

Fig. 1 gives a block layout for a typical Half-Bandwidth dividing network, as would be employed for converting a 405 line television signal to an overall bandwidth of 1½ Mc/s, before application to a land line or transmitter modulator. The signal applied, in Fig. 1, to the dividing equipment consists of conventional 405 line video information and, as such, has component parts whose frequencies may vary within the limits 0–3 Mc/s.

This incoming signal is first of all split up into six "Trigger Frequency Bands," these extending over the following ranges: 0 to 0.5 Mc/s, 0.5 to 1 Mc/s, 1 to 1.5 Mc/s, 1.5 to 2 Mc/s, 2 to 2.5 Mc/s, and 2.5 to 3 Mc/s. This splitting into Trigger Frequency Bands is carried out by tuned filter combinations, the responses of which have extremely steep skirts at their outside edges. In practice, the edges of each Trigger Band response are slightly removed from the round figures just quoted, this being done to ensure that the changeover frequency between one filter and the next appears at a point in the video spectrum where there is little video information. (The subcarrier of a colour television transmission is similarly positioned at a point of little video information.) Specifications for the actual frequency edges of the Trigger Band tuned filter edges have not as yet been released for publication.

The input television signal, after application to the trigger tuned filters, becomes split up into a number of frequencies within the range of the individual sections. It must be noted at this point that the Trigger Selectors not only select frequencies within their own particular ranges, but that they also develop individual control voltages which change from 10 volts negative to 10 volts positive (relative to earth) during the time that they pass a signal within their band of frequencies. These control voltages are applied to gating valves later on in the system.

The six separate bands of trigger frequencies are next applied to the first "D.T.C." section. D.T.C. stands for Damped Tuned Circuit, and this section employs tuned circuits which set up damped trains of oscillations at whatever frequency is fed to them. The whole purpose of this section is that of ensuring that a train of oscillations is fed to the next part of the system and that its frequency follows that of any cycle, or part of a cycle, passing through the Trigger Frequency tuned filters. In Fig. 1 the damped tuned circuit section is shown, in simplified form, as a number of L-C combinations. In practice, the D.T.C. section is much more complex, a very large number of components being employed, especially in the 0 to 0.5 Mc/s range.

The next part of the Half-Bandwidth process consists of dividing the trigger frequency by a scale of 2:1. It might at first sight be thought that this could be carried out by the conventional multivibrator type of divider, but such is not the case. The reason for this is that a simple multivibrator divider requires at least one cycle of its control frequency before it can run at the division frequency, and the amount of time taken up by complete cycles from the first D.T.C. section would be excessive. In consequence, each trigger frequency is initially *multiplied* by a factor of 9 before being applied to the multivibrator dividers, it being assumed that these dividers will then always respond to a new frequency after a time equivalent to one-ninth of the cycle being divided. The multiplication process is achieved by conventional harmonic generation, the multipliers in each band containing two distortion amplifiers in cascade which work under conditions giving rise to strong third harmonic distortion. Simple tuned filters between the first and second distortion amplifiers, and between the second distortion amplifier and the output, ensure that the correct band of harmonics is selected.

The frequency division section which follows employs conventional dividers, these working in the factors $\frac{1}{3}$, $\frac{1}{2}$ and $\frac{1}{3}$, and giving a total of one-eighteenth division of the signal which was previously multiplied 9 times. The output from the multivibrators is, therefore, one-half of the original Trigger Frequency.

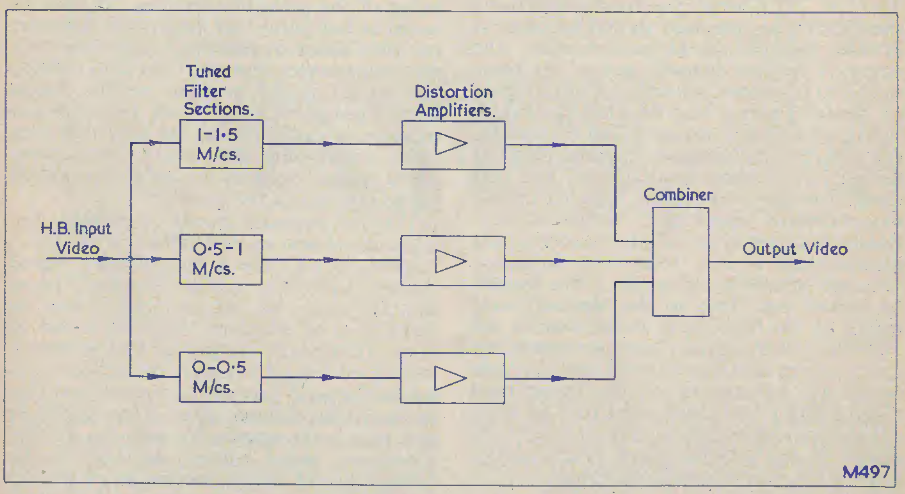

Fig. 2. The relatively simple conversion equipment needed at the receiving end of a Half-Bandwidth system. Such equipment would be required to ensure true reproduction of the Half-Bandwidth test transmissions on u.h.f.

Since the output from the dividing section consists of waveforms which are largely square in character, these are brought back to approximate sine wave shape by passing through the second D.T.C. section, this being similar to that which succeeded the Trigger Frequency selector section. In consequence the output from each band in the second D.T.C. section contains further damped oscillations whose frequencies are one-half of those which were applied to the multiplying section. Only that part of the half-frequency information which corresponds in time to the existence of the original fundamental frequency is required in the final signal, and the outputs from the second D.T.C. section are applied to gating valves. These valves pass signals only during the time that the original frequencies are applied to the Trigger tuned filter section, gating being effected by the control voltages, mentioned above, obtained from that section. As a result the half-frequency signals appear in the output for the same periods of time as do their full-frequency counterparts. The six half-frequency outputs are finally fed to a combiner, after which they are ready for application to the subsequent land line or transmitter modulator.

Receiver Circuits

As will have been gathered, the operation of dividing the video signal at the transmission end involves the use of a large amount of equipment. At the receiving end far less processing is needed.

A typical Half-Bandwidth multiplying converter for use at the receiver end of a land line or broadcast transmitter-receiver system is illustrated in Fig. 2. The processes involved here are quite simple and might not be beyond the capabilities of the more experienced home-constructor who is prepared to carry out the experimental work required.

In Fig. 2 the Half-Bandwidth signal is first of all applied to a tuned filter section. This tuned filter section is similar to that which provided the Trigger Frequencies in Fig. 1. The three bands of frequencies from the tuned filter section are next applied to three multipliers, these consisting of distortion amplifiers having a high second harmonic content in their output. The correct harmonics are selected by harmonic tuned filters, and these are then finally combined to form the original full-bandwidth 3 Mc/s signal.

As was stated above, it is possible for the keener experimenter to take advantage of the present u.h.f. transmissions if he feels himself competent to construct his own multiplier equipment. The writer would, in fact, be extremely interested to hear from anyone who has success with experiments in the reception of Half-Bandwidth signals, and would sincerely like to wish any person making the attempt the best of luck.

Acknowledgments

Grateful acknowledgments are due to Mr. F. Spon, Press Officer for Cavil Telecommunications Ltd., who has provided the writer with much assistance in the preparation of the material for this article.

Appendix

The fact that an information transmission system is capable of being operated under Half-Bandwidth conditions can be shown in the following manner.

Let us assume that the bandwidth of a conventional communications system is equal to C Mc/s, and that the bandwidth of a signal which is applied to it is S Mc/s. Then, under normal conditions, successful transmission will occur when

$$C = S \quad . \; . \; . \; (1)$$

However, if C is equal to S we can then say

$$C^2 = SC$$
$$\therefore C^2 - S^2 = SC - S^2$$
$$\therefore (C-S)(C+S) = S(C-S)$$
$$C+S = S \quad . \; . \; . \; (2)$$

We have already assumed (1) that S is equal to C, so we may now state, from (2), that

$$C+C = S$$
$$\therefore C = \tfrac{1}{2}S$$

Or, in other words, that the bandwidth of the communication system need only be half that of the signal applied to it.

This calculation is of especial interest insofar that an alternative result may be obtained from (2).

