London: Printed in Gt. Britain by Hanbury, Tomsett & Co., Ltd., Kensal Rise, N.W.10, for the Proprietors, Amalgamated Short Wave Press, Ltd., and Published at 57, Maida Vale, Paddington, London W.9— June, 1950

RADIO CONSTRUCTOR

1/3
Vol. 3 No. 11
JUNE 1950

For Every Radio Enthusiast

★

Contents

BUILDING YOUR OWN VALVE TESTER
by W. G. Morley
Part One

GENERAL PURPOSE QUALITY AMPLIFIER
by A. R. Tungate, G3ELB

TELEVISION PICTURE FAULTS
Part 3
Illustrated by Tele-Snaps

Ex-R.A.F. COMPONENT VALUES
Submitted by Readers

Surplus Radio Equipment: TRANSMITTER TUNING UNIT TU9B

and usual supporting features.

★

AN AMALGAMATED SHORT WAVE PRESS PUBLICATION

THE MODERN BOOK CO.

A HOME BUILT FM RECEIVER. By K. R. Sturley. **4s. 6d.** Postage 3d.
THE WILLIAMSON AMPLIFIER. Articles reprinted from "Wireless World," **3s. 6d.** Postage 2d.
TELEVISION SERVICING MANUAL. By E. N. Bradley. **4s. 6d.** Postage 3d.
THE RADIO AMATEUR'S HANDBOOK 1950 EDITION. By A.R.R.L. **20s.** Postage 9d.
DATA and CIRCUITS OF MODERN RECEIVER and AMPLIFIER VALVES. Book 3. **12s. 6d.** Postage 9d.
SHORT WAVE RADIO and the IONOSPHERE. By T. W. Bennington. **10s. 6d.** Postage 9d.
RADIO AMATEUR CALL BOOK MAGAZINE. Winter Number. **18s.** Postage 9d.
RADIO INSTRUMENTS and their CONSTRUCTION. By D. Allenden. **2s. 6d.** Postage 2d.
A HOME BUILT TELEVISOR for SUTTON COLDFIELD RECEPTION. **4s. 6d.** Postage 3d.
RADIO VALVE DATA. Compiled by "Wireless World." **3s. 6d.** Postage 3d.
THE PRINCIPLES of TELEVISION RECEPTION. By A. W. Keen. **30s.** Postage 9d.
PRINCIPLES and PRACTICE of RADAR. By H. E. Penrose. **42s.** Postage 9d.
HANDBOOK of WIRELESS TELEGRAPHY. Vol. 1, **5s.** Vol. 2, **6s.** Postage 1s. the set.
PRACTICAL WIRELESS CIRCUITS. By F. J. Camm. **6s.** Postage 4d.
ELECTRONICS: EXPERIMENTAL TECHNIQUES. By Elmore & Sands. **32s.** Postage 9d.
TELEVISION. By M. G. Scroggie. **6s.** Postage 3d.
INEXPENSIVE TELEVISION. New Edition. By A.S.W. Press Ltd. **2s. 6d.** Postage 2d.

We have the finest selection of British and American radio books in the Country. Complete lists on application.

19-23 PRAED STREET, (DEPT. RC) LONDON, W.2

PADDINGTON 4185

GARLAND RADIO

Valves: 6L6G, ECH35, 6K8, EF55, 3S4, 6SN7, 6AC7, IT4, IR5, IS5, VR105/30 @ **7/6.** KTW61 6K7G, 6Q7GT, 6J7G, EBC33, 6X5GT, 6SK7GT 6V6G, 5U4G, 5Z4, U50, 6F6, 6F6G, 6N7GT, 6AG5, 807 6B4G, 6C5GT, 1S4, EL32, 3Q5, CV66 @ **6/6.** 12A6, 9002, 9003, VU111, 6B8G, 9D2, 8D2, 4D1, RK34, AR8 @ **5/-.** 6SH7, 954, 955, 7193, P61 @ **3/6.** D1, EA50, 6H6, 6H6GT, EB34 @ **2/6.** TX and Special Valves: 803, 805 @ **10/-**; 8012 **7/6**; 807, TT11 **6/6**; VU113, VU133, CV54 **3/6**; CV73 **2/6.**

Mains Transformers (1): P. 0-200-220-250. S. 250-0-250v. 80 mA, 6.3v. 3A, 5v. 2A. Upright. Special offer **11/6.**

Mains Transformer (2): P. 0-200-220-250. S. 350-0-350v. 80mA, 6.3v. 3A, 5v. 2A. Upright or Drop-through. Special offer **13/6.**

Aladdin Coil Formers: Type F804, complete with iron-dust cores. 5d. each, 4/6 per doz., **48/-** per gross, **£12** per 1000.

S.B.C. Neons: 200/220v. Resistor in cap. 2/-. Holders, 6d.

Plessey Light-Weight P.M. Speakers: 5in **10/-.** 8in **13/6.** 10in **17/6.**

2in M.C. Meters: 500 uA, cal. 0-15v & 0-600v. Used tested surplus **4/-.**

Crystal Diodes: CV102, IN22. 3/3.

Selenium Rectifiers: Bridge 160v, 600 mA, **9/-.**

Ceramic Air-spaced Trimmers: 3-30 pF. 4d. each, 3/6 doz., 24/- 100.

Post Office Type Racks: 19ins wide by 5ft 6in high. New condition. 20/- each, collect or carriage forward.

Garland Radio, Chesham House, Deptford Broadway, London, S.E.8

Phone: TIDeway 4412/3

METAL WORK
with a Difference!

If you want a well-made, attractive and robust cabinet for that receiver or transmitter; if you need a chassis for a modulator, amplifier or converter; in fact, if you need any metalwork at all for your ham requirements

YOU CAN DO NO BETTER THAN TO WRITE US FOR AN ESTIMATE

All metal work "made to measure"

For full details and address of nearest agent, contact—

L. J. PHILPOTT (G4BI)

(E. J. PHILPOTT)

Chapman St., Loughborough

Telephone: 2864

RADIO CONSTRUCTOR

OP-AID

Printed on good heavy paper, with durable stiff cover, the "Op-Aid" gives you the latest revised information about **Distances, Amateur Codes and Abbreviations, Zone Boundaries, QSL Bureaux of the World, International and Amateur Prefixes, Call Areas, the Amateur Transmitting Licence, Morse Code, International Q and Z Codes, Standard Frequencies, and Local Time Conversion**

PRICE 1/6 (post 2d.)

from your local supplier or direct from

AMALGAMATED SHORT WAVE PRESS Ltd.

57 Maida Vale, Paddington, London, W.9

'Phone: - - CUN. 6518

1000's and 1000's of "VERIES" and SWL/QSL CARDS

have been supplied for Hams in many Countries by:

G6MN

who knows your requirements

Printer of QSL'S since 1925

Send for Samples to

G6MN
CASTLEMOUNT,
WORKSOP, NOTTS.

Come to SMITH'S *of* EDGWARE ROAD
the friendly shop for all radio components

We stock everything the constructor needs—our 25 years' experience of handling radio parts and accessories enables us to select the best of the regular lines and the more useful items from the surplus market in:—

Loudspeakers and Phones	Valves and CR Tubes
Transformers and Chokes	Cabinets and Cases
Meters and Test Equipment	Capacitors and Resistors
Pickups and Turntables	Coils and Formers
Switches and Dials	Plugs and Sockets
Metalwork and Bakelite	Aerials and Insulators
Books and Tools	Motors and Generators
Valve Holders and Cans	Wires and Cables
Metal Rectifiers	Panel Lights and Fuses

Sleeving, Nuts and Bolts, Tags, Clips, Grommets and all other bits and pieces

NOTHING TOO LARGE—NOTHING TOO SMALL!

Everything you need under one roof — at keenest possible prices

No general catalogue is issued owing to constantly varying stocks and prices, but we shall be pleased to quote you. Lists are available for the following lines, in which we specialise, and can thoroughly recommend:—

1. The increasingly popular "Electro-Voice" range of Transformers and Chokes. "As good as the best—yet cost little more than the cheapest!"
2. The "G.L.G." 16-gauge Aluminium Chassis. "For the man who takes a pride in his rig."
3. "K-A Products" Television Aerials. "A real engineering job."

H. L. SMITH & CO. LTD.

287/9 Edgware Road, London, W.2

Telephone: Paddington 5891
Hours 9 till 6 (Thursday, 1 o'clock)

Near Edgware Road Stations, Metropolitan and Bakerloo

INEXPENSIVE TELEVISION

A revised and greatly enlarged edition of this popular book. The contents cover the Voltage Doubler EHT Circuit, Half Wave Rectification, Metal Rectifiers, RF Oscillator EHT, Tube Data and Networks, Time Bases, Modified Time Base Amplifier, R1355 Receiver, Using RF26 Unit for London, Using RF27 Unit for Birmingham, the 45 Mcs Strip, the 194 Unit, Home Built Vision Receiver, Converting R1355 to Sound, Adding a Sound Channel to R1355, Modifying the 194 IF Strip, Constructional Data for London and Birmingham Aerials, etc., etc. Price 2/6, Postage 2d.

THE BASIC SUPERHET

This book describes the Construction of a simple superhet receiver. "Centre Tap" also describes suitable extensions, such as Adding as RF Stage, A Preselector, and a BFO, by means of which the performance can be enhanced to approaching that of a communications type receiver. Coil Data is included. Price 1/-. Postage 2d.

Both the above publications are obtainable from your local supplier, or direct from:—

Amalgamated Short Wave Press Ltd.
57 Maida Vale, Paddington, London - - - - - - W.9

Telephone: CUNningham 6518

Radio Constructor

Vol. 3, No. 11 **Annual Subscription 16/-** **June, 1950**

Editorial Offices—57, Maida Vale, Paddington, London, W.9. Tel.: CUNningham 6518
Advertising—Radio Constructor, 15, Charterhouse St., London, E.C.1. Tel.: HOLborn 8655

Edited by : C. W. C. OVERLAND, G2ATV

EDITORIAL

FINISH

IN past issues we have commented more than once on the finish which the constructor gives to his gear. Some succeed in imparting that professional appearance, whilst others. . . . . In our next issue, space permitting, we hope to introduce a series of items which will be of practical assistance to those readers anxious to build apparatus which will look more than just a "hook-up."

WHAT IS QRP ?

The Editorial in our March issue was devoted to the activities of the ISWL QRP Research Group. The Editor of "QRP" writes us as follows :—

To the Editor, Radio Constructor.

May I encroach upon your valuable and all too restricted space to correct a misunderstanding which has arisen out of the Editorial in the March issue of Radio Constructor ?

You were good enough to devote that page to the subject of the QRP Research Group of the ISWL and, in mentioning some of our activities, you stated that ". . . In most recent Group contest, for example, an HRO and an R107 took part . . . ."

This statement is perfectly correct but it has been unfortunately interpreted by several of my correspondents as meaning that they entered the contest as QRP receivers.

The facts are, that the contest in question was a Handicap Challenge, the object of which was to attempt to demonstrate that WATT for WATT the QRP receiver is a more efficient instrument than the Communications rig. The points gained were in each case divided by the HT wattage of the receiver concerned, the results being thus reduced to a "per watt" basis. Only two QRO receivers accepted our challenge and, though it is true enough that they "took part" in the contest, they most certainly did not do so in the guise of QRP receivers.

You stated, moreover, in the same paragraph that ". . . QRP does not necessarily mean using a minimum number of valves . . ." This again is a perfectly correct statement, but it has been taken, in one or two cases, as meaning that ANY size of receiver is eligible for QRP classification. This of course is quite incorrect and I would like to elucidate the position by pointing out that it does entail a maximum HT wattage. This max consumption has been fixed at 1.25 watts, a limit which does not give much scope for the use of more than about four valves. Therefore QRO and "communications" receivers are automatically excluded.

As most of your readers will be aware, our Group is a pretty extensive one with a membership that at present stretches from America to Berlin, and there is always a warm welcome for the newcomer. I shall always be pleased to send further information to anyone who is interested, and the enclosure of 6d. (stamps or P.O.) will bring a sample copy of "Q R P."

Yours sincerely,
JOHN WHITEHEAD, G1323

6 Abbot's Tilt, Hersham,
Walton-on-Thames, Surrey.

Sorry, John, that we were the cause of some misunderstanding. This letter should clarify matters and will also, we hope, bring you a few enquiries.

G2ATV

NOTICES

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

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

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6518.

BUILDING YOUR OWN
VALVE TESTER

By W. G. MORLEY

PART ONE

An Introduction to the Principles involved.

A RELIABLE valve tester is an extremely useful piece of test equipment, particularly to the radio enthusiast who may meet many different types of valves in the equipment with which he works, but who does not have the necessary stock facilities to enable him to discover any faulty valve by substitution. In any case, even although checking a valve by substitution is sufficiently accurate for such things as general service work, it is always convenient to be able to know the exact characteristics of a particular valve under dynamic conditions. And, of course, there often occurs the case in which it is impossible to check a supposedly faulty valve by substitution, either because the valve is obsolete, or because it is used in special purpose equipment ; whereupon the use of a valve tester can clear up any doubts immediately.

In this series of articles it is proposed to describe the construction of a very versatile valve tester which may be used to check almost as many different types of valves as the constructor can provide valve holders. The available facilities offered by this tester include a check of mutual conductance, emission (anode, screen-grid or cathode current), checks for short-circuits between electrodes, an insulation test between cathode and heater, checks for rectifiers and detector diodes, and a dynamic test for tuning indicators.