Thus: if $C+S=S$
then $C=0$,

in which case not only have we reduced the bandwidth of the transmission system to zero but we have also entirely eliminated the signal itself. Such findings, incidentally, are very liable to occur when the differential calculus is employed, in which case the reader is strongly advised to differentiate against the seasonal term:

APRIL FOOL

The "Communications" Pre-Selector

(*continued from page* 652)

ment is quicker with the aid of a signal generator but the net result is the same. Incidentally, it should be pointed out that, when a signal generator is employed, it is preferable to insert a condenser of approximately 100pF between its "hot" output lead and the aerial input socket of the preselector in order to approximate to the loading given by an average aerial.

Operation

Although the operation of the preselector is extremely simple, a few words on this subject may not be out of place in conclusion.

When it is desired to select a signal at any particular frequency, both the receiver and the preselector, the latter being set to maximum gain, should be adjusted approximately to that frequency. It will be found that, even when slightly off tune, the preselector still allows quite an adequate amount of signal energy to be fed to the receiver, this being in many cases sufficient for initial searching. It is, in any event, quite a simple matter to keep the preselector exactly in step with the receiver, due to the rise in background level which is given as the former passes through resonance. After the required signal has been found the preselector is tuned for optimum level, final settings being made by adjusting the aerial trimmer. It may, in a number of cases, be necessary to reduce preselector gain in order to prevent overloading in the receiver, or to eliminate "cross-modulation" effects from a strong local transmitter.

TUNING METERS and INDICATORS

By F. G. RAYER

Correct tuning can be much simplified by fitting some form of visual indicator, and such a device may be added to any ordinary superhet. With such receivers, the action of the a.v.c. circuit tends to flatten the audio output, while the ear cannot distinguish small changes in volume. For these reasons, the visual indicator gives a much more rapid and accurate means of tuning.

If a meter is employed, it will also show relative signal strengths. Any improvement in signal strength, due to increased efficiency in the aerial or earth system, will be immediately visible. Correct alignment throughout the receiver can also be checked with the tuning meter or indicator, which will allow all circuits to be peaked for maximum gain. The meter will also be useful if a panel trimmer is fitted (as may be the case when maximum possible efficiency is required) as it will indicate exactly when resonance is achieved.

Such indicators are in some way controlled by the a.v.c. system. This means that they can be used with ordinary superhets, both mains and battery operated, but cannot be used with t.r.f. receivers having no automatic volume control circuit.

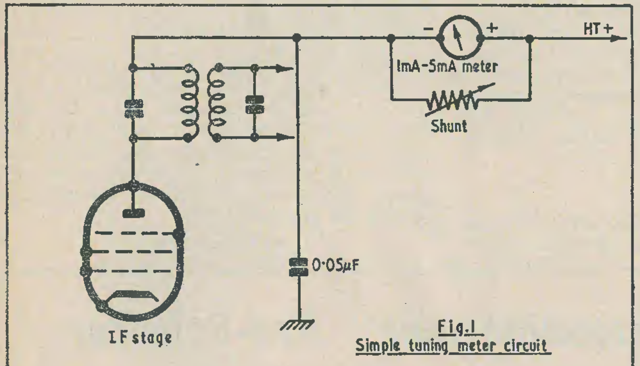

Fig.1
Simple tuning meter circuit

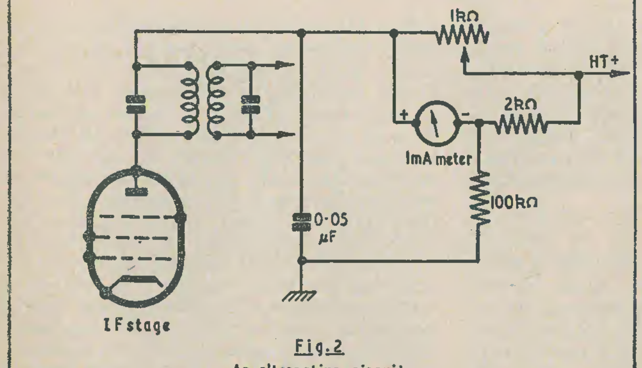

Fig.2
An alternative circuit

Meter Circuits

A meter is probably the most accurate and sensitive type of indicator, as signal strengths can be read against a scale fitted to it. One simple method, very satisfactory in practice, consists of wiring the meter in series with the anode circuit of an a.v.c. operated i.f. stage, as in Fig. 1. With no station tuned in, the meter will indicate a fairly high anode current. This current drops as a station is tuned in, minimum current reading being the correct tuning position. The extent to which the pointer falls back will also depend upon the signal input to the receiver (that is, transmitter power, aerial efficiency, etc.).

If the meter has a full-scale deflection of *less* than the no-signal anode current, a variable shunt may be fitted, as shown. This shunt is adjusted until the meter reads exactly full-scale, when no signal is being received. For most meters, a 100 ohm wire-wound variable or pre-set resistor will be suitable, though this naturally depends on the actual anode current, and meter. Mains valves such as the 6K7 will pass about 10mA, with no signal; most battery valves will pass about 2mA to 4mA.

A meter with a full-scale reading greater than the no-signal anode current of the valve may be used. But no shunt will be required, and it will not be possible to adjust the meter so that it indicates full scale, with no signal.

A 2in diameter meter will usually do well, and it is best to be of the flush-mounting type. The 0.05μF condenser is merely for by-pass purposes.

Fig. 2 shows a circuit which is similarly operated by the i.f. stage, but which works in the reverse direction to that in Fig. 1. That is, the meter rests at zero, for no signal, rising across the scale in proportion to signal strength.

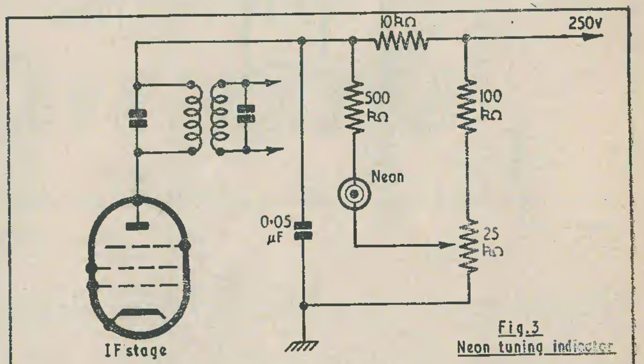

Fig.3
Neon tuning indicator

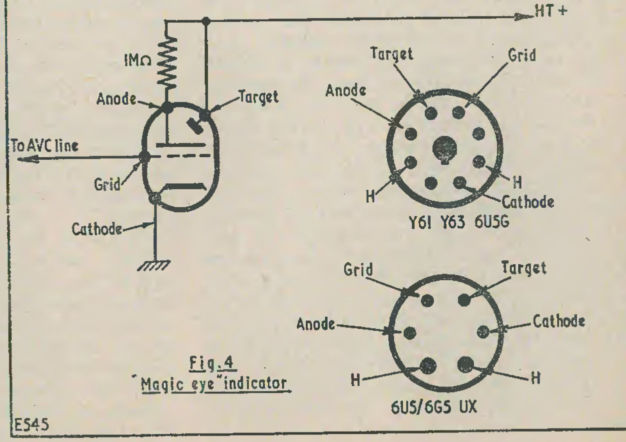

Fig.4
"Magic eye" indicator

With no signal tuned in, the 1kΩ potentiometer or resistor is adjusted until an equal voltage is applied to each terminal of the meter. This is the zero signal adjustment, and the potentiometer can then be left untouched. As anode current falls (station tuned in) reduced voltage drop in the 1kΩ resistor allows the positive terminal of the meter to become more positive. By using a sensitive meter, with variable shunt, conditions can be so adjusted that the meter reads full scale with the most powerfully received local station. Control over the deflection obtained with a given signal may also be achieved by using a 2kΩ potentiometer instead of the 2kΩ fixed resistor shown.

If the meter has a scale reading from 0 to 1.0 (or 0 to 1mA) this will often prove suitable. Or a signal strength scale, numbered from 1 to 9, may be fitted. If so, it must be remembered that delayed a.v.c. will give no indication with very weak signals, as described later.

Neon Indicator

This requires very little panel space indeed, and will give quite a good indication with local stations, especially with a receiver having a strong a.v.c. action. As shown in Fig. 3, the neon is wired from the anode side of a 10kΩ resistor. The 25kΩ potentiometer is adjusted so that the neon *just* fails to strike, with no signal. When a station is tuned in, the voltage drop across the 10kΩ resistor falls, increasing the voltage across the neon. It thus commences to glow, maximum glow being achieved when the station is correctly tuned (anode current at minimum). An Osram Button Tuneon can be used in this way, though some ex-service neon bulbs are satisfactory. The available h.t. voltage must exceed the neon striking voltage, so that the circuit is unsuitable for battery receivers.

It is worth trying the effect of modifying the value of the 10kΩ resistor. Very high values will cause excessive voltage drop, so that some loss of amplification arises. Low values, on the other hand, will make the indicator circuit rather insensitive. Values over 10kΩ are not normally required, this being about the maximum, especially with mains valves. Indeed, if the anode current is fairly heavy, the value can be reduced to some 2kΩ or so. The 500kΩ resistor merely limits the neon current, and must not be omitted, though its value is not critical.

"Magic Eye" Indicators

These are well known, and magic eye tuning indicators can often be obtained quite cheaply. A suitable circuit is shown in Fig. 4. The eye will not normally require more than about 5mA h.t. with 0.3A for the heater, and this should be available without any danger of overloading. If, however, heater current is not available, it may be possible to remove a dial light, or use low consumption bulbs. (This does not, of course, apply to a.c./d.c. circuits, where a 0.3A heater can be wired in series with other 0.3A valves.)

A 250V h.t. supply is often employed. Some control over the sensitivity of the eye can be achieved by modification of the 1MΩ resistor, or by reducing the h.t. voltage applied to the eye. As the h.t. voltage is reduced, sensitivity increases. With a given eye, for example, 22V bias is required for zero shadow angle, with a 250V supply, but falls to only 8V with a 100V supply. Lower h.t. voltages may readily be obtained from a potential-divider network in parallel with the h.t. supply.

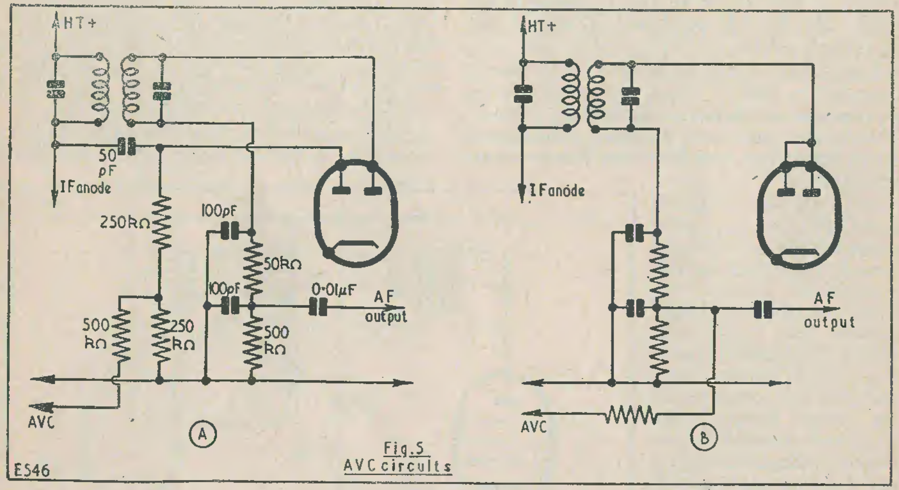

Fig. 5
AVC circuits

Pin connections for some popular eyes are given in Fig. 4, and the eye should be so mounted that its top appears in an aperture or window in the panel. If the eye is insufficiently sensitive, an improvement can be achieved as explained. If it is too sensitive so that complete overlapping readily arises, its grid can be fed from a potential divider consisting of two resistors in series, from a.v.c. line to chassis. The results obtained will depend on the type of eye, and receiver.

The A.V.C. Action

Simple receivers of the F.C.-I.F.-D.D.T. type usually have a delay bias applied so that the a.v.c. system does not operate on very weak signals. This delay is usually caused by the cathode bias used in the d.d.t. stage, which results in the cathode being positive with respect to the chassis. As a result, the meter or indicator will only come into operation when signal strength exceeds a certain level. This is frequently no great disadvantage, and may often be ignored. If, however, the indicator is to be as sensitive as possible, then the delay voltage must be removed.

This can be done by eliminating the cathode bias resistor and condenser, obtaining bias by using a leak of 8 to 10MΩ. (The bias components should not be removed without increasing the leak value.) Or, if this is undesirable, a separate double-diode may be used for detection and a.v.c. with a triode for a.f. amplification.

Such a modification will cause some reduction in volume, due to the increased efficiency of the a.v.c. action. It is thus most suitable for receivers having an r.f. stage, or two i.f. stages, at least.

In some cases, the a.v.c. voltage is taken from the junction of two resistors, as at "A" in Fig. 5. The actual a.v.c. voltage is thus lower than the voltage at the a.v.c. diode. In such cases, it may be worth while taking the a.v.c. voltage for one stage, or for a tuning eye, from the diode itself, adding a series resistor of about 500kΩ in circuit. This will give maximum a.v.c. action for the eye or important i.f. stage, leaving other stages operating normally.

"A" in Fig. 5 also shows a usual circuit with one diode employed for a.v.c. and the other for detection. With most i.f. transformers, trimming or aligning the final secondary will cause a slight fall in a.v.c. efficiency, due to the increased signal taken by the secondary at resonance. This can be overcome by using the circuit shown at "B." With this arrangement, the final secondary may be aligned in such a manner as to produce maximum a.v.c. action, or appropriate indication on the meter or eye.

A tuning meter, in particular, will give such a good indication of alignment that it is worth checking this, after adding circuits such as those in Figs. 1 and 2. A fairly strong signal should be tuned in, and alignment checked upon the meter, which will show any improvement. When maximum sensitivity and selectivity are required, all i.f. stages should be peaked for maximum signal. But for maximum quality, especially with more than one i.f. stage, the transformers should be slightly "staggered" to give a wider band-width.

TRANSMITTING

A Simple VALVE KEYER

By E. H. TROWELL, G2HKU

THE KEYING OF A C.W. TRANSMITTER IS A relatively simple operation, be it screen, grid block, or cathode, but the results obtained vary enormously as is only too apparent on any amateur band. The shaping of the keying waveform is sometimes left to chance, or an r.f. choke and a condenser hopefully connected at the key contacts and any clicks or chirps blamed on receiver overload.

A valve keyer offers a cheap and effective means of keying when correctly adjusted and installed. It leaves nothing to chance and produces clickless keying without chirp or "wooliness," provided that the stages following the keyed stage (if any) are operating correctly.

Circuit

In Fig. 1 it will be seen that a negative bias voltage is applied to the grid of the triode-connected 6L6 after passing through a filter network. This bias voltage is variable by means of R_2 and is set so that the 6L6 is completely cut off when the key is open. R_3 and C_2 determine the keying waveform and may be varied to suit the transmitter in use.

Construction

There is nothing critical in the construction of the keyer, which may be built in any convenient form. The writer uses his bolted to the side of an Electronic Key on a small vertical chassis to save bench space. The live lead to the key should be well insulated; and if more than one 6L6 is used, as explained below, a transformer with a heavier heater current will be required.

Operation

The keyer may only be used in the cathode of the keyed stage, and a 6L6 is used as a triode in order to obtain a low impedance. If a heavy current is to be handled another 6L6 may be connected in parallel. There is a voltage drop across the keyer valve and this will result in a small drop in the anode voltage of the keyed stage. If a further 6L6 is connected in parallel this will decrease the voltage drop, and it follows that the smaller the current that the keyer valve is called upon to handle, the smaller will be the voltage drop at the anode of the keyed stage. Hence it is a sound policy to key the cathode of an early stage in the transmitter, say the buffer stage following the crystal or v.f.o. However, the stage to be keyed may be left to the operator's choice, as this valve keyer will key the p.a. stage, if required.