By far the most important test of all those mentioned above is that for mutual conductance. Nearly all the circuits in the tester are designed to carry out this check, and it would be very advisable if we were to devote some time to this characteristic ; and also to the practical methods of doing so which are incorporated in this particular tester. It will also prove helpful, at the start, to obtain a concrete definition of the term " mutual conductance ".

Mutual Conductance.

The mutual conductance, (or **transconductance**) of a valve is given by the change in anode current caused by a change in grid voltage and may be expressed thus :—

$$gm = \frac{(dIa)}{(dVg)} \text{ where Va is constant,}$$

and where gm = mutual conductance,
Ia = anode current,
Vg = grid voltage
and Va = anode voltage

Building your own Valve-Tester.

The deviations in grid voltage (to cause the changes in anode current) should be small. Since the mutual conductance will vary with different standing grid bias voltages, it is helpful to measure the mutual conductance at the bias value recommended by the manufacturers for normal use. As the equation above gives the " slope " of the anode current/grid voltage curve of the valve, use of the recommended bias voltage will, for most purposes, ensure that the mutual conductance is measured at the centre of the straightest part of that curve. In the case of variable-mu valves where the " slope " may be considered straight (for small deviations) at all reasonable values of bias, the mutual conductance may be measured at any grid bias. For test purposes, however, we may check the mutual conductance of a variable-mu valve at the bias tabulated in the manufacturer's literature and see if we get the value of mutual conductance given for that particular value of bias. It will be seen from the formula that the anode voltage remains constant.

Mutual conductance is usually expressed in mA per volt. Thus, if a change of ½ volt in the voltage applied to the grid of a certain valve causes a change of 1½ mA in the anode current (anode voltage remaining constant) then the mutual conductance will be 3 mA per volt.

It will be found that, sometimes, (particularly in American technical literature and valve tables) mutual conductance is expressed in μmhos. This is, incidentally, a very convenient method of showing mutual conductance. As we will very probably find it necessary to consult American tables when using our tester it would be extremely advisable to fully comprehend the method of obtaining this expression.

It was stated above that the mutual conductance of a valve has the mathematical representation $\frac{dIa}{dVg}$; in other words, a current divided by a voltage. Going back to Ohm's

Law we may also remember that an expression for resistance in a simple resistive circuit can be given by $R = \frac{V}{I}$. Now a "mho" is a unit of **conductance** and is equal to the reciprocal of an ohm. For example, a circuit of resistance 2 ohms would have a conductance of ½mho.* Thus conductance may be measured as $\frac{1}{R}$ or, in a simple resistive circuit, $\frac{I}{V}$. Therefore, as mutual conductance is represented as a current divided by a voltage it may be expressed as an actual figure in mhos, instead of in mA per volt. Thus :—

$$gm = \frac{dIa}{dVg} \text{ mhos (where I is measured in amps, and V in volts)}$$

However, it is usual to give the numerical value in μmhos ("μ" equals one-millionth). In addition, changes in anode current are measured, almost always, in mA. It may then be seen that the value of mutual conductance of a valve in μmhos is equal to one thousand times the value in mA per volt. To take an example, a mutual conductance of 2,500 μmhos is equal to one of 2.5 mA per volt.

Testing Mutual Conductance.

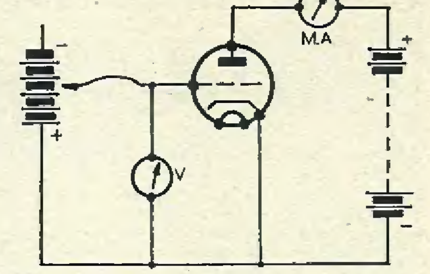
There are quite a few methods of measuring mutual conductance, some of which are fairly complicated and need special components or measuring instruments. However, in this case, we shall use a fairly obvious and simple method.

Fig. 1 shows an extremely simple method of obtaining a reading for mutual conductance. A triode valve is connected so that its grid voltage may be varied by tapping into different connections on a battery. A volt meter is connected between grid and cathode to give an accurate indication of the voltage applied between these two electrodes. In addition, a milliameter is connected in the anode circuit to read anode current. It is assumed that the battery supplying the anode current has constant voltage and negligible internal resistance.

Let us now suppose that the values in Fig. 1 are such that the voltage applied between grid and cathode is 4.5 and that the anode current is 5 mA. The grid voltage is then changed to 6 volts, whereupon the anode current drops to 2 mA. Thus, for a change in grid voltage of 1.5 volts there is a deviation in anode current of 3 mA. The mutual conductance of the valve is therefore 3 divided by 1.5, *i.e.* 2 mA per volt.

To make this somewhat clumsy tester simpler to operate, it would help if we changed the grid voltage in, say, one-volt steps, whereupon the mutual conductance would be shown numerically by the difference between the two anode currents as read on the milliameter.

* No pun intended !



RC740

Fig. 1. Simple circuit for measuring mutual conductance of a valve.

Practical Valve Testers.

Many commercial valve testers are so arranged that all the operator has to do is to plug a valve into the appropriate socket, set the switches, and switch on the supply. As the valve warms up, a meter needle moves along a scale of which one half is marked "good", the other half "bad". If the needle comes to rest in the "good" section the valve may be considered serviceable. This can prove to be an extremely useful method of checking a valve provided we are certain that we are measuring an actual characteristic. For instance, some of the earlier types of testers simply measured emission, so that unless a valve was really on its last legs, the meter would always read "good". This type of tester, incidentally, was extremely useful for shop counters where slight manipulation of the grid bias control would always "prove" to a customer whether a certain valve was good or bad ! However, for serious service work, the value of such a tester was just a little above nil.

Valve testers employing mutual conductance or amplification factor tests then came into being, and, by use of ingenious circuits, it was still possible to fit a meter graduated "good-bad", or to use a calibrated meter and give a minimum meter reading for each type of valve that might be tested.

To simplify the obtaining of these readings, mutual conductance (or amplification factor) tests were sometimes taken with values of grid bias, anode voltage and so on which were not always the same as those supplied to the valve when in actual use in a receiver, or similiar item of equipment.

The reason for doing this was either to reduce the switching which would be required to give different voltages for different valves, or to ensure that the "good-bad" sections on the meter scale held true for all types. Using these different voltages was, of course, quite permissible since, although the mutual conductance readings so obtained would not be the same as that which would be given when the valve was used at its optimum voltages, it would still serve as a useful check of the efficiency of the valve.

This course is not, however, open to the home-constructor for several reasons. Firstly, the only information he has about the vast majority of valves is that given in the manufacturers literature or which is published in the various valve manuals obtainable by him. These publications will give the mutual conductance of the valve in which he is interested but only at certain values of bias and voltage, etc. Secondly, to make a tester calibrated directly in "goodness" and using voltages other than those published in the various tables, etc., it would be necessary to check every type of valve which the tester is capable of testing, in order to obtain an empirical performance figure at the particular voltages supplied to the valve by the tester. These empirical figures would then have to be checked against the performance curves of each valve.

All this is completely beyond the resources of the home-constructor. In the first place, he does not have the thousands of different types of valves which would be needed to obtain the empirical figure, and secondly, he would find it extremely difficult to obtain sufficiently detailed information on each type of valve to be able to work out performance figures at the various voltages employed.

——to be continued——

"RADIO CONSTRUCTOR"

QUIZ

Conducted by W. Groome

(1) Mr. Brain, our stooge, found that his TV pictures were marred by a very thin dark horizontal line, which always appeared in the same position on the screen, even when he shifted the picture. What was the cause, and could it be remedied?

(2) A triode with a 470 ohms cathode resistor and 47,000 ohms anode load is running with a 250V HT supply and drawing 3 mA. If the valve is driven to cut-off by the application of a high negative potential to the grid, what voltage will appear at the anode?

(3) Give two reasons why long heater leads, *i.e.*, from the transformer to the valves, are undesirable.

(4) What is the basic principle of sync separation? Expressed in another way, what are the operating conditions of the valve, and what does it do to the signal?

(5) What is an auto-transformer.?

(6) $E=\frac{R}{I}$ Right or wrong?

(Answers on page 310)

TRADE REVIEW

WOLF-CUB HOME CONSTRUCTOR ELECTRIC DRILL KITS AND EQUIPMENT

Although not a tool intended primarily for radio constructors, we have decided to review this innovation because real "hobby men" could apply this in many ways to our particular interests.

The tool itself comprises a fundamental or basic drill. This is a beautifully constructed piece of apparatus (revolver shape) for quarter-inch chuck, which for its size is surprisingly powerful. (Watts in on full load—210 Watts. Spindle speed on full load—1,330 revs per minute.) Assuming this to be the parent component, a very large variety of additions may be obtained such as the bench clamp, drill stand, drilling, grinding and polishing kit, saw kit and lathe kit.

At the Trade Demonstration recently held at the Caxton Hall, we saw this tool fulfilling a great variety of operations. As a normal electric drill up to a quarter-inch, the speed and power under full load provides good clean holes, and in conjunction with the drill stand, perpendicular drilling can also be obtained. After setting up the drill in the bench clamp, the wolf-cub saw kit. or lathe kit, may be set up to turn chair legs, candlesticks, etc., from soft or hard woods. The saw kit we saw cut (couldn't resist that) half inch hard woods with a really clean edge.

There is no doubt that this is an extremely useful tool which, with a little ingenuity, could be applicable to radio construction in many ways. All the units mentioned may be purchased as seperate items and are very simply attached to the drill which, of course, supplies the power. The drill itself would be an acquisition to any tool kit, and is very reasonably priced. For further details, readers should contact the makers, Wolf Electric Tools Ltd., Pioneer Works, Hanger Lane, London, W.5.

A.T.

Design of the SUPERHET

PART 8 By R. J. CABORN

Tuning Indicators.

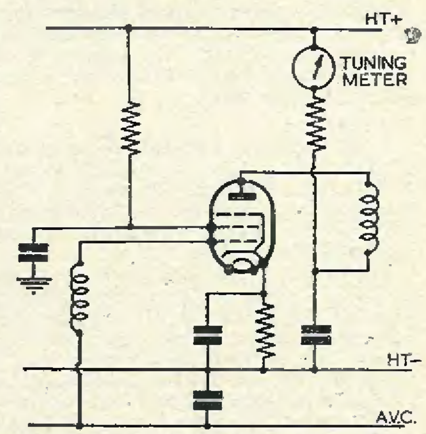
LAST month we discussed the functioning of automatic volume control. Let us now spend some time in reviewing one of the disadvantages that follow in the train of the AVC circuit.

Owing to the fact that AVC ensures that signals of widely differing strength are reproduced at almost the same level in the loudspeaker, it is occasionally difficult to exactly tune in a required station. Instead of the position of maximum volume being also the position of correct tuning, we find that as soon as we tune sufficiently near to a station to be able to hear it, the AVC circuits keep the loudspeaker volume almost constant. To overcome this defect, tuning indicators are fitted to some receivers to enable the position of most accurate tuning to be seen visually.

The simplest form of tuning indicator incorporates a meter connected in the anode or cathode circuit of an AVC-controlled valve. As the negative voltage increases, the anode current of the valve drops. Thus, as the position of most accurate tuning will correspond to greatest AVC voltage, so will it also correspond to the minimum reading in the tuning meter. In communications type receivers, a meter of this type is often calibrated in units of signal strength, *i.e.* S1-9, these readings giving a useful method of comparing different signal strengths. Usually, a variable pre-set resistor is shunted across the meter in this type of receiver to enable it to be set to full deflection when no signal is being received. If the receiver has an RF amplifier, the tuning indicator is often connected in this stage, since the RF valve is usually given less standing bias than are the other valves. Therefore, this valve presents a proportionately larger anode current deviation for the same change of AVC voltage than do the others.

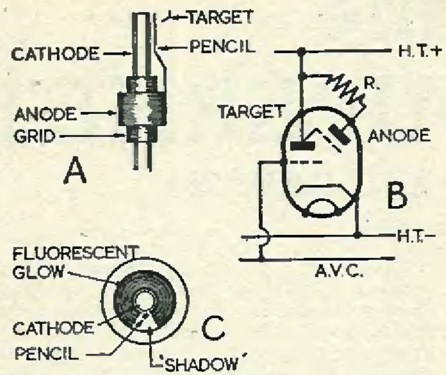
The "Magic Eye" is a very popular form of tuning indicator. The construction of this valve is shown in Fig. 2 (a). The lower part of the valve consists of a simple triode, to the anode of which is fixed a piece of wire called the "pencil", projecting into the upper part of the assembly. The cathode is also elongated, protruding through a hole in the centre of the fourth electrode—the "target". The indicator is connected as shown in Fig. 2(b). The full HT voltage on the target causes a steady flow of electrons to it from the cathode. These fluoresce, causing a green glow. However, owing to the anode current present in the triode section, a voltage is dropped across the resistor R, causing the potential of the anode, and the pencil, to be less positive (or more negative) than the target. For this reason the electrons flowing from the cathode are repelled by the pencil projecting through the target and give the appearance of a "shadow", (Fig. 2(c)). When, however, the AVC voltage increases on tuning in a signal, the triode takes less current, (since its grid becomes more negative) and therefore the voltage dropped across R becomes less. The pencil thereupon becomes less negative with respect to the target and so the "shadow" becomes smaller. Thus, minimum shadow corresponds to the position of most accurate tuning.

Another form of indicator met in American receivers utilises a very ingenious principle and is worthy of a brief mention here. It is illustrated in Fig. 3. In this circuit a choke possessing a small inductance is connected in the anode (or cathode) circuit of an AVC-controlled valve. Often, a separate triode is used for the purpose. The windings on the choke are so arranged that the normal anode



RC734.