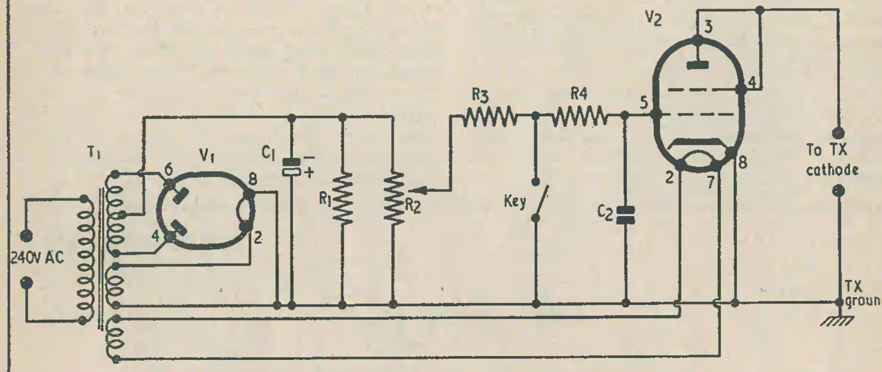

Fig.1
A simple valve keyer

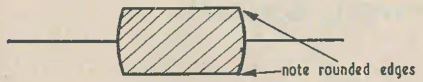

Fig.2
Ideal keying waveform

Fig.3
Incorrect keying waveform

Component List

R_1	220kΩ 1W	C_1	8μF 350V wkg.
R_2	50kΩ 5W	C_2	0.001 μF
R_3	1MΩ ½W	V_1	5Y3
R_4	470kΩ ½W	V_2	6L6
T_1	250–0–250V 60mA, 5V 2A, 6.3V 1.5A		

Adjustment

Select the stage to be keyed and connect the keyer in its cathode, making sure that the keyer ground is connected to the transmitter ground. Switch on the transmitter, using an artificial aerial or dummy load to avoid causing interference to other stations, and with the key open adjust R_2 until the 6L6 is cut off and the transmitter silent. Tune the receiver to the transmitter frequency, preferably without an aerial to avoid overload, and key the transmitter. Listen carefully to the note, making sure that there are no clicks or thumps as the key is pressed or released. Only a breathing noise should be heard on the receiver at any point other than the transmitter frequency. If this is not so, then R_3 and C_2 may be increased in value and adjusted until the correct keying note is obtained. If an oscilloscope is available, a parallel-tuned circuit consisting of a coil and variable condenser tuned to the transmitter frequency plus an r.f. pick-up loop may be connected to the Y plates. R_3 and C_2 may then be adjusted to conform to the ideal keying waveform as shown in Fig. 2, with the X plates synchronised to scan at the transmitter keying speed. Sharp edges as in Fig. 3 must be avoided, as they will result in hard keying with pronounced clicks causing severe interference over a wide range of frequencies.

Technical Forum

The Measurement of Transients

Last month in these pages we discussed the importance of limiting the values of peak currents and voltages in radio and television equipment in order to lengthen component life. This month we are describing practical methods of measuring these peak parameters using apparatus which quite a number of the more serious constructors will have available. Because of the wide range of circuit impedances and waveforms which are encountered it is not feasible to make a universal direct reading ammeter or voltmeter, and the measurements are thus normally made with the aid of a sensitive valve voltmeter or an oscilloscope. Whichever instrument is used, it does not have to be one of those expensive precision-made jobs but a relatively simple one of the type described in *The Radio Constructor* from time to time.

Voltage Measurement

When making measurements of any type, one very important requirement must always be borne in mind—the inclusion of the instrument in the circuit must not seriously alter its working conditions. For example, it can easily happen that a voltmeter connected across a high impedance circuit will introduce damping and reduce the voltage present. The meter will read the lower voltage, but as soon as it is removed the conditions will return to the normal higher value. Thus an incorrect reading will have been made. The method of making a measurement will depend to some extent upon the value of the voltage in question. Should it be in excess of 500V, as may occur in television line timebases, an e.h.t. rectifier valve in conjunction with an electrostatic voltmeter provides the best solution. These e.h.t. diodes (EY51, EY86, etc.) have a low shunt capacitance and do not offer much damping to the circuit. The anode of the valve should be connected by a very short lead to the reading point, its heater supply being provided by a 6V dry battery.

During measurement the battery will be raised to the high potential being measured and it must, therefore, be suitably insulated, preferably with polythene sheet. The general arrangement is shown in Fig. 1.

To measure voltages below 500V a valve voltmeter fitted with a diode probe is most suitable, but if not available an oscilloscope can often be used provided the input leads are kept very short. Either instrument is, for example, suitable for taking measurement in the timebase oscillators and video stages of a television set. The majority of diode probes use a thermionic diode which is non-reversible, so that they are only suitable for the measurement of positive-going peak voltages; for negative-going measurements the oscilloscope should be employed. The oscilloscope must also be used for transient voltages because the mechanical inertia of a meter needle does not allow it to follow a single fast pulse.

When using a 'scope as a voltage measuring instrument it is necessary for it to be accurately calibrated; that is, one must know the amount of deflection of the trace for a given input voltage. For voltages between 10V and 1kV the direct Y plate input terminals should be used, although measurement of the higher values will involve the use of a resistive attenuator. A little care is required in selecting suitable values for the individual resistors which comprise the attenuator. It is important to use values which are sufficiently high to prevent undue damping of the circuit under measurement, but also the values must be selected to give the required ratio, bearing in mind the input resistance of the oscilloscope. This will be clarified by considering a practical example. Suppose the oscilloscope has an input resistance of 5MΩ and that it is planned to measure a voltage of about 60V in a circuit of 1MΩ impedance. In this case a 3 to 1 reduction in voltage will give a good display on the 'scope and this is obtained by using two 5MΩ resistors as shown in Fig. 2. The upper limb of the potential divider consists simply of R_1, whilst the lower limb is R_2 with the input resistance of the oscilloscope in parallel with it. As both of these components have a resistance of 5MΩ the effective value for the lower limb is 2.5MΩ. In this way a third of the voltage to be measured across R_3 is fed to the oscilloscope, and thus the reading obtained by measuring the trace height on the tube must be multiplied by 3.

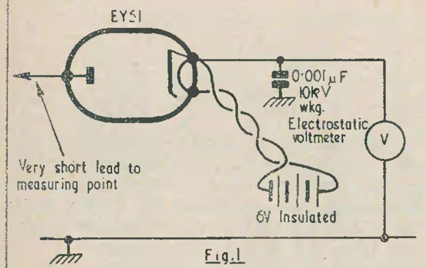

Fig.1

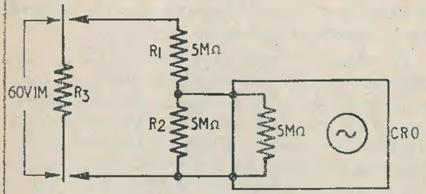

Fig.2

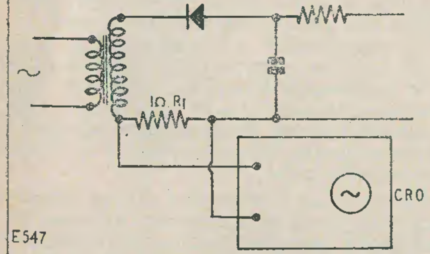

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Fig.3
Measurement of current wave-form & peak current in a rectifier circuit

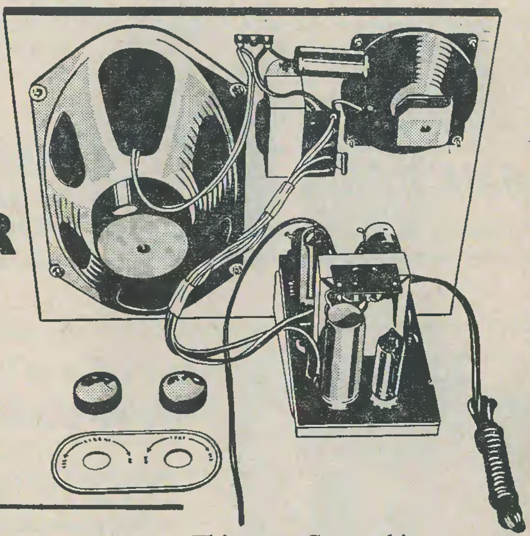
Current Measurement

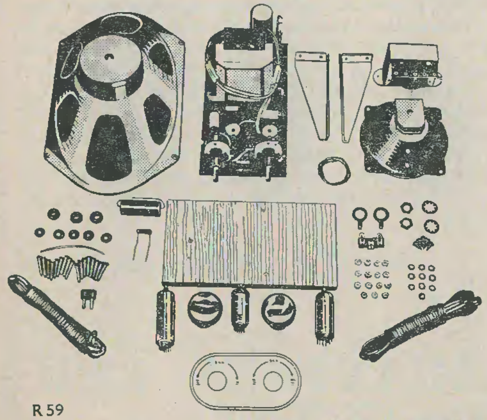
Let us now consider the procedure involved in the measurement of peak or surge currents. Here the basic arrangement is to add a small value resistor into the circuit under measurement and with the aid of an oscilloscope to measure the voltage appearing across the resistor. Then by the use of Ohm's Law the peak value of current may be obtained by using the peak voltage reading in the calculation. As before, some care is necessary in selecting a value for the resistor used in the measurement, as its inclusion in the circuit should in no way modify the normal operation. By way of an example, consider the problem of measuring the peak rectifier current in the half-wave circuit shown in Fig. 3. The measuring resistance must be added in series with the rectifier circuit, and in order that the 'scope may be connected to the common earth line a suitable position for the resistor is R_1. The use of a common earth is always an advantage when employing an oscilloscope, as it avoids the possibility of unwanted pick-up on the leads. As the peak current in the circuit will be well in excess of 100mA a 1 Ω resistor will be suitable. The waveform displayed on the c.r.o. will, of course, be that of the current flowing in the circuit.

Exactly the same procedure may be adopted when measuring the peak cathode current of valves, or the surge current in a switched circuit at the instant the switch is opened, or closed. When dealing with transients of this nature an oscilloscope fitted with a long persistence tube is an advantage, but is by no means essential. The low value resistor used in the test may be made up of a number of standard carbon resistors in parallel, or it may be constructed of resistance wire. In the latter case the wire must be non-inductively wound on the former to avoid any false reading being obtained.

Calibration of C.R.O.

The accuracy of a measurement depends largely upon the accuracy of the c.r.o. calibration. This is conveniently checked by feeding a 6.3V 50 c/s sine wave, or some fraction of it, into the 'scope when it is functioning under the conditions used in the test; that is, with the same settings of the gain control, etc. The 6.3V may be checked by a standard voltmeter reading r.m.s. values and the peak-to-peak deflection of the trace will then equal 2.8×6.3=17.6 volts. By measuring the height of the trace, the sensitivity in millimetres per volt can then be obtained.





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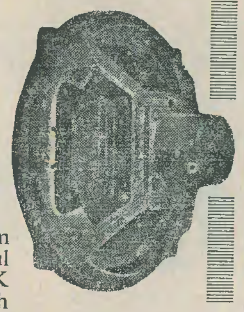

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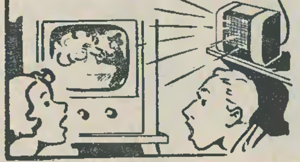

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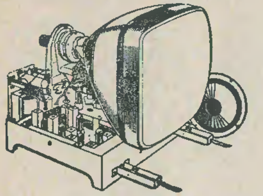

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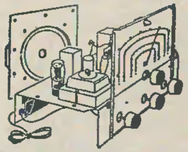

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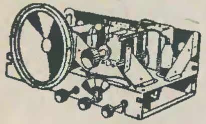

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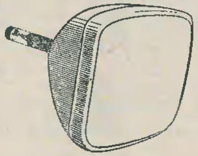

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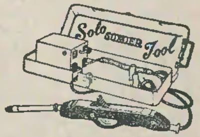

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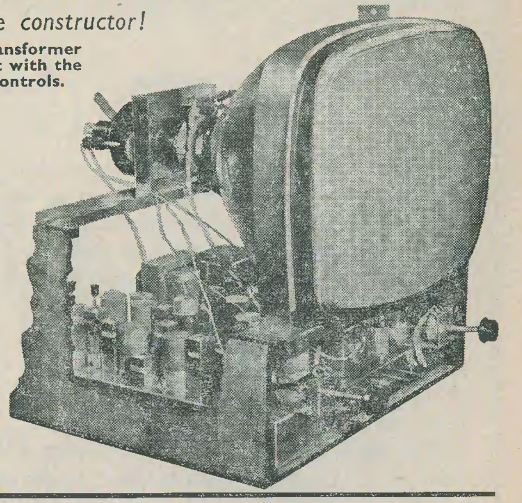

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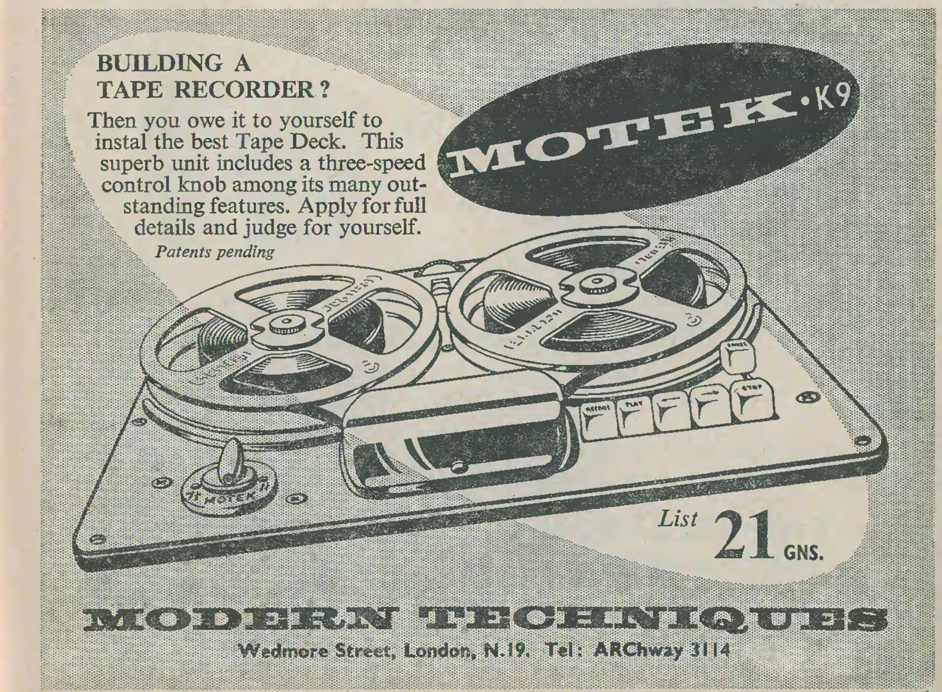

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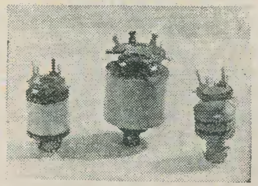

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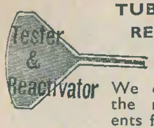
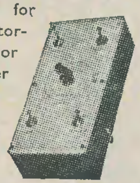


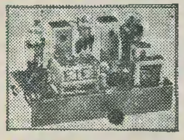
We can supply all the main components for making this unit which will not only test cathode ray tubes but also will reactivate them. Supplied complete with full instructions. Price **£3**, plus 2/6 post and ins.

TRANSISTOR TIMER



All the parts for making transistorised Enlarging or Process Timer with constructional details. **£2.10.0**, plus 2/6 post and packing

BEGINNER'S SUPERHET



All the components including metal chassis, valves, metal rectifier, coils, tuning condenser, etc., required to build the "Beginner's Superhet" as described in the January issue, are available as a parcel. Price **£3** plus 3/– post and ins.

CONDENSER TESTER AND REACTIVATOR

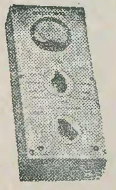
This unit tests condensers under correct working conditions at proper voltages. It can also be used for "reforming" electrolytics. All basic parts and full instructions, **50**/–, plus 2/6 post and ins.

BAND III CONVERTER

Suitable Wales, London, Midlands, North, Scotland, etc. All the parts including 2 EF80 valves, coils, fine tuner, contrast control, condensers and resistors. (Metal case available as an extra.) Price only **19/6**, plus 2/6 post and ins. Data free with parts or available separately 1/6

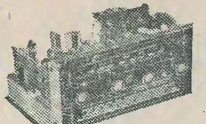
A.C./D.C. MULTIMETER KIT

15 Basic Ranges



Measures a.c./d.c. volts, d.c. current and ohms. All the essential parts including metal case, 2″ moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions. Price **19/6** plus 2/6 post and insurance.