Fig. 1. A typical method of connecting a tuning meter.



R.C.735

Fig. 2(a). Internal construction of cathode-ray tuning indicator.
Fig. 2(b). Method of connecting the indicator.
Fig. 2(c). Appearance at end of indicator tube.

current of the valve is sufficient to nearly saturate its core. Also wound on the choke is another coil, this being connected between a small pilot lamp and a source of low AC voltage such as the heater supply. When the valve is passing full current, the near-saturation of the choke causes the secondary winding to possess only a small amount of inductance and so the impedance in series with the AC lamp circuit is low, causing it to glow brightly. When a negative AVC voltage is applied to the valve, its anode current decreases, as also does the current through the first winding of the choke. The inductance of the choke therefore becomes greater, as does the impedance of the coil in series with the indicator lamp, which now becomes dimmer. The position of most accurate tuning corresponds to the dimmest indication in the lamp.

The BFO.

In all superhets intended for reception of CW or morse signals, it is necessary to include a BFO (Beat Frequency Oscillator). This is because these signals are not modulated and are therefore either inaudible or, at most, receivable only as clicks.

The BFO is a local oscillator in the receiver, which is tuned to oscillate at some frequency slightly removed from the IF such that it beats with the incoming signal to give an audible tone. Thus, if the IF of a receiver were 465 kcs, a BFO tuned to 464 kcs would cause a note of 1kcs to be heard with each carrier received.

Any form of oscillator may be used for the BFO, although a simple tuned-grid circuit is as good as any, on account of its simplicity. Owing to the relatively low frequency of the IF found in the average receiver, there is little necessity to worry about the stability of frequency of the BFO.

The BFO should be well screened from the rest of the set. Due to the fact that the voltage of the oscillations generated is fairly large, it must be very loosely coupled to the receiver circuits, as otherwise it may block the detector. If AVC is fitted, switching on the BFO could cause the formation of too much AVC, with a consequent de-sensitising of the receiver. Indeed, on some commercial receivers, it is necessary to switch the AVC out before the BFO can be used. This is no disadvantage in most practical instances, since few operators will attempt to read CW with AVC in, in any case.

Coupling from the BFO is usually applied to the last IF transformer or signal diode by a very small value capacitor. Often, adequate coupling is obtained by mounting a short lead, connected to the BFO anode or grid, near to the transformer or diode wiring.

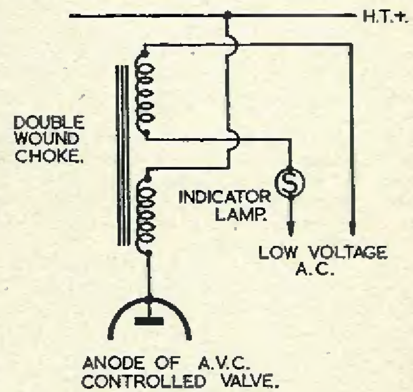
The AF Stages.

There is little that need be said about the AF stages as they are, of course, exactly similiar to those encountered in the straight receiver. Usually, in the simple type of superhet, AF amplification is carried out by the triode of the double-diode-triode, followed by an output pentode. When more complicated AF circuits are used, this is not necessarily to provide greater amplification but to ensure a higher fidelity of reproduction ; and, as such, hardly concern us here.

The Superhet as a Whole.

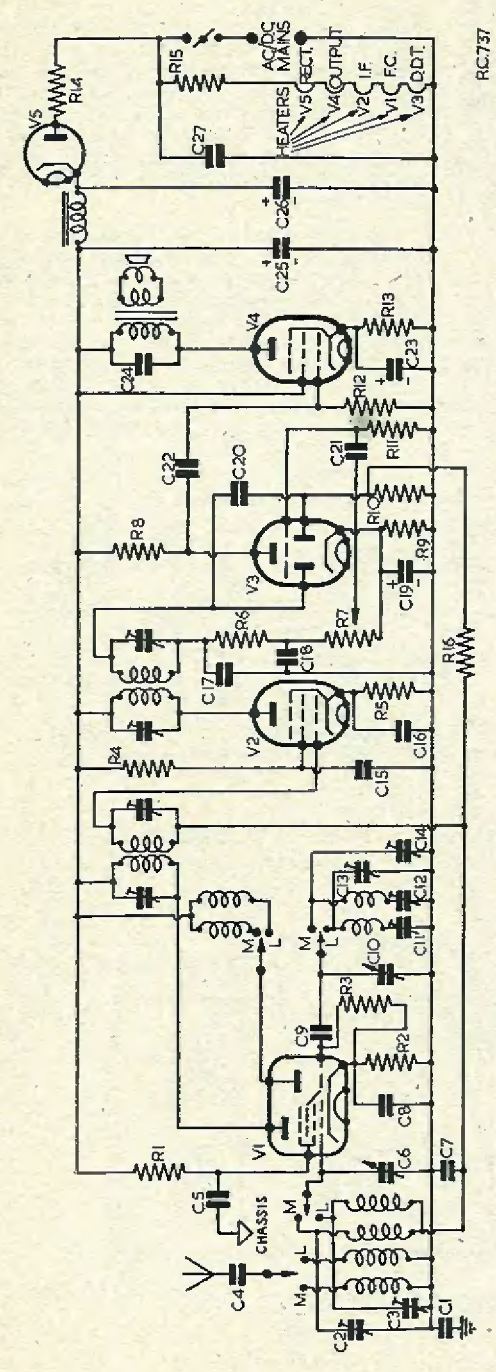
Having given our attention to the various stages in the receiver, let us now consider the complete superhet.

The circuit diagram of a simple form of superhet is shown in Fig. 4. This is the



R.C.736.

Fig. 3. The circuit of an alternative type of tuning indicator, (see text).



R.C.737

Fig. 4. Circuit diagram of a simple medium and long-wave receiver.

VALUES OF COMPONENTS

R1 - 25 K Ω	*R10, R11, R16 - 1 M Ω*	*C6, C10 - 500 pF (2-gang)*
R2 - 300 Ω	*R12 - 250 K Ω*	*C9, C17, C18 - 200 pF*
R3 - 20 K Ω	*R13 - 400 Ω*	*C11 - 150 pF. approx. (LW pad)*
R4 - 50 K Ω	*R14 - 150 Ω 5 watt. (Limiter)*	*C12 - 450 pF approx. (MW pad)*
R5 - 400 Ω	*R15 Line-cord. (Resistance depends upon valves used.)*	*C19, C23 - 25 μF, 25 WV*
R6 - 10 K Ω		*C20 - 50 pF*
R7 - 250 K Ω (Volume control)	*C1, C4, C27 - 0.01 μF 750 WV*	*C21 - 0.002 μF*
R8 - 100 K Ω	*C2, C3, C13, C14 - 50 pF (Trimmer)*	*C22, C24 - 0.01 μF*
R9 - 1000 Ω	*C5, C7, C8, C15, C16 - 0.1 μF*	*C25, C26 - 16 μF, 300 WV*

circuit of a fairly sensitive receiver that will be found very simple indeed to build.

A suggested layout is shown in Fig. 5. Little need be said about this layout except that it shows most of the constructional points that help in designing a receiver of this type. It will be seen that, by taking advantage of the chassis, it has been possible to space out the components with the minimum of possible paths for interaction between circuits, whilst at the same time maintaining a logical layout which is by no means unwieldy.

By mounting the aerial coils above, and the oscillator coils below the chassis, we prevent any interaction, particularly "pulling", between the two. (This point is of importance mainly on short wave bands, assuming that unscreened coils are used). The IF transformers move progressively away from the frequency-changer to ensure the minimum of unwanted feedback. And so the lay-out of stages proceeds until we reach the output stage ; each stage being adjacent only to the previous one. The rectifier is mounted next to the output stage. As the latter, being the last of the amplifying chain, is the least sensitive stage, it is least liable to be subject to hum or mains modulation caused by unwanted capacitance couplings, etc., from the rectifier wiring.

Fig. 6 shows the RF and IF stages of a much more ambitious superhet. For simplicity, only one set of coils is shown in the diagram. If wave-band switching were used, the switches would be connected at the points marked "X". Extensive decoupling is used in the anode circuits of this receiver, as the high degree of amplification would otherwise cause instability. The AVC circuits are decoupled as well. To ensure smooth control, the AVC

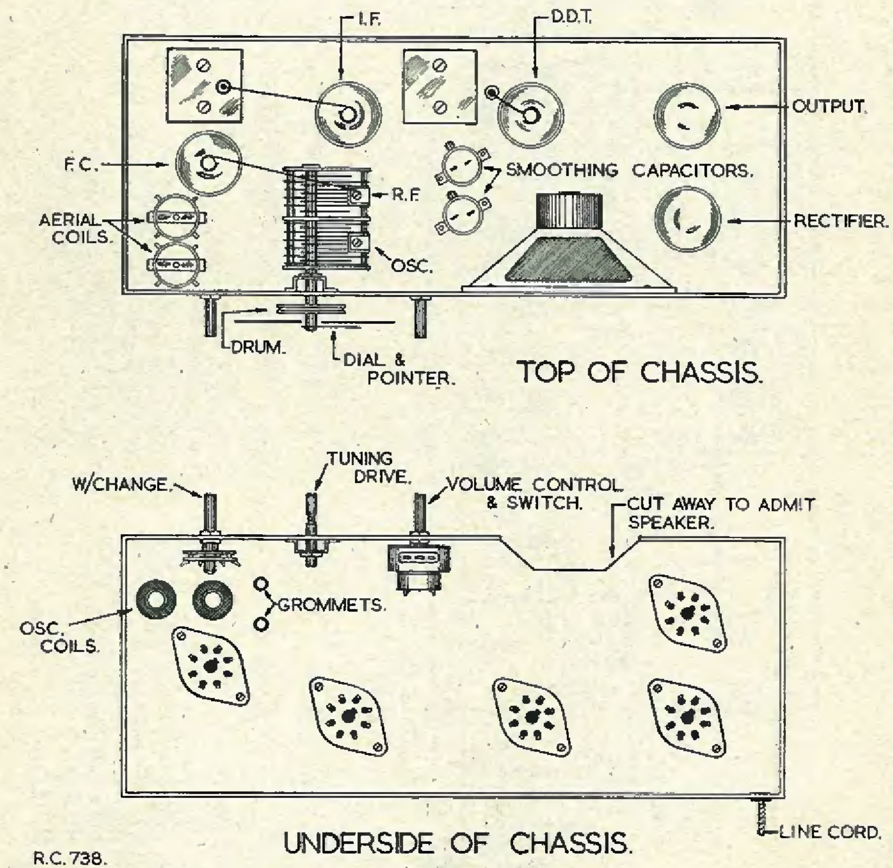


Fig. 5. Suggested layout for the receiver of Fig. 4.

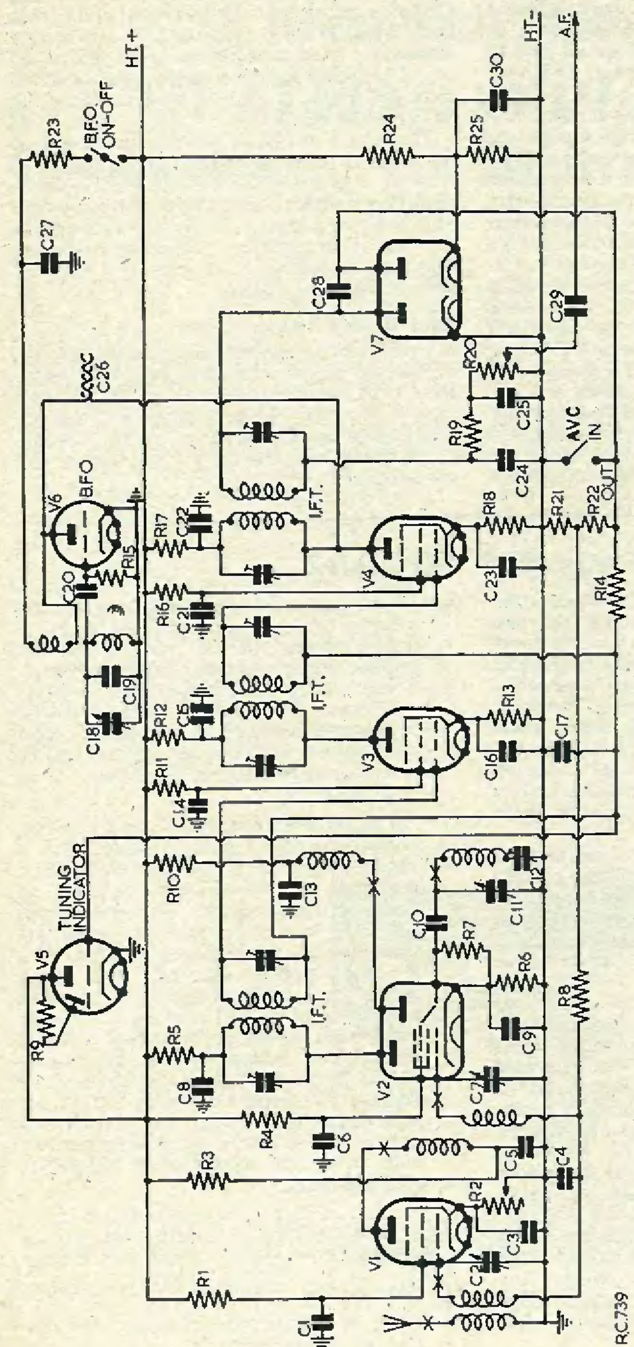


Fig.6. RF IF and detector circuits of a more ambitious receiver.

VALUES OF COMPONENTS

(Parallel RF trimmers not shown in diagram)

R1, R11, R16 - 50K Ω
R2 - 50K Ω (RF volume control)
R3, R5, R10, R12, R17, R19, R23, R25 - 10 K Ω
R4, R7, R15 - 20 K Ω
R6 - 400 Ω
R8, R9, R21 - 1M Ω
R13, R18 - 500 Ω
R14, R24 - 500 K Ω
R20 - 250 K Ω (AF volume control)
R22 - 1.5 M Ω
C1, C3, C4, C5, C6, C13 - 0.02 μF
C2, C7, C11 - 3-gang capacitor
C8, C9, C14, C15, C16, C17, C21, C22, C23, C27, C30 - 0.1 μF
C10, C20, C24, C25 - 100 pF
C12 - Padder
C18, C19 - See text
C26 - Less than 3pF. (*Twisted pair*)
C28 - 50 pF
C29 - 0.001 μF

voltages supplied to the various valves are split up by the potentiometer network, R21 and R22. If one were building a set of this type, all the RF oscillator and IF circuits would have to be well-screened from each other, and very careful layout, indeed, of the whole receiver would be necessary to prevent instability.

In Fig. 6 the incoming aerial signals are amplified by the RF stage before being applied to the frequency-changer. The intermediate frequency is then developed across the primary of the first IF transformer. The IF signal then undergoes two stages of amplification before being applied to the double-diode detector. In this case a double-diode having two separate cathodes is employed, so that a separate delay voltage may be applied to the AVC detector. The values of R24 and R25 given in Fig. 6 are such that they would give a delay of approximately 5 volts, assuming an HT voltage of 250. Signal detection is carried out in the usual manner and the detected signal is applied to the AF stages for amplification in the normal way. A visual indicator and BFO are also provided. The capacitors C19 and C20 are used to tune the BFO grid coil. It is fairly usual practice to make C19 a relatively large-value fixed capacitor of some 200 pF or so. C18 would then be a small value capacitor sufficiently large to enable panel control of the BFO note to be made.

The circuit of Fig. 6, however impressive at first sight, is nevertheless not so complicated as it looks. As it stands, it could form a fairly useful communications receiver ; and it would only need the addition of, say, a crystal gate in the first IF transformer circuit, to make the diagram very similiar to that of a pre-war communications receiver.

Next Month's Article.

Up to now we have considered those aspects of superhet design which are concerned mainly with what may be described as the domestic type of receiver. In next month's article we shall pass on to more advanced points of design, commencing with the theory and practice of noise limiters.

ANSWERS TO QUIZ

1) The fluorescent screen of Mr. Brain's tube was burned, through running the line time base by itself, without turning down the brilliance. Consequently a narrow section of the screen had been bombarded by an electron stream which, had the other time base been operating, would have covered an area some 400 times greater.

There is no cure. The trouble can be avoided only by keeping the brilliance low when screening a stationery spot or single line.

(2) 250V. When a valve is cut off, current ceases to flow, and without current flowing there can be no voltage drop in the circuit. Therefore the anode voltage is the same as that of the HT supply, regardless of the value of any resistor(s) in circuit.

(3) Owing to the heavy current carried by heater leads, a quite small resistance can cause a drop in voltage amounting to an appreciable percentage of the nominal value. This is more pronounced in the case of 4V valves than in the 6.3V types, the former having a much greater current rating. To avoid loss of efficiency, heater leads should be kept as short as is possible, and should consist of heavy gauge wire.

A second reason is to reduce the risk of hum pick-up from the heater wiring. This risk is often minimised by twisting the pair of leads, so that the magnetic fields around each are in opposition, and thus cancel out.

(4) Usually a valve is arranged to cut off sharply when a negative-going signal is applied to the grid. If, then, the signal is applied with the picture content negative-going, and the sync pulses positive-going, the former will be suppressed by cut-off action and the latter, by causing the valve to conduct, will appear at the anode, where through phase reversal they will be negative-going.

(5) An auto-transformer has a single winding, tapped to form a potentiometer. For a single output, it is provided with three terminals, one of which is common to both input and output. The output will be greater or less than the input, according to the method of connection. Thus, with a centre-tapped winding, and input across the whole winding, the output voltage will be half the input. If the input were across one end and the tap, the output voltage across the whole would be twice that of the input. The wattage will remain constant, apart from some small transformer loss, so that the current will increase or decrease respectively with an output voltage lesser or greater than the input.

(6) Wrong. The correct expression is $E = I \times R$, and is, of course, one way of writing Ohm's Law. Alternative expressions are $I = \frac{E}{R}$, and $R = \frac{E}{I}$. E = PD in volts, R=Resistance in ohms, and I= Current in amperes.

A General Purpose QUALITY AMPLIFIER

By A. R. Tungate, G3ELB

A "fellow slave" recently confronted the writer with a request to construct an amplifier, if possible from the salvaged components of a broadcast receiver—the interior of which, during the course of its life, had been subject to a fire. Investigation of the receiver showed that a fair number of components had escaped the flames, and therefore could possibly be utilised, but obviously some parts would, of necessity, have to be purchased to enable construction to be commenced.

Firstly, all components were stripped from the chassis and tested individually. From the selection of valves, only three were found to be of any use, namely a 6SK7 RF pentode, a 6SL7 double triode, and a 6F6 beam tetrode.

A circuit was drawn up around the 6SK7 and 6F6, and a list of new components that would be needed was compiled. Purchases were effected at negligible cost. For experimental purposes, the broadcast receiver chassis was utilised, and the construction of a simple, yet effective, quality amplifier began.

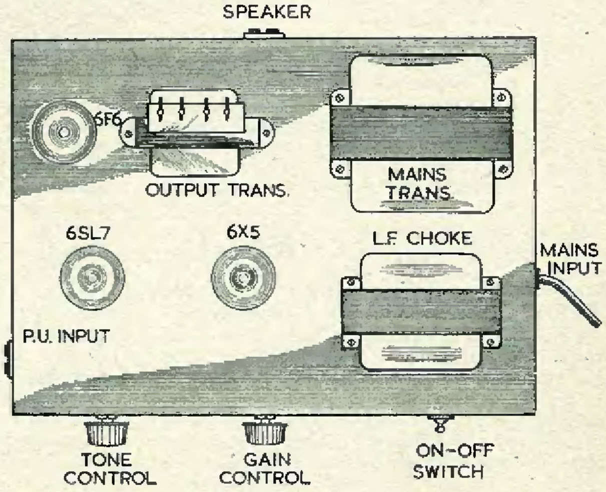
Unfortunately, in one respect the 6SK7-6F6 line-up proved a failure, for great difficulty was experienced in keeping the hum level down to a minimum when the gain was increased. This snag, it is believed, was due to the fact that the high gain pentode has its control grid among the base connections, and not as a top cap, which is a desirable feature when using this type of valve as a pre-amplifier.

Further, needle scratch was prominent when using the 6SK7. Thus, it was decided to utilise the 6SL7 as a pre-amplifier, and so another circuit was drawn up and trial and error experiments began again.

The output stage was constructed first, and when connected to the half wave power supply, tests for output, frequency response and distortion were made with the aid of a home constructed RF/LF signal generator.

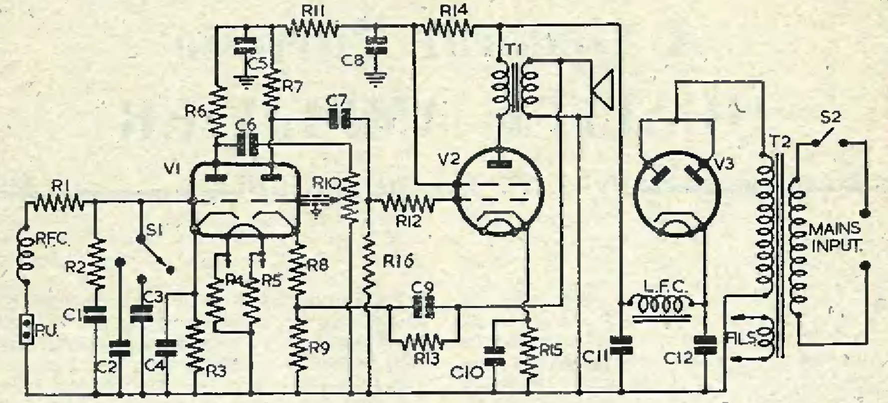
The input stages and pre-amplifier were then wired and connected to the 6F6, and experiments were made to find the best values of components which would give the desired high fidelity.

Above chassis layout of the amplifier



RC749

FIG. 2.



R.C.747

Fig. 1. Circuit of the GP amplifier

COMPONENT VALUES

C1, 0.02 μF 350V	*V1, 6SL7*	*R1, 100 kΩ ¼W*
C2, 0.005 μF 350V	*V2, 6F6*	*R2, 33 kΩ ½W*
C3, 0.001 μF 500V	*V3, 6X5*	*R3, 9, 13, 500 Ω ½W*
C4, 25 μF 12V	*S1, SP 3-way*	*R4, 5, 12, 100 Ω ½W*
C5, 11, 12, 16 μF 350V	*S2, SPST*	*R6, 7, 220 kΩ ½W*
C6, 7, 0.01 μF 500V	*T1, Output trans.*	*R8, 2.5 kΩ ¼W*
C8, 8 μF 350V	*T2, Std. Primary*	*R10, 1 MΩ pot.*
C9, 0.05 μF 500V	*HT: 250V at 60mA*	*R11, 25 kΩ ½W*
C10, 50 μF 25V	*LT: 6.3V at 2A*	*R14, 2.5 kΩ 1W*
PU, Moving iron	*RFC, Universal HF choke*	*R15, 330 Ω 1W*
	LFC, Smoothing choke	*R16, 500 kΩ ½W*

The circuit finally adopted is shown in Fig.1, and the components so chosen gave a surprisingly high degree of quality, with stability—another all-important factor.

A survey of the circuit shows that V1, the double triode, is RC coupled to V2, the beam tetrode, the output of which feeds an 8″ permanent magnet speaker. Power supply is obtained from a conventional half wave rectifying circuit utilising a 6X5 rectifier having both anodes strapped together. Half wave rectification was employed because the mains transformer from the broadcast receiver was "dissed" on one half of the HT winding but it was desired to use it in order to keep down the cost. Full wave rectification is better, and there is no reason why it cannot be used in this amplifier should the transformer have to be purchased or a suitable one be on hand. No alterations are needed to the smoothing circuit.

The input from the pick-up (or high impedance microphone) is applied to the grid of the first section of the double triode, via a pancake type HF choke, R1, R2 and C1, which together comprise a bass compensating network, necessary when reproducing sound tracks of ancient discs. The values of the components specified here are those found to give the best results, and therefore deviation from these values by constructors is not advisable if optimum performance is required.

C2 and C3, brought in or out of circuit by S1, a three-way single pole Yaxley (part of the BC receiver wavechange switch, slightly modified) constitutes a tone control. Here again, the components chosen are the result of experiment to determine the best values.

R3 and C4 provide cathode bias and decoupling for the first section of the 6SL7, with R6 as the anode load. C6 couples the output of the first section to the grid circuit of the second half. R10 is the gain control, and R7 the anode load of the second triode. Both anode circuits and the HT line are adequately decoupled throughout—another step towards stability. Across the heater pins of V1 a humdinger arrangement was connected to keep hum down to a negligible value. The heater wiring was twisted and tucked well away into the corners of the chassis. The only grid lead it was found necessary to screen was in the second half of V1, as shown in the circuit diagram.

Negative feedback is applied to the cathode circuit of the second half of V1 via C9 and R13 from the output transformer secondary winding. Negative feedback is an asset in amplifiers, giving much improved quality, even though the output is somewhat reduced. This latter, however, is no drawback in this instance, for there is enough output from this amplifier to make the speaker dance.

C7 couples V1 to V2. R12, a parasitic suppressor, is another component which adds to the final stability of the amplifier.

The screen voltage for V2 is taken from the junction of R11 and R14. A customary practice is to put the full HT which is available on to the output valve screen. Although this increases the power output, it does not allow true Class A operation of the output stage, which is necessary for best quality.

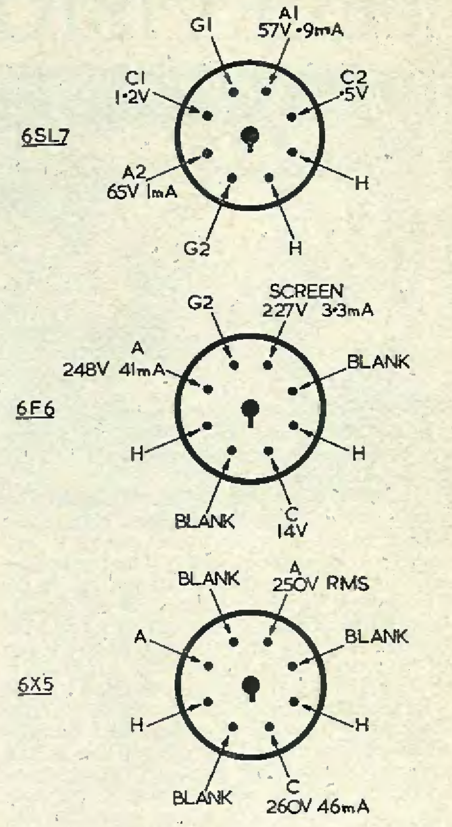
A moving iron pick-up, with a DC resistance of 3200 ohms, and giving an output of approximately 0.2V, was used. Adequate gain from the two sections of V1 was achieved, without any trace of distortion, to allow the gain control to be set to some three quarters of its traverse, and still drive the 6F6 to give an output of around 2.9 watts.