AM/FM CHASSIS



Made by the famous McCarthy Radio. This employs a printed circuit in the f.m. tuner section, it uses 8 valves and has a very attractive three-colour dial, size approximately 12″ x $5\frac{1}{2}$″, covers four wavebands: 1,000–2,000m, 200–550 m, 15–50 m, and 88–100 Mc/s. This is a precision made chassis with four controls, tuner, volume, wave change and tone. Fully guaranteed—price **£22.10.0**, post and insurance 5/–

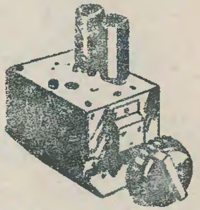
19 RANGE TESTMETER

Can be yours for only 10/– deposit and 19 payments of 10/– weekly. Like all AVO meters it is a very fine instrument; it has a sensitivity of 10,000 ohms per volt and 19 most useful ranges as follows: d.c. volts 0–1,000 (7 ranges), a.c. volts 0–1,000 (5 ranges), d.c. current 0–1 amp (5 ranges), resistance 0–2 megs (2 ranges) (complete with test leads). Immediate delivery. Cash price **£9.10.0.**

Non-callers please add 3/6 post and insurance.

FREE GIFT.—All purchasers of the above item this month will receive the M.M. Range Extender which adds capacity 0.1μF in two ranges, inductance 0–100 henrys and decibel – 20 to +36

NOW TWO MODELS TURRET TUNER

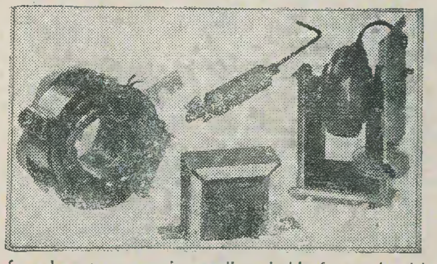


Brand new stock, not surplus, with coils for Band I and III, complete with valves. Model 1: I.F. output 33/38 Mc/s, series heaters. Model 2: I.F. output 16–19 Mc/s, parallel heaters with instructions and circuit diagram, **79/6.** With knobs **3/6** extra, post and insurance 2/6

THIS MONTH'S SNIP

A 10-valve unit complete with valves, unused in original packing case, for only **19/6**, plus 7/6 carriage and insurance. This unit, the R1135, contains a famous i.f. strip which is usable almost without modifications for television. It is in fact an i.f. amplifier for the r.f. units 24, 25, 26, 27, etc. Data is available showing how to make a television. Contains valves, transformers, coils, pot-meters, etc. Bargain not to be missed.

FOUR ITEMS FOR THE PRICE OF ONE



This set of modern t.v. parts is equally suitable for modernising an old televisor or for building into a new one. Suitable for wide angle 14″ or 17″ tubes using e.h.t. or 12-14kV. The four items comprise: (1) line output e.h.t. transformer; (2) 70° scanning coils on ferrite yokes; (3) width control with ferrite core; (4) frame output transformer. With these parts we also give free, complete circuit diagram of modern televisor which uses them. We offer the whole lot at the price of the line output transformer only, namely **57/6** plus 2/6 post and insurance.

ELECTRONIC PRECISION EQUIPMENT LTD

For prompt attention post orders should be sent to our Eastbourne address marked Dept. 7

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BAND 3 TV CONVERTER

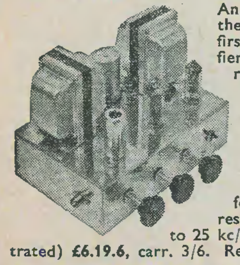
185 Mc/s—199 Mc/s

Suitable London, Birmingham, Northern and Scottish ITA Transmissions

Mk. 2 Model. Latest Cascode circuit using ECC84 and EF80 valves giving improved sensitivity (12 db) over standard circuits, built-in power supply a.c. 200-250V. Dimensions only $6\frac{1}{2}$″ x 3″, ht. 4″. Simple and easy to fit—only external plug-in connections. Wired, aligned and tested ready for use. State channel required. Guaranteed. Bargain offer—good results or full refund, only **£3.19.6.** Carr. and pkg. 2/6

CONVERTER ACCESSORIES. Band 1–Band 3 Cross-over Unit, **7/6.** Var. attenuators 6 db–36 db, **6/9** BBC pattern filter, **8/6.** Band 3 aerials—outside single. dipole with 4 yds coax., **13/9.** 3-element beam, **27/6.** 5-element, **35**/–, etc., etc.

MULLARD "3-3" QUALITY AMPLIFIER



An ideal companion unit to the JASON Tuner. A really first-class 3-valve 3W Amplifier giving hi-fi quality at a reasonable cost. Mullard's latest circuit. Valve line-up: EF86, EL84, EZ81. Extra h.t. and l.t. available for Tuner Unit addition. Variable treble cut and bass boost controls, sensitivity 100mV for 3W output. Frequency response + or — 1db, 40 c/s to 25 kc/s. Complete kit (as illustrated) **£6.19.6**, carr. 3/6. Ready built **8 gns.**

FM TUNER-UNIT (87 Mc/s–105 Mc/s) by **Jason.** Designer Approved Kit of Parts for only **5 gns,** post free. Set of 4 spec. valves **30**/–, post free. Illustrated handbook with full details, **2**/–, post free. 48-hr alignment service, **7/6**, p. & p 2/–

CONDENSERS. Mica or S. Mica. All pref. values. 3pF to 680pF, **6d.** each. Ceramic types, 2.2pF to 5,000pF, **9d.** each. Tubulars, 450V, Hunts and T.C.C. 0.0005, 0.001, 0.005, 0.01 and 0.1, 350V, **9d.**; 0.02, 0.05, 0.1, 500V Hunts, T.C.C., **1**/–; 0.25 Hunts, **1/6**; 0.5 Hunts, **1/9**; 0.001 6kV T.C.C., **5/6**; 0.001 20kV T.C.C., **9/6**

TRANSISTORS. Mfrs. surplus PNP junction type. **Audio Type,** 800 kc/s 250mW, **9/6**; **R.F. and L.O. Mixer Type,** 2.5 Mc/s, **19/6.** All tested and guaranteed

TRANSISTOR COMPONENTS. Midget i.f. transf., 315 kc/s, **5**/–; Ferrite Slab Aerial (dual range), **13/6**; M. and L.W. Osc. and 1st I.F., **11/6**; Push-pull interstage transf., **8/6**; Push-pull output transf., **8**/–; M/coil phone inserts dia. 2″, **4/6**; M/1 dynamic inserts dia. $1\frac{1}{8}$″, **3/9**

RESISTORS. Pref. values 10 ohms 10 megohms, 20% tol., $\frac{1}{4}$W, **3d.**; $\frac{1}{2}$W, **5d.**; 1W, **6d.**; 2W, **9d.**; 10% tol., $\frac{1}{2}$W, **9d.**; 5% tol., $\frac{1}{2}$W, **1**/–; 1% h-stab, $\frac{1}{2}$W, **2**/–

PRE-SET W/W POTS. TV knurled slotted knob type. 25 ohms to 30,000 ohms, **3**/–; 50,000 ohms, **4**/–; 50,000 ohms to 2 Megohms (carbon), **3**/–

S.T.C. RECTIFIERS. E.H.T. types, K3/25 2kV, **5**/–; K3/40 3.2kV, **6/9**; K3/45 3.6kV, **7/3**; K3/50 4kV, **7/9**; K3/100 8kV, **13/6**, etc. Mains types: RM1, 125V 60mA, **4/9**; RM2 125V 100mA, **5/6**; RM3 125V 120mA, **7/6**; RM4 250V 250mA, **16**/–; RM4B type 250V 275mA, **17/6**, etc.

LOUDSPEAKERS. P.M. 3 ohm, $2\frac{1}{2}$″ Elac, **16/6**; $3\frac{1}{2}$″ Goodmans, **18/6**; 5″ R. & A., **17/6**; 6″ Celes., **18/6**; 7″ x 4″ Goodmans, **18/6**; 8″ Rola, **20**/–; 10″ R. & A., **25**/–

SPEAKER FRET. Expanded bronze anodised metal: 8″ x 8″, **2/3**; 12″ x 8″, **3**/–; 12″ x 12″, **4/3**; 12″ x 16″, **6**/–; 24″ x 12″, **8/6**, etc. **TYGAN FRET** (Murphy pattern): 12″ x 12″, **2**/–; 12″ x 18″, **3**/–; 12″ x 24″, **4**/–, etc.