Fig. 2 shows the layout finally adopted, using a commercially made chassis measuring 8″ by 5″ by 2½″, but anyone contemplating the construction of this amplifier will be aware that the layout is not critical. This point was proved when a completely different layout to that of the test model was used in the final version. No change in either quality or response was detected after the change-over.

All components were self-supporting with the exception of C5 and C8 which, being cardboard case electrolytics, needed fixing clamps So construction was a simple matter.

The voltage and current chart included in this article indicates the readings obtained at various points, measured on a universal Avo Model 7.

The 'fellow-slave' for whom the amplifier was made was delighted with the finished product, and he has since built the unit into a cabinet, and now seeks aid in the design of an acoustic labyrinth for use with a 10″ speaker.



VOLTAGE & CURRENT CHART WITH BASE CONNECTIONS

RC.748

"HIS MASTER'S VOICE" EQUIP R.A.F. RESERVE CENTRE.

On Friday, May 12th, Mr. Aidan Crawley, M.B.E., M.P., Under Secretary of State for Air, opened the new Royal Air Force Reserve Centre, at 77, Hallam Street, London, W.1.

This handsomely equipped building will provide amenities for all ranks of the R.A.F. Reserve and is a particularly convenient recruiting centre for Central London.

Recreational activities and entertainment from Radio, Records and Television are well provided for by "His Master's Voice," in the form of a 15″ Tube Television Receiver, the latest "H.M.V." Radiogram and a Table Receiver and Record Player.

THE EDITOR INVITES . .

- **Constructional articles suitable for publication in this journal. Prospective writers, particularly new writers, are invited to apply for our "Guide to the writing of Constructional Articles" which will be sent on request. This guide will prove of material assistance to those who aspire to journalism and will make article writing a real pleasure!**

TELEVISION PICTURE FAULTS

Part three of a series, illustrated by photographs from a Televisor screen by courtesy of Mr. John Cura.

THE TIME BASES

THE function of the time base is to deflect the spot made by the CRT in such a manner as to scan the area on which the picture is to be formed.

The line time base moves the spot at a steady speed from the left hand side of the picture to the right, and then returns it very rapidly to its starting point. The frame time base, operating much more slowly, moves the line, formed by the spot traversing the picture, downwards at a steady rate until it reaches the bottom, and then returns it rapidly to the top of the picture to recommence the operation.

Depending on the type of deflection used to scan the tube, a graph of the voltage (electrostatic deflection) or current (magnetic deflection) obtained from either time base will appear as a series of triangles with a straight long side and an almost vertical side returning to the base line. See Fig. 1. For perfect operation, the steady rise or fall of the voltage or current should be linear, and the return to zero for the start of the next scan should be very rapid compared with the time taken to form the steady rise or fall.

The effects caused by a time base not conforming to these conditions are generally very obvious on a picture, and to a greater extent on the Test Card " C " radiated by the B.B.C. Taking the effects one at a time, we will show how these appear on a picture, though it must be borne in mind that, when a receiver or time base is being tested for the first time, several faults may be in existence at one time and cause some confusion or difficulty in interpreting them. This, of course, is applicable whatever part of the televisor is being tested, and very careful consideration should be given to preventing a lot of unnecessary work being done on an apparently single fault when it is actually a combination of two or more.

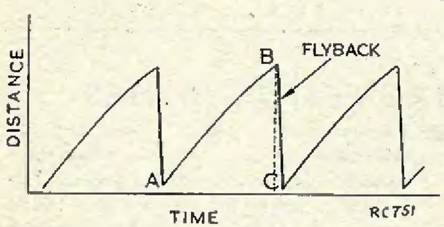


Fig. 1. Illustrating the difference in time of Scan and Flyback. The time B-C is greatly exaggerated in order to be shown clearly.

Certain other causes giving picture distortion may be due to errors in design, rather than a fault directly attributable to the time base, and these will be dealt with first.

Distortion of the Raster.

The raster should be rectangular, with straight vertical and horizontal sides, and with opposite sides parallel to each other. Cathode ray tubes using electrostatic deflection may have very slight errors in the alignment of the deflector plates, but this is very seldom responsible for unequal deflection. They may be, however, susceptible to unbalance of voltages from plate to plate, and also to any pair of plates on one axis to the last anode in the gun assembly. This means that care must be taken to see that large unbalanced DC voltages should not appear on any plates in order to obtain positioning of the picture. The same applies to the deflecting voltages used to scan the tube. This means that the rise in voltage on one plate must be accompanied by an equivalent drop on the opposite plate, which can only be obtained by push-pull deflection.

Where serious unbalance occurs, the picture or raster will assume various shapes, depending on the type of unbalance. The most common form is trapezium distortion, which frequently occurs when deflection voltages are applied to one plate only of a pair. This is excellently shown in Fig. 2, where the right hand vertical

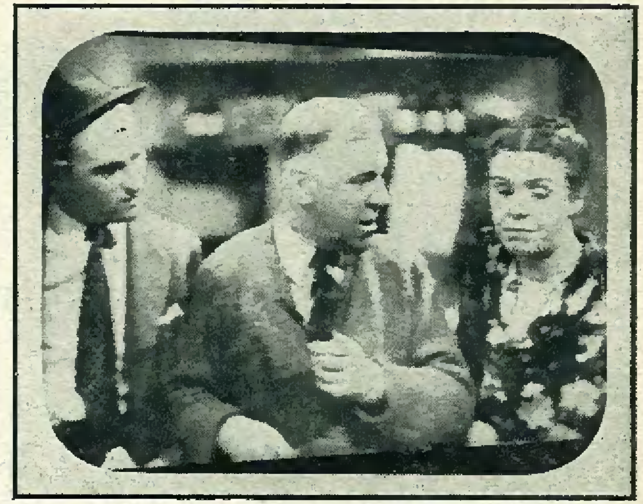


Fig. 2. Effect on picture of Trapezium Distortion.

(John Cura Tele-Snap)

edge of the picture is clearly shorter than that on the left.

When this occurs on both pairs of deflecting plates, the outer edges of the raster will form a four-sided figure with no two edges parallel.

Serious unbalance of the voltages in the CRT deflection system may also cause astigmatism or distortion of the spot shape, which may prevent accurate focusing being obtained, producing a fuzzy picture with poor definition. This can often be investigated by removing the deflection voltages and examining the stationery spot on the tube screen.

The small capacitances between deflector plates may also cause some interaction to produce astigmatism, but this may be reduced to negligible proportions if the output impedance of the time base is made small compared to the input impedance of the deflector plates themselves. As the interplate capacitance is usually of the order of a few picofarads, this effect seldom occurs, even at line frequencies where the coupling between plates may be equivalent to an impedance of a megohm.

In magnetic deflection systems, trapezium

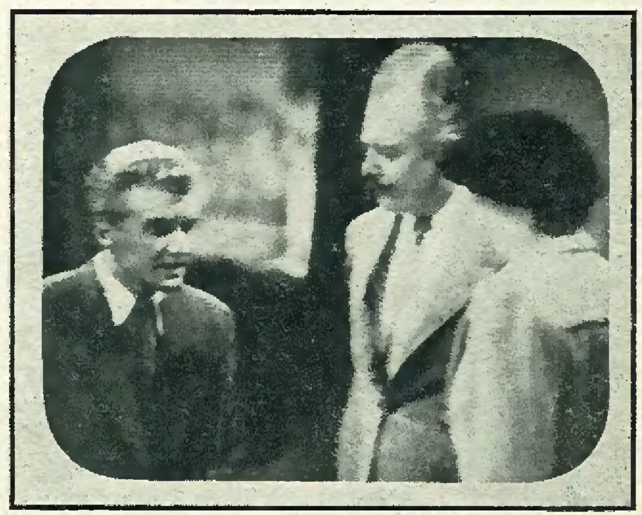


Fig. 3. Non-linear frame scan resulting in opening of lines at top of picture.

(John Cura Tele-Snap)

distortion occurs when there is misalignment of the deflection coils. Some adjustment to the coils may be possible, but this depends on their construction. It would be advisable to refer to the manufacturer, however, as they are easily damaged, rather than attempt to realign them.

Non-Linearity of Scan.

It can be shown that a sawtooth waveform, such as that which is required to traverse the spot across the picture, is, like other geometrical waveforms, equivalent to a very large number of sine waves, of different amplitudes, whose frequencies are related. For the circuits to handle these without distortion, care is needed in design to prevent the necessary component frequencies being attenuated.

The frame time base circuits are not so critical in this respect, as the fundamental frequency is 50 cps. The line time base, however, repeating at a rate of 10,125 times per second is much more critical, and linearity is more difficult to achieve.

In the electrostatic system of deflection, a sawtooth waveform has to be applied to the deflector plates and, unless complex amplifiers are used in order to achieve large scans, little difficulty should be had in obtaining linearity.

With the VCR97 and similiar types of CRT, working with a third anode voltage in the region of 2.5 kV, sufficient scan can be obtained with simple time bases consisting of a Miller integrator type of sawtooth generator driving another valve which has its gain reduced to unity (anode to anode) by negative feedback. The output is taken from the two anodes in 'push-pull'.

Due to the large ratio of negative feedback, the amplifier will be very linear, and all that is required is that the sawtooth waveform from the oscillator be of good shape. Any other form of sawtooth generator could be easily adapted, and the plate to plate deflection voltage is roughly twice that of the sawtooth generator by itself.

The most likely sources of trouble are unbalance in the outputs from the two valves which may be adjusted by varying the amount of negative feedback on the amplifier, and non-linearity of the oscillator due to leaking capacitors. A leakage of greater than 10 megohms in the charging capacitor of a Miller type of oscillator may give considerable opening-out of lines at the top or bottom of the picture in the case of the frame time base, and a similiar stretching at one side of the picture in the case of the line time base. Fig. 3 shows the appearance of this type of non-linearity in a frame time base. No attention should be paid to the formation of the flyback lines, as they give no indication of non-linearity.

——To be continued——

LOGICAL FAULT FINDING

By J. R. DAVIES

11: THE TEST BENCH

The last in a series of articles to assist the home constructor in tracing and curing faults

As the test bench is the focal point of all repair work, and as it is the place where one may spend many consecutive hours at a time, then it is always very advisable to treat this item with due consideration, particular attention being given to the comfort of the worker, to the availability of the necessary equipment, and to the liabilities of shock or burns.

Comfort.

The comfort of the serviceman presents a very real factor, if the hours spent at the test bench are to consist of pleasurable work and not of onerous labour.

For this reason, the test bench should be of such a height that the serviceman is able to stand at his work without stooping, as well as being able to pull up a chair and sit down comfortably to such jobs as those of alignment, voltage checks, and so on. The writer sees no point in standing up if it is possible to sit down. The bench therefore should have its surface some three feet from the floor, with plenty of leg room beneath it.

Its width from back to front should be at least two and a half feet and its length, if possible, some six feet. Plenty of space is always useful and the larger the surface of the test bench the easier it is to work on it.

It is advisable to keep the bench free from such things as heavy vices, etc. The amateur usually subscribes to various other interests in addition to radio servicing, and the professional serviceman often finds it necessary at times to carry out a little heavy ironmongery. Should there be sufficient space available work of this nature should be relegated to another bench, and the actual servicing bench treated more in the light of a laboratory table. Although this procedure may savour somewhat of over-fussiness, it will certainly show dividends in saved time and more careful workmanship should anything other than occasional work be contemplated.

Adequate lighting is another detail worthy of attention. If possible, the test bench should be placed against a window so that full advantage of daylight may be obtained. Servicing often involves the need of adjusting components which are set very close together : a good adjustable reading lamp proves very helpful for work of this nature. For work in the evening and at night time, a pendant lamp sliding on a wire raised above the bench will be found useful. Fluorescent tube lighting is excellent for servicing work, as the light-emitting surface on this type of lamp covers a far larger area than is provided by the normal electric light bulb, with the consequence that fewer shadows are cast.

Availability of Equipment.

The availability or accessability of the various items of equipment used during servicing is another point meriting careful attention.

The soldering iron will, for instance, be used from time to time and should therefore be always warmed up and ready for use. A good iron made by a reputable firm will not overheat, even if it is left on for considerable lengths of time. The iron should be kept on a stand in the right-hand corner, (if the serviceman is right-handed) sufficiently out of the way to obviate risks of accidental burns, and sufficiently near to be reached without getting up from one's chair. It should be provided with a good length of flex, (that fitted by the manufacturer usually has to be lengthened), so that it may be taken to any part of the bench without straining. The soldering iron should always be taken to the work : there should never be any need to carry the work to the iron. Resin-cored solder is ideal for servicing work, but a tin of flux should also be available for the odd cases in which the requisite length of solder does not provide sufficient resin to make a good joint. (Resin-cored solder tends to make one lazy insofar that when one encounters a "cold" joint already over-burdened with solder, even more is added as the resin-cored solder is melted onto the joint to take advantage of the flux in its core.)

As, during the course of servicing, one will meet receivers fitted with different types of mains plug, a lot of time is saved by fitting to the back of the bench a board carrying a selection of all the various types of mains sockets likely to be encountered. These sockets may be connected in parallel and taken to the mains.