RECORD PLAYER CABINETS

Contemporary style rexine covered cabinet in two-tone grey and green. Size $18\frac{1}{4}$″ x $13\frac{1}{2}$″ x ht. $8\frac{1}{4}$″, fitted with all accessories, including speaker baffle board and plastic fret. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14″ x 13″. Cut mounting boards available.

Cabinet Price **£3.3.0** Carr. and ins. 3/6

2 VALVE AMPLIFIER (to fit above cabinet), modern circuit with EL84 output, ready built, with 6″ speaker and output transformer, **£3.12.6** carr. and ins. 2/6

RECORD PLAYER BARGAINS

SINGLE PLAYERS—3 speed **BSR** (TU8), **92/6**; 4 speed **BSR** (latest model, TU9), **99/6**; 4 speed **COLLARO, 5 gns**; 4 speed **GARRARD** (4 S.P.), **£7.10.0**, carr. and ins. 3/6

AUTO CHANGERS—3 speed **COLLARO** (RC54), **£7.19.6**; 4 speed **BSR** (UA8), **£8.15.0**; 4 speed **COLLARO** (RC456), **£9.15.0**; 4 speed **GARRARD** (RC120/4H), **$9\frac{1}{2}$ gns**; carr. and ins. 4/6. All above models brand new and guaranteed. Fitted latest style lightweight Xtal PU, with turnover head and twin sapphire stylii.

VOLUME CONTROLS Log. ratios, 10,000 ohms–2 Megohms. Long spindles. 1 year guarantee. Midget Ediswan type.

No Sw.	S.P.Sw.	D.P.Sw.
3/–	**4**/–	**4/9**

Linear Ratio, 10,000 ohms–2 Megohms. Less switch, **3**/– each. **Coax Plugs, 1/2. Coax Sockets, 1**/–. **Couplers, 1/3.** Outlet **Boxes, 4/6**

80 *ohm cable* **COAX**

STANDARD $\frac{1}{4}$″ diam. Polythene insulated. Grade "A" only. **8d.** yd.

Special. Semi-air spaced polythene. 80 ohm. **Coax** $\frac{1}{4}$″ diam. Stranded core. Losses cut 50%. Ideal Band 3, **9d.** yd

MAINS TRANSFORMERS. Made in our own workshops to top grade spec. Fully interleaved and impregnated. **RADIO AND AMPLIFIER TYPE** 250V 60mA, F.W. sec., 5V or 6.3V 1A rect. 6.3V 2.5A set htrs., **22/6**, etc. **C.R.T. HTR. ISOLATION TYPE.** Low leakage with or without 25% sec. boost voltage. Ratio 1 : 1 or 1 : 1.25, 2V, 4V, 6V or 13V, **10/6** each. Ditto with mains primaries 200/250V, **12/6** etc.

L.F. CHOKES—10H 65mA, **5**/–; 15H 100mA, **10/6**; 10H, 120mA, **10/6**; 20H 150mA, **15/6**

OUTPUT TRANSF.—Standard pentode, **4/6**; push-pull 12 watt, **13/6.** Small pentode, **3/9.** Midget battery pentode (1S4, etc.), **4/6**

I.F. TRANSFORMER 465 kc/s

Brand new ex-manufacturer's midget I.F.T., size $2\frac{1}{2}$″ x $\frac{3}{4}$″ x $\frac{3}{4}$″, dust core tuning. Litz wound coils, high Q. Bargain offer, **7/6** pair

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25/25V, 50/12V	**1/9**	8+8/450 T.C.C.	**4/6**
50/50V, 4/500V	**2**/–	8+16/450 Hunts	**5**/–
100/25V, 2/450V	**2**/–	16+16/450 T.C.C.	**5/6**
8/450V B.E.C.	**2/3**	32/350V	**4**/–
8/500V Dub.	**2/9**	32+32/275V Hunts	**4/6**
8+8/500V Dub.	**4/6**	32+32/450 T.C.C.	**6/6**
8+16/450V T.C.C.	**5**/–	250/350 B.E.C.	**8/6**
16/450V B.E.C.	**3/6**	100+200/275V	**12/6**

MIDGET TRANSISTOR TYPES. 2μF, 4μF, 8μF 6V, **3/6**; 6μF, 10μF, 16μF 3V, **3/6**; 32μF $1\frac{1}{2}$V, **3/6**

8″ P.M. SPEAKER (3 ohms)

Ex-manufacturers' Units: Rola, W.B., Celestion, etc. All reconditioned and guaranteed. Ideal ext. unit. Bargain, **7/6**, carr. 1/6

VALVES—NEW BOXED—ALL GUARANTEED
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SPECIAL—1R5, 1T4, 1S5, 1S4 or 3S4 or 3V4 per set **27/6**

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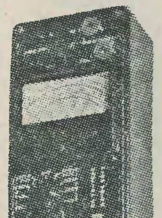
All Transistors are Tested and Guaranteed

TRANSISTOR BASES ... ... 9d. each



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Milliamps 0–10/100/500
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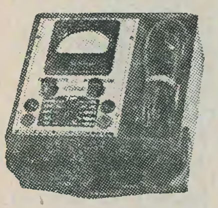

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Milliamps 1.2/12/60/600mA
Ohms 0–5,000/5 meg
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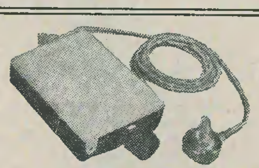

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Total cost **49/6** complete

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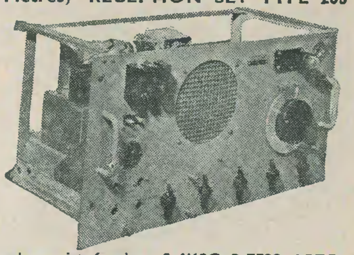
SHORT-WAVE RECEIVER 10–60 MC/S (5-30 Metres) RECEPTION SET TYPE 208

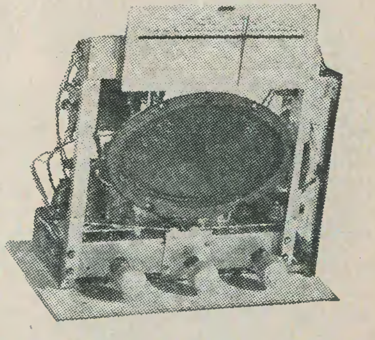


Complete with 6 valves, 2-6K8G, 2-EF39, 6Q7G and 6V6G. Internal mains power pack and 6V vibrator pack. Built-in 6½" speaker. Muirhead slow-motion drive. B.F.O. and R.F. stage. I.F. freq. 2 Mc/s. Provision for phones and muting and 600 ohms. **Input 110/250V a.c.** 6V vibra pack included for battery operation. All sets in new condition and air tested. **£6 . 19 . 6.** Carr. 15/6

BE PREPARED TO LISTEN TO THE SATELLITES

5-VALVE A.C./D.C. PORTABLE RADIOGRAM CHASSIS THREE WAVE BAND SUPERHET 200/250V A.C./D.C.

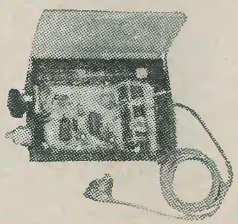
(With Internal Aerial)



Short 160–50m. Med. 187–575m. Long 900–2,000m. (With gram. switching.) Five Marconi valves, type: X109, W107, DH107, N108 and U107, and 7" x 4" elliptical speaker. Ideal for Portable Radiogram. Chassis size 10" x 4" x 4"

£7.12.6 p.p. 7/6

Also available as above at the same price, similar chassis with following specifications: Short Wave 11.27–31.9m. Short Wave 31.2–91m. Medium 187–575m. and gram. switching.



"HOMELIGHT" TWO TRANSISTOR PERSONAL PORTABLE

Variable tuning. We can supply all components, including two transistors, diode, resistors, condensers and miniature hearing aid and plastic case, size 4¼" x 2⅞" x 1⅝" and 3V battery for **52/6.** Practical layout

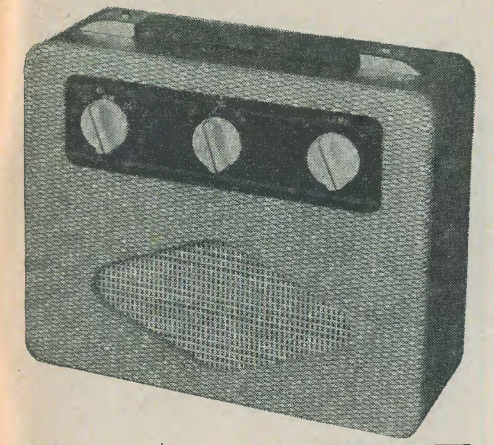
All items sold separately

The "TRANSISTOR - 8"

Push-Pull Portable Superhet

COMBINED CAR RADIO & PORTABLE

TWO SETS FOR PRICE OF ONE



This Portable 8-Transistor Superhet is tunable for both Medium and Long Waves and is comparable in performance to any equivalent Commercial Transistor Set. Simplified construction enables this set to be built easily and quickly into an attractive lightweight cabinet supplied.

TEN STAR FEATURES

- ★ 8 specially selected Transistors
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- ★ Medium and Long Waves
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- ★ Drilled Chassis 8½" x 2½"
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- ★ Economical. Powered by 7½V battery
- ★ Ideal as a car radio
- ★ Attractive lightweight contemporary case

All components as specified can be supplied at an inclusive price of

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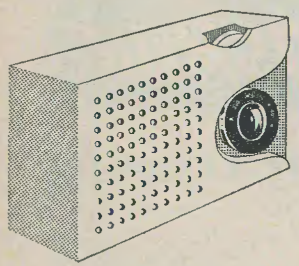
Car radio conversion components 8/– extra

N.B.—Pair of XC101's supplied at additional cost of 40/–
Call and hear demonstration model

MINI-7 POCKET TRANSISTOR PORTABLE



Size 5⅛" x 2⅛" x 2¾"

ULTRA SENSITIVE!
ECONOMICAL!
HIGHLY SELECTIVE!

May be Built for **£10.10.0**

THIS SUPERHET IS SUPERIOR IN PERFORMANCE TO MOST COMMERCIAL TRANSISTOR SETS AND COSTS LESS THAN HALF THE PRICE

SPECIAL FEATURES

- ★ 7 selected transistors
- ★ Internal ferrite aerial
- ★ Operates from 6V battery
- ★ Practical layout
- ★ Drilled chassis
- ★ Medium and Long wave
- ★ Attractive plastic case

All components as specified can be supplied at an inclusive cost of £10.10.0 p.p. 2/6

Send 1/6 for Instruction Booklet and Prices

● WELL RECOMMENDED ●

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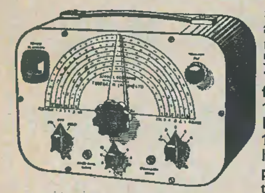

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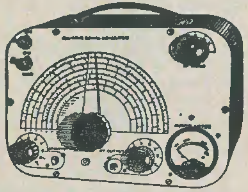

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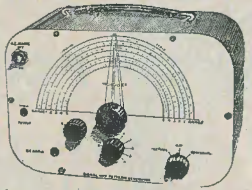

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PRIVATE

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continued on page 687

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1A3	2/6	6SA7M	7/6	866A	12/6	EL91	7/6
1L4	5/–	6SG7M	7/6	959	7/6	EM80	10/–
2A3	8/6	6SH7M	5/–	1616	5/–	EZ40	8/6
2X2	3/6	6SJ7M	7/6	1629	4/–	EZ80	8/6
3A4	5/6	6SK7M	6/6	EA50	1/6	HK24G	25/–
3Q4	8/6	6SL7GT	7/6	EABC80	10/–	KT33C	9/6
5B/254M		6SN7GT	6/6	EAC91	4/6	PCC84	10/6
	21/–	6SQ7M	7/6	EAF42	10/6	PCF82	10/–
5R4GY	10/6	6X4	6/6	EB34	2/6	PL82	9/6
5Y4G	6/6	6X5GT	7/6	EB91	6/6	PL83	10/6
6AC7M	5/–	7B7	9/–	EBC33	7/6	PCL83	12/6
6AG5	3/6	7C5	9/–	EBC41	10/6	PY80	9/–
6AK5	5/–	7C6	9/–	EBF80	10/–	PY81	9/6
6AL5	6/6	7Y4	8/6	EBF89	10/–	PY82	9/6
6AM6	7/6	12A6M	7/6	ECC82	9/6	PY83	11/6
6AQ5	8/6	12AT6	8/–	ECC83	9/6	R19	12/6
6AT6	8/–	12AT7	9/–	ECC84	11/–	SP61	3/–
6AU6	8/6	12AU6	9/–	ECC85	10/6	TT11	4/–
6B8G	4/6	12AU7	8/6	ECF80	12/6	UAF42	10/6
6BA6	8/6	12BE6	8/6	ECF82	11/6	UBC41	10/6
6BE6	7/6	12C8M	7/6	ECH42	10/6	UBF89	10/6
6BR7	11/6	12Q7GT	9/–	ECH81	10/–	UCC85	10/–
6C4	5/–	12K7GT	9/–	ECL82	12/6	UCH42	10/6
6C5M	5/6	12SC7M	2/6	EF36	4/–	UF41	10/6
6F6M	5/6	12SK7M	7/6	EF37A	8/6	UF89	10/6
6F8G	4/6	12SQ7M	8/6	EF39	5/–	UL41	10/6
6G6G	4/6	35L6GT	9/6	EF41	10/6	UY41	8/6
6J5GT	5/–	35Z4GT	8/6	EF50	3/–	UY85	10/–
6J5M	6/–	35Z5GT	8/6	EF50(S)	5/6	UABC80	
6J6	4/–	42	7/6	EF55	7/6		10/6
6K7G	5/6	50L6GT	9/6	EF80	9/–	VU39	9/6
6K8G	8/6	80	8/6	EF85	10/–	VR150/30	
6K8M	10/6	446A	10/6	EF89	10/–		7/6
6H6M	3/6	801A	7/6	EF91	7/6	VR116	4/–
6L6G	9/–	803	20/–	EL32	4/–	VS70	3/–
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1T4	7/6	6SA7	8/–	DK92	9/–	EK32	8/6
3S4	7/6	6SL7GT	8/–	DK96	9/–	EL32	7/6
3V4	8/6	6SN7GT	8/6	DL92	7/6	EL41	10/–
5U4G	8/6	6SS7	6/6	DL94	8/6	EL84	10/6
5Y4G	7/–	6V6G	7/6	DL96	9/–	EL91	7/6
5Z4G	9/6	6V6GT	7/6	EA50	1/6	EY51	11/6
6AG5	6/9	6X4	7/6	EB91	6/6	EZ35	8/–
6AM6	8/6	6X5GT	7/6	EBC41	8/–	EZ40	8/–
6AL5	6/6	12AT7	9/–	EBC33	8/6	KT33C	7/6
6AT6	8/–	12AU7	9/–	EBF80	10/–	KT66	11/6
6B8	7/6	12AX7	9/–	ECC81	10/6	PCF82	11/–
6B8G	7/6	12K8GT	13/6	ECC84	11/6	PL82	10/6
6BA6	8/6	12K7GT	8/6	ECF82	11/–	PY81	10/6
6BE6	7/6	12Q7GT	8/6	ECH81	10/6	PCC84	11/6
6BR7	10/6	35Z4GT	8/6	ECH42	10/–	U76	8/6
6BW6	8/6	35L6GT	9/6	ECL80	10/6	UBC41	10/–
6G6G	4/9	807	6/9	EF36	7/6	UCH42	10/–
6J5G	5/6	5763	10/6	EF37A	14/6	UF41	10/–
6J5GT	6/6	DAF91	7/6	EF39	5/6	UL41	10/–
6J7GT	8/6	DAF96	9/–	EF41	10/–	UY41	8/–
6K7G	5/6	DF91	7/6	EF80	9/6	W76	8/6
6K8G	9/6	DF96	9/–	EF85	10/6	X65	10/6

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

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SMALL ADVERTISEMENTS

continued from page 685

PRIVATE—*continued*

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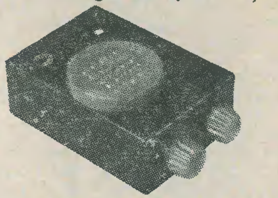

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