A shelf fitted above the bench is very useful for holding signal generators and other items of test equipment. These may be fixed permanently in position, if necessary, sufficiently long leads being fitted to enable connections to be made to the receiver under test at any position on the bench. The writer personally prefers to have his signal generator on the bench itself, it being placed in any convenient position adjacent to the chassis. Since frequent alterations have to be made to the signal generator settings during alignment, it is better to have the controls under one's hand rather than have to reach up each time a new adjustment is required. This is a purely personal view, of course, and may not commend itself to another serviceman.

Similiarly, the testmeter may also be free to move on the bench or can be fixed to the shelf, according to the user's desire. A more important consideration, in the view of the writer, is to see that the testmeter is provided with sensible long leads and with good strong adequately-insulated test prods. As most voltage checks are made with respect to chassis, the negative lead to the meter can often be terminated in a crocodile clip, this being clipped to the receiver chassis for almost all the tests required.

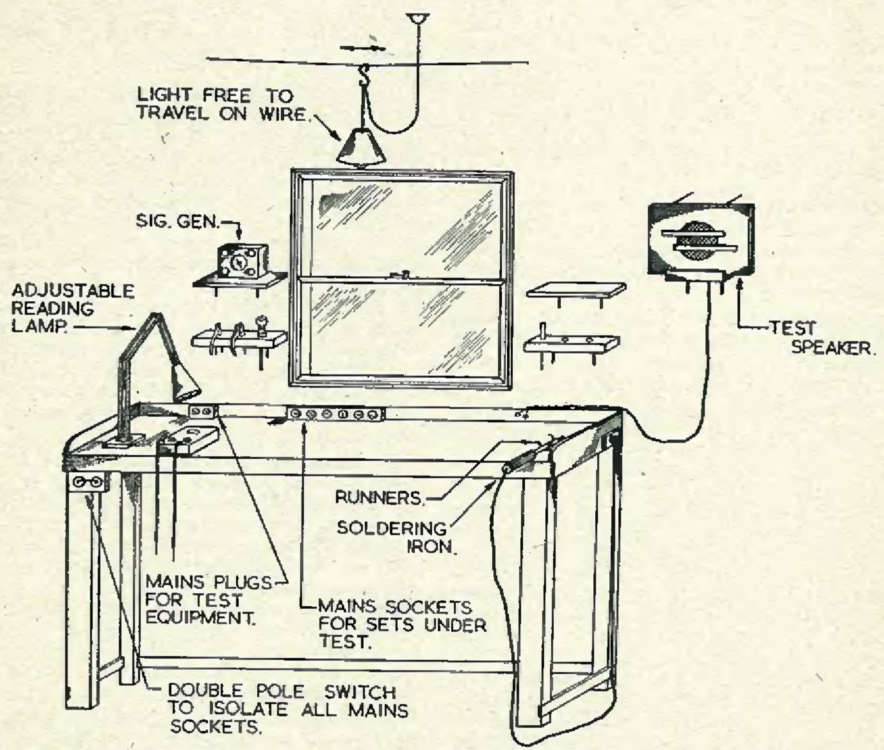
If the serviceman feels justified in going to the expense, an adjustable jig for holding the chassis in any required position may prove a reasonable investment. An alternative tip is to provide oneself with a few wooden blocks of different sizes, (something like a child's building blocks). These can be used to prop up the chassis, thereby avoiding damage to valves, tuning scales and so on, should the chassis have to be turned on its side or upside down.

Avoiding Shock.

Apart from the shocks liable to be received from HT circuits, etc., in the receiver, the most prolific source of danger in this respect is given by the AC/DC type of chassis. As the chassis in sets of this type are connected to one side of the mains, the serviceman may be the recipient of really serious shocks unless special care is taken.

As it is, of course, necessary for the serviceman to handle the chassis with his bare hands, the best course is to ensure that no path exists between his body and earth. For this reason there should be no earthed metal within easy reach. The signal generator, for instance, should have its case free and not connected to earth. Similiarly, it is advisable to have the metalwork of the soldering iron and any other electrical tools free from earth, even if provision is made for an earth connection.* The floor on which the serviceman stands whilst working must also offer no path to earth. Wooden floorboards, if dry, and particularly if covered with linoleum, should be quite safe. Concrete floors are dangerous, even if covered with lino. Wooden planks or duckboards should be laid in front of the bench in the latter case. (Rubber-soled shoes afford no protection against shock, the writer having satisfied himself on that point on several accidental and spectacular occasions ! (*Were the rubber soles nailed ?*—Ed).

* It should be remembered that, even if a signal generator is not connected to earth, there will still exist an AC path between its case and the mains, this being provided by the filter capacitors fitted to the mains input. These capacitors are often sufficiently large in capacitance to give an unpleasant shock when the case or the output leads are touched, and to give a noticeable spark when connected to an earthed or " live " object.



R.C. 733.

Fig. 64. A well laid out test bench.

A Few Refinements.

Every serviceman adds refinements to his particular test bench, these, of course, being suited to meet the peculiar needs encountered in his particular layout.

An addition that may be found useful is the provision of a double pole switch in the mains lead feeding the supply to the receiver under test, this switch being within easy reach whilst working. In the event of an accident such as may be occasioned by dropping a length of solder into the chassis or by some similiar eventuality, the mains can be immediately switched off before any damage is done.

Another useful refinement consists in covering the surface of the bench with a sheet of some smooth material such as plywood or linoleum. If any small screws or nuts are accidently dropped they cannot then find their way into the crevices offered by a bench with a rough surface. Runners fitted to the side and back of the test bench also help in preventing the disappearance of stray nuts and bolts.

A little thought soon brings to mind all manner of useful accessories that may be fitted to the bench. A selection of several aerials is very helpful in checking a receiver's performance. One of these may be a well-insulated high aerial situated outside the building, whilst another can consist simply of a few yards of wire strung up inside the room itself. An earth connection is, of course, a useful adjunct but should be kept well out of the way unless required, owing to the risk of shock mentioned above.

Fig. 64 shows a good example of a test bench which provides all the facilities mentioned in this article. If due attention is paid to all the various details raised in these articles, there is no reason why receiver servicing should not prove itself to be a very pleasant and fascinating occupation, not only paying dividends in results, but also in the experience gained concerning the commercial designer's approach to his receiver.

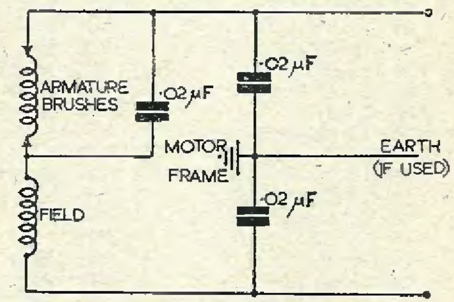
from our mailbag . . .

Dear Sir,

Whilst experimenting with a small series-wound universal motor, which was to be used in a wire recorder, it was found that considerable interference occured with a sensitive receiver due to RF radiation.

None of the conventional line suppression circuits were very effective, presumably because the field acts as a choke and isolates the brushes, so leaving them free to radiate.

Eventually the circuit shown in Fig. 1 was evolved, and with this no interference resulted, even when the motor was running a few feet from a sensitive short wave receiver.



RC 680 A

Fig. 1. The capacitors are mounted on the motor body. All leads should be as short as possible.

All capacitors are 0.02 μF 750V wkg metal-cased tubular non-inductive paper types. It must be ensured that all "floating" metal parts are connected to the motor frame, as in some cases where plastic bodies are used the stator or rotor may be electrically isolated from the frame.

In view of the large number of motors of this type which are employed for domestic and industrial purposes, this arrangement may be helpful to those readers who wish to operate sensitive receivers, such as communications types, whilst such motors are operating.

(L. F. Sinfield, Luton, Beds)

Ex-R.A.F. COMPONENTS

We present the third list of ex-RAF components, together with reference numbers and values. This list is compiled from information supplied by readers. As before, all the numbers stated are preceded by the reference 10/C. We regret that no copies are available of issues containing previous lists. Our thanks to those readers who supplied the information given below.

1	Filter Choke Type V	
5	0.000μF	25V
9	.002μF	350V
13	80pF	500V
19	200pF	350V
21	50μF	
23	0.5μF	
36	2.0pF	500V
38	100pF	500V
42	LF Choke 5H 200mA	
43	6.0μF	500V
44	4.0μF	500V
47	10+10+4+4	250V
50	2.0μF	250V
61	4.0μF	450V
62	1.0μF	
72	LF Choke Smoothing Type 26	
73	LF Choke Large 27	
74	LF Choke Mains 28	
75	LF Choke Large 29	
76	LF Choke Smoothing 30	
82	.002μF	350V
83	18pF 2 Gang Vari	
85	3.2pF Neutralising Vari	
86	3.2pF Neutralising Vari	
87	100μF	2.5kV
88	59-5pF Vari	
93	4.0μF	500V
99	4.0μF	1.5kV
101	.001μF	350V
104	400pF	750V
214	.001μF	350V
223	5.0μF	
233	10pF	
234	40pF	
241	.0275μF	
242	.06μF	
243	.165μF	
244	.01μF	350V
245	.003μF	350V
247	2.0μF	500V
251	4.0μF	250V
271	300pF	350V
274	.25μF	
275	2.5μF	500V
276	10μF	250V
279	2.5μF	500V
289	20μF	50V
308	50pF	500V
312	4.0μF	750V
333	0.1μF	250V
336	.0025μF	2kV
339	4.0μF	
344	14-350pF	
351	40pF	
366	0.003μF 2 Gang Vari	
367	.001μF	350V
368	0.0005μF 2 Gang Vari	
369	Vernier SM	
370	0.01μF	
371	140-220pF trimmer	
372	0.1μF	
374	23.5—30pF Vari	
375	20.0001μF Vari	
377	0.005μF	
378	25pF trimmer	
379	0.0001μF	
380	2.0μF	250V
381	0.5μF	
382	2.0μF	200V
388	LF Output Choke	
392	.001μF	
393	2.000pF	5kV
394	3.000pF	3kV
395	.004pF	
397	.25pF	
398	50pF	
399	18pF Vari	
469	1μF	250V
475	20.001μF Vari	
477	0.5μF trimmer	4kV
481	0.0005μF	
496	.001μF	350V
497	.003μF	
504	1.0μF	
531	60μF	200V
532	16μF	250V
533	.1μF	500V
534	50μF	12V
535	.01μF	1kV
543	20pF Vari	
545	6pF	500V
552	.25μF	350V
559	32μF	600V
560	2.0μF	350V
561	.5μF	550V
564	80pF	6kV
565	16μF	700V
566	4.0μF	800V
567	4:0μF	450V
568	16μF	700V
569	4.0μF	700V
571	LF Choke 45H 30mA	
572	LF Choke 8H 8mA	
579	LF Choke 1.21-99H	
580	LF Choke 22H	
581	LF Choke 8.5H	
582	LF Choke 1H	
605	LF Choke 2.50H 150mA	
607	32μF	650V
608	2.0μF	250V
609	4.0μF	150V
610	160μF	15V
634	5pF Silver Mica	
652	200μF	35V
653	800μF	9V
654	800μF	12V
655	1μF	500V
658	LF Choke 35H 400mA	
666	60μF	9V
667	110μF	500V
672	25pF	500V
673	50pF	500V
674	700pF	350V
682	45pF	350V
683	.1μF	450V
684	.01μF	450V
686	.02μF	6kV
695	.1+.1μF	600V
696	.05+.1μF	5kV
697	.1μF	2kV
706	.1μF	1kV
707	.01μF	3kV
710	2+1μF	350V
711	26μF	40V
712	350pF	500V
713	15pF	500V
714	100pF	500V
715	2+1μF	600V
716	60μF	12V
728	16pF	500V
729	4.0pF	500V
731	2-30pF Vari	
732	160pF	500V
734	.0016μF	350V
735	.001pF	500V
740	150μF	350V

(*continued on page* 323)

Query Corner

A " Radio Constructor " service for readers

The Vision Carrier.

" I fail to see how the diode detector of a television receiver can give a positive output voltage when the RF stages are tuned to the lower side band. I fully appreciate that, when double side band operstion is employed, either polarity may be obtained by reversing the connections to the diode detector."

L. Adams, Hillingdon.

This question can best be answered by considering the results of taking an oscilloscope and examining the wave forms at the detector of both a single side band television receiver and a receiver whose tuning arrangement covers both the upper and lower side bands. Firstly, let us connect our 'scope to the RF transformer, which feeds the detector diode of a double side band receiver. As would be expected the signal appears as a replica of that which is transmitted by the B.B.C. A section of this television signal is reproduced in Fig. 1, from which it will be seen to consist of a carrier, the video or modulating frequency, and the synchronising pulses; these latter two components are made to modulate the carrier at the transmitter.

If, now, we transfer the oscilloscope to the input circuit of the detector of a receiver which is tuned to the lower side band only, we may be surprised to find that it is impossible to determine any difference between the wave forms found in the two receivers. The reason for this may be best understood by considering the separate frequencies which make up the television signal. The carrier is of constant amplitude and fixed frequency, and is modulated by the video signal and the sync. pulses. This modualation varies both in amplitude and frequency between zero and 3 Mcs. The combination of these two frequencies may be expressed simply as fc plus or minus fm, where fc is the carrier frequency and fm is the modulating frequency. Now, if we allocate a value to fc, say 45 Mcs, and take the modulating frequency at its maximum value of 3Mcs, we find that the modulated signal will cover the band 42 to 48 Mcs. Thus a double side band receiver will be tuned to provide a reasonably flat response over this range. Because of the difficulty of obtaining this bandwidth without sacrificing a great deal of stage gain, it has become normal practice to tune the receiver so that it accepts one or other of the side bands, normally the lower one. This means that the " plus fm " component is rejected from the signal by the tuned stages in the receiver, and the voltage fed to the detector stage consists of fc minus fm, or, using values, 42 to 45 Mcs when fm varies by 3 Mcs. It cannot, however, be too highly stressed that the removal of this one component from the vision signal does not materially alter its general shape, but it does make it much easier to obtain the maximum amplification with a bandwidth of 3 Mcs in place of the 6 Mcs which would otherwise be required. Because of this it will be apparent that, even with a single sideband transmitter, it is possible to obtain a positive or negative going video voltage depending upon the orientation of the diode detector.

Having considered this explanation, it will be clear that the radiation of both the sidebands from a television transmitter is in general unnecessary, and even a disadvantage because of the wide bandwidth required. The importance of this latter point will be appreciated when it is considered that the B.B.C. are erecting several transmitters, each of which must operate on a different frequency if the likelihood of interaction is to be avoided. Thus it is, then, that the decision was taken to operate the Sutton Coldfield transmitter on the single sideband system.

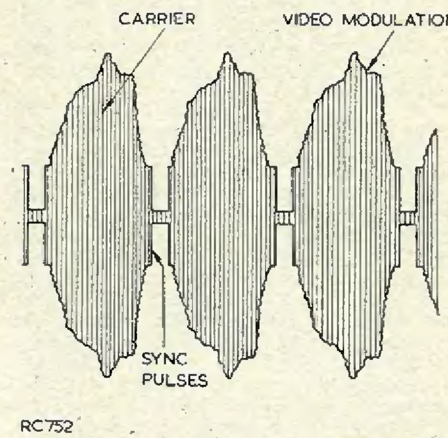


Fig. 1. A section of the television signal. The relative frequency of the carrier is shown considerably reduced in order to clarify the diagram.

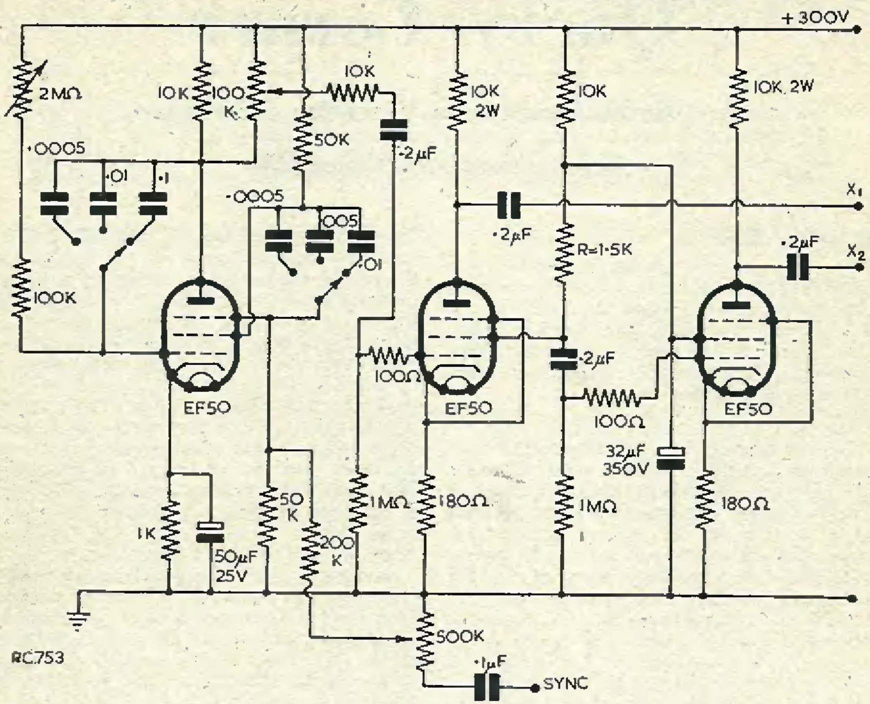


Fig. 2. Transitron Oscilloscope Time Base. The value of the screen grid load resistor " R " should be adjusted for balance of the paraphase amplifier.

A transitron CRO time base.

" *I have noticed that the transitron type of oscillator is recommended for use in the time bases of the Inexpensive Television receiver. Would you recommend its use in the time base of a cathode ray oscilloscope and if so, could you please suggest a circuit.*"

L. Hammond, Isleworth.

The transitron oscillator when coupled with a Miller integrator circuit is capable of providing extremely satisfactory results as the time base in a cathode ray oscilloscope. The circuit diagram showing a time base of this type is indicated in Fig. 2, and it will be seen that it is basically the same as that employed in the Inexpensive Television receiver. The major difference between the two circuits results from the necessity of providing a means of adjusting the frequency between quite wide limits, and this is obtained by switching the integrating capacitor and the suppressor-to-screen-grid feedback capacitor. It has been found in practice that the majority of radio and television waveforms may be viewed with the aid of a time base having a frequency range of 25 cycles to 20 kc per second, and this coverage is simply obtained in this circuit by means of a two-pole three-way switch, used to select one of three capacitors in each of the two circuits. Fine adjustment of the time base frequency is obtained by a variable charging resistor in the control grid circuit. The combination of resistors and capacitors indicated on the circuit diagram enable a smooth non-critical frequency control to be obtained. The time base frequency may be locked or synchronised at a submultiple of the frequency under examination by applying part of the latter to the suppressor grid of the oscillator valve. The synchronising voltage is obtained from one of the vertical deflector plates.

Deflection defocussing is the term used to describe the phenomena which causes a gradual defocussing of the spot on the CRT screen as it is deflected away from the centre of the screen. This rather annoying effect is minimised by arranging that the mean potential of the deflector plates equals the potential of the final tube anode; condition which is best fulfilled by feeding the deflector plates of the tube from a paraphase amplifier. A paraphase output is obtained in this particular circuit in a rather novel manner. The amplifier consists of two valves, the first of which feeds one of the horizontal deflector plates (X.1.) The input voltage to the second valve is developed across a small load resistance in the screen-grid circuit of the first; as the second stage requires only a small drive voltage the value of the load resistance may be of sufficiently low value to prevent its presence upsetting the general balance of the circuit. The frequency response of the amplifier is sufficiently flat to enable the amplification of the time base waveform to be accurately reproduced at its highest frequency without noticeable distortion, and satisfactory results will be assured providing two important points are borne in mind (1) To avoid stray pickup and ensure complete stability, it is essential that all the leads associated with the time base are as short as possible. The valves should be mounted in a straight line, and it is convenient to situate resistors and capacitors on a tag board placed on one side of the valve holders.

(2) There must be no ripple on the HT supply voltage. Any such ripple will appear at the output terminals of the amplifier and cause a jittering of the time base trace; this effect is particularly noticeable at low frequences.

As the time base and amplifier are fed from a 300V HT line, sufficient output voltage will be obtained to fully deflect a six inch cathode ray tube such as the VCR.97, when the latter is operated at a final anode potential of 1.5 kV. If a 3" cathode ray tube is employed a 250V HT supply will be adequate.

" Query Corner " Rules

(1) A nominal fee of 1/- will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to " Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London W.9.

(6) A selection of those queries with the more general interest will be reproduced in these pages each month.

(continued from page 320)

741	32µF	320V
742	100pF	500V
744	.075µF	350V
745	300pF	350V
746	.5µF	350V
769	100+100pF SW Vari LH	
770	100+100pF SW Vari RH	
772	Inductance .65µH	
784	10pF	750V
785	15pF	750V
788	50pF	750V
790	150pF	750V
791	300pF	750V
826	4mH	
838	.01µF	350V
842	.01µF	1kV
843	16µF	450V
844	250µF	12V
846	LF Choke 8H	
851	.1µF	500V
853	40pF	500V
857	48pF	500V
858	45pF	500V
859	70pF	500V
861	35pF	500V
868	.05µF	600V
869	200µF	500V
872	130pF 2 Gang Vari	
873	.002µF	350V
874	30pF	500V
883	.01 + .01 + .01 + .01 + .01µF	600V
884	.0005µF	350V
886	.1µF	750V
892	0.42mH	
894	100+100pF Vari	
900	.5µF	1kV
910	.0001µF Vari	
911	8.0pF	500V
912	Inductance 0.59mH	
913	0.29mH	
915	60pF Vari	
916	60pF Vari	
917	.0001µF Vari	
939	0.1µF	4kV
941	.1+.1µF	8kV
954	25pF	500V
961	.1+.1µF	250V
1804	0.3µF	300V
1805	1µF	150V
2012	93pF	350V
2020	.01µF	600V
2024	.25µF	1kV
2025	.001µF	350V
2026	3.0µF	500V
2028	.025µF	450V
2029	32µF	400V
2030	4.0µF	600V
2032	Inductance 8H	
2046	.25+.25µF	4kV
2047	1+1µF	100V
2048	.1µF	350V
2055	.004µF	350V
2069	3-18pF	
2076	300pF	350V
2089	300pF	
2092	LF Choke 32H	
2093	LF Choke 20H	

COPENHAGEN PLAN—NEW WAVE-LENGTH DIALS.

The G.E.C. announces that following the introduction of the above Plan, new tuning dials will be available for all the Company's post-war radio and television receivers affected. The following are the receivers affected:—

BC.4641	BC.4855	BC.5060
4650/L	4940/L	5068
4655	4941	5070/L
4750/L	4945	7092
4758	4956	7094
4758R	5050/L	9144
4835	5054	3443
4835R	5055	3839
4850/L		

Not all dials are immediately available but distribution will be made through the usual trade channels. Dials for incorporation in existing trade stocks, wholesale or retail, will be issued to the trade on a no-charge basis, on receipt by normal G.E.C. sales channels of certified stock lists. Dials for resale to users will be treated as normal sales.

Radio Miscellany

THE urge for the Spring clean that threatened last month was too strong to be denied, and so I made an extra early start this year. Despite what I said about weeding out the items that have been hoarded for seven years or more, I must admit to finding a number of museum pieces when I began to dig deeply.

An old pocket type moving-iron meter was among the relics unearthed. It worked too—just as badly as it did when new !

Possibly many of the constructors of to-day having grown up in a world where a meter needle does as it is supposed to and glides smoothly and silently over to the reading and settles without any bother or fuss, cannot imagine what those so-called "dead-beat" needles were like. As soon as you touched down with the prods the needle shot over to the back stop with an audible kick, bounced back and then swung violently backwards and forwards in diminishing arcs. In a matter of fifteen seconds or so it hovered quiveringly over some part of the scale.

Then the fun began. Desperately you would try to remember whether the reading with the meter in the vertical position, or lying flat on its back, gave its most nearly correct reading. Whichever it was you could never be quite sure, so you tried both. Standing up it might say 65 volts and lying down it showed 115. With the aid of a stump of pencil and the back of a cigarette packet you worked out the average.

If you attempted to re-check the reading a few minutes later you probably got two quite different readings. Not that a detail of that sort worried you much. Indeed, having four figures to mess around with, one felt that the average might well be somewhat nearer the true voltage. Then you simply added a given percentage for the voltage dropped by the heavy consumption of the meter itself and left it at that.

In later years, when after much self-denial you saved up enough money for a meter comparable with the modern instrument, you found youself taking readings simply for the joy of watching the needle swing smoothly to position and then stop. It was fascinating. Amateurs would invite their friends round to witness it, and found an obvious delight in their discomposure at this phenomenom.

Tough Guys

The average constructor of the early days was essentially a handyman, and in truth it must be said that a great number of them never became anything more.

Strange as it may seem to-day, some of them even resented the introduction of more advanced designs—probably because the added complications threatened to drag them out of their depth. I heard more than one old die-hard bemoan the introduction of the first dull-emitter valves on the grounds that it wasn't real radio and that they could not possibly be any good anyway. Apparently they considered the hunking of enormous accumulators round to the local garage as part of the joy of the hobby and as evidence of their manly qualities.

They had no faith in a valve they could not see light up. The old clear-glass types which could be depended up to retain their bright, cheerful glow for years if need be, were the sort for them. They argued that you could at least see they were working alright. Quite how, I never discovered. But it was certainly a long time before they would have anything to do with the new-fangled, flash-in-the-pan dull emitters. It was also argued that one could not see them "blue-glow," and a bright blue fluorescence in those days was considered the hall-mark of a good detector. If one could not see the blue-glow how could one be sure of the best operating voltage ?

When they failed, as the early dull-emitters so often did, they were not slow to put on the what-else-did-you-expect act and congratulate themselves for being far too sensible to waste their money on such fanciful fripperies.

Design de Luxe

Also unearthed was an old electric soldering iron of Japanese origin, which used to retail at 1/11d. You would hardly buy the flex and plug at that price to-day, let alone pay the purchase tax, but amazingly enough they worked. Actually most people bought a good electric iron for "best use," too.

Thinking of electric irons reminds me of my earliest days in the Forces. Things were pretty quiet during the "cold-war" stage and equipment was slow in filtering through. One chap in the workshops made himself an electric iron. Believe me, he started something. It became a positive rage.

In next to no time everybody was making soldering irons. Fancy bits of shapes that even Euclid never thought of, interchangeable bits, interchangeable elements, switched elements for "extra-hot," "normal" and "idling" which were popularly known as 3-speed models, pistol grips, trigger switches, and "self-balancers" which held the bit a couple of inches above the workbench when laid down. Even self-feeding solder models and automatic point cleanrers began to make their appearance, to be admired, criticised, copied and improved upon.

While on the subject of soldering I find it hard to believe that there can be still so many untidy and bad joints in amateur construction in these days when the electric iron is almost universally used. There is some excuse for those compelled to use a plain iron and who have not quite mastered the knack of "sensing" the bit temperature which only comes from experience, and where the problem of cleaning the point without cooling it has also to be solved.

Successful radio-work soldering begins at an earlier stage than the beginner thinks. In fact, it starts before he buys the solder, whether it is resin cored or not !

Rule 1 in the "Beginners Guide to Successful Soldering" should read, "Buy only solder where the tin to lead ratio is stated by the manufacturer and make sure you get the right sort."

A high ratio of tin to lead is important. The greater the amount of lead the more the heat that will be required. Nor does it flow so easily and it also has the disadvantage of tending to "crystalise."

It is false economy to buy a bigger coil at bargain price unless you can be sure that it is not some old war-time stock which, owing to its shortage, had a reduced tin content, or a cheap line unsuited to radio use.

CENTRE TAP
TALKS ABOUT
Old Times and Components — Instability

L.F. Instability

I recently mentioned the tendency of constructors to wrongly associate certain faults with particular parts of a circuit or its components, only. A further instance of this pitfall has since come to light. This time it was instability and the constructor could readily understand that it could arise in the RF end of a receiver or even in the IF stages, but could not imagine his trouble could be due to instability in the LF stage. I suspect too that not until the fault was cleared up in his presence did he really believe it.

With modern high gain tetrodes it is by no means uncommon, and for the benefit of others who may meet similar trouble, here are the remedies. Normally only one, possibly two, should clear it up, but there is no reason why in a particularly obstinate case they should not all be used.

Firstly, a grid stopper resistor connected in circuit at the grid pin of the tetrode should be used. This should have a value up to about 50,000 ohms.

Secondly, a form of decoupling between the anode and screen of the tetrode should be tried. A suitable value for the resistor would be 100 ohms and there is no need to use a decoupling capacitor.

Thirdly, the gain can be reduced by omitting the by-pass capacitor across the cathode bias resistor thus applying a form of negative feedback. Alternatively, negative feed-back can be applied by connecting a resistor and small capacitor between the anodes of the tetrode and the preceding valve (direct to the pins on the holders). Suitable values would be, a resistor of .5 megohm upwards in parallel with a postage-stamp variable capacitor of 150pF maximum.

The third and fourth methods result not only in a reduction of gain, but also in an accentuation of the higher frequencies and apparent loss of bass. To obviate this, a small reduction in the H.T. voltage would probably give full stability yet leave the musical response unaffected.

The Enquiring Mind

I am asked why the two-piece metal screens for clipping on to glass valves are called "Goat-cans."

I cannot even venture a guess and can only refer the enquirer to some American periodical. It started over there just like such terms as hum-dinger, bug key and tickler coil, and we just accept them without asking why.

SURPLUS RADIO EQUIPMENT

described by B. Carter

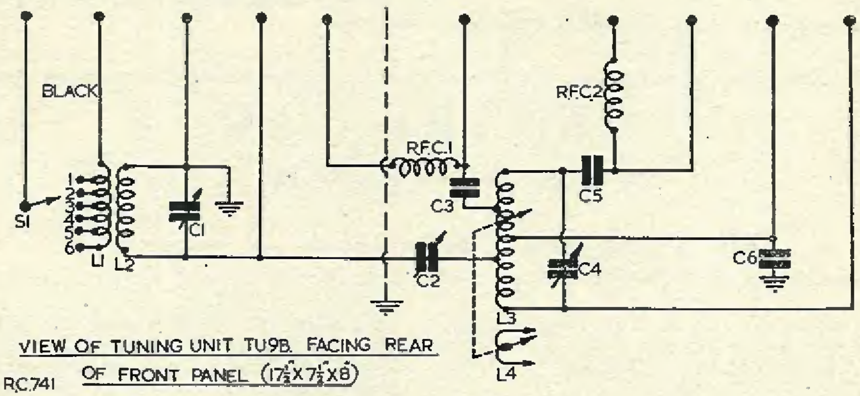
In this series of articles it is intended to describe units that have (a) immediate application, after some modification perhaps, in the amateur world, and (b) to list the contents of those units that can best become sources of valuable components. This month's unit comes under category " B."

TRANSMITTER TUNING UNIT TU9B
(Frequency Range 7,700—10,000 kcs.)

MODIFICATION of a similiar unit has been dealt with before in this magazine (see pages 541-543, April, 1949), but it is the intention of this article to list the contents and to give the circuit diagram of this particular type of tuning unit, so that the reader may decide for himself what modifications he could make or whether parts would be useful to him.

The construction is of heat-treated aluminium and is very firmly put together. A No. 6 Allen key will be needed for all grub-screws and the like, and a ¼" box spanner for some of the nuts that will be encountered. All components are "hung" on the front panel and are enclosed by the vertical sides which are formed in one piece. The top and bottom are perforated plates screwed to the flanges of the sides. The unit may be fitted into a carrying case which is a black crackle finished box enclosing all sides but the front panel.

In service life this unit was used with the transmitter BC-375.



Circuit of the TU9B unit.
Component List

L1 (inside L2) & *L2*, 7462701
L3, 7462702
L4, Alignment ring
C1, PA Tune (C), T 7660443-3 20-156 *μμF*
C2, neutralising, T 7660443-8, 10-30 *μμF*
C3, C5, mica 9H, 7661663, 400 *μμF* 2.5 *kV wkg.*
*C4, MO Tune (B), P*7761569-6, 20-140 *μμF*
C6, mica 9LS, 7761443-2, 400 *μμF* 2.5 *kV wkg.*
S1, ANT COUPLER (D), 6 *position*
15 *Ceramic Pillars.* 1 *Ceramic Shaft Coupling*
1 10-*way Banana Socket Strip.* 2 *Slow-Motion Dials.*
2 *Ceramic and* 1 *Fibre Coil Formers.*

Radio and Electronic Component Manufacturers' Exhibition

IN attending an exhibition of this sort, your representative immediately wonders just how much is going to appeal to the amateur. At this stage then, it must be stated at once that some are interested in our custom and some are not.

One very well-known firm of capacitor manufacturers had on display several new types of trimmers and variable capacitors which would surely have had an immediate appeal to the amateur. However, the information was that these are not for general sale but for the specific requirements of a large radio set manufacturer. The capacitor concerned, which indeed would have been useful to the writer, was a small three gang variable (0005 μF) with a built-in 6: 1 ratio slow motion.

Generalising on the Exhibition itself, emphasis appears to be laid on quality and miniaturisation. In the field of television, experimental set-ups for projection occupied a lot of attention, as did the aluminised tubes which will be available very soon to replace most existing tubes. Some of these are available now, and the characteristics seem to be very similiar, apart from requiring additional E.H.T. and scanning output voltages. The changeover will be worthwhile due to the manufacturer's claims of an increase of as much as 10 times in contrast and brilliance. Confusion is greater than ever in the fearsome subject of valve bases, and indeed another one has made its appearance, the Noval. This has been introduced by Messrs. Mullard. In this particular case I imagine the amateur will welcome this range, particularly the new pentode and triode in one envelope. This can be used as a mixer or a triode detector and pentode amplifier, which opens up another great field of compact design. Also obtainable from the above valve manufacturer are some flat sub-miniatures for hearing aids, three of which will fit into a thimble. The filament wire is less than one-tenth the diameter of a human hair. Whilst on the subject of valves, it is painful to realise the chaos. My sympathies go to Messrs. McMurdo's, who are manufacturing 90 different types of valve bases.

Somewhere or other in most exhibitions, one usually expects to find a real fashion movement, and here this appeared to be in the construction of transformers. There can be no doubt that the old type transformers, with the exposed windings or semi-shrouded types that we have known for so long, are on the way out. Messrs. Parmeko and Messrs. Woden, for example, were both showing their new ranges of hermetically sealed models. These are filled with different materials, oils, jellies, etc., which would mean insipient breakdowns, flash-overs, etc., being reduced to a minimum. This has always been particularly troublesome in the matter of high voltage transformers for transmitters, and for E.H.T. supplies in television.

For those interested in gramophone accessories, the Erwin-Scharf three-way pick-up has been designed for 33⅓, 45 and 78 r.p.m. This, of course, was primarily designed for the U.S. market.

Westinghouse have made great efforts to simplify and cheapen television rectifiers with their new ranges of met-rectifiers which can be used in a great variety of ways, including the dispensation of mains transformers completely—a great space and weight saving.

Messrs. Partridge have introduced mains and audio transformers using the " C " cord construction not previously marketed in this country. This will probably be greatly welcomed by the amplifier enthusiast.

In our opinion, elasticity can be seen in the industry as a whole, and we noted a willingness of the manufacturer to cater for the unusual. This is a very big point, considering that all of our industries are directed towards export, and, without the slightest possible doubt, an effort would be made to supply most requirements to stringent specification. We can only refer you back to the first paragraph and trust that if you really need some special component you will get it. Quality and accuracy were undoubtedly the hallmarks of this show, apart from external appearance. The finish of a great many components left the writer to regret that they would probably not be seen once installed.

A.T.

JONES *and the* Electronic Treasure Finder

By C. NOALL

MY friend Jones, I am pleased to report, has now been set at liberty once more, following his temporary incarceration in a lunatic asylum. He is—almost—his normal self again, and seems to be quite recovered from his EHT burns and bruises.

Thinking it desirable to keep him pleasantly occupied until he should have settled down again, I gave him one of those No. 5A Polish mine-detector units—a neat little job which can be converted and used for tracing buried metal. "He can't blow himself up with *this*," I thought. "It only works from batteries, so where's the harm ?"

Of course, I should have known better. It's just fatal to put any new electronic ideas into Jones' ingenious head.

Mind you, he didn't go off the rails at once. In fact, he accomplished wonders with that old detector. He unearthed a 2,000 lb. unexploded H.E. in his back garden and an old brass helmet in Farmer George's broccoli field. (Jones said this latter object was first century Tenth Legion, but our local antiquarian pronounced it nineteenth century Fire Brigade.) But it was the Queen Anne farthing he found in my cucumber frame that really gave him his Great Idea.

"I *wonder*," said Jones, caressing the little coin lovingly, "if it would be possible to build an electronic treasure detector—an instrument, that is, which would only give a reaction in the presence of gold and other precious metals ?"

I tried to dissuade him from the practical pursuit of this notion, and thought I had succeeded. But then alarming reports began to circulate about Jones' activities which made me realise I had failed, after all.

For—so my little birds told me—Jones had been snooping around the junk shops again and had purchased: 1 heavy ex-W.D. lorry; 1 large petrol-driven generator; and enough radar gear to fit out a battle squadron.

I knew then that we were for it. Nor was it long before the blow fell.

"I've made it !" cried Jones exultantly when I met him one evening in town. "Come back with me to my garage and try out the Jones Patent Electronic Treasure-Finder for yourself !"

I tried to escape; but Jones fastened a ju-jitsu hold on my arm; and off we went.

Yes, there was the lorry, a covered-in affair, crammed now to the roof with the generator and radar equipment.

"Now," said Jones, showing me a metal box attached by multi-way cord to the lorry, "this is the business end of the apparatus. It works thus: I discovered, after many experiments, that every metal has its own individual radio-frequency resonance characteristics; this makes it possible—when you know how—to 'tune-out' unwanted metals, like iron and copper, and 'tune-in' the wanted ones, such as gold. I've actually arranged for press-button tuning for gold and silver, so it's very easy to operate. When the detector box is placed within a radius of about 50 ft. from any small gold object it 'clucks,' like a Geiger counter. The more gold there is, the louder it sounds. Now for a demonstration. Have you any gold object upon you ?"

Reluctantly I produced my beautiful gold repeater.

"Hide it somewhere in the garden," said Jones. "Then I'll come along and 'detect' it for you."

Well, I hid the watch under a raspberry bush whilst Jones revved up the generator. Of course, he kept the garage doors closed for this, and nearly knocked himself out with monoxide poisoning.

When we had sent the ambulance away, Jones, still a little white about the gills, began to totter around the garden, detector-box in hand, searching for my repeater.

Crossing the lawn, the thing began to cluck.

When he stood over the raspberry bush, it stopped clucking, and crowed.

Between ourselves, and without boasting, mine is a *very* good watch indeed. Twenty-two carats, plus rubies.

"Now," said Jones, switching off the engine, "to-night we're going treasure-hunting."

"I've got hundreds of QSL's to get off——" I began feebly.

"Afraid ?" sneered Jones.

"I'll be there," I said, nettled. "But I'll make my will first."

"Good," he said. "Now listen. This morning I went for a spin in the old lorry. I kept the detector switched on all the time—just in case. Well, when I was passing a piece of waste ground, the instrument started to react. I couldn't very well make any further investigations then in broad daylight, because—well——"

"Look here," I said uneasily, "you're not proposing we go digging up somebody's tennis court at midnight, are you ?"

"I give you my solemn word," said Jones, putting his hand on his heart, "that it's a piece of derelict land and belongs to nobody at all."

Well, at half-past midnight we set off. Jones drove the old lorry at breakneck speed down a maze of streets and lanes and at last drew up under a high wall.

"Here we are," he said. "Hold the box whilst I start up the generator."

The engine coughed, then began to purr steadily. Jones switched on his torch and conducted me through a gap in the wall. The detector was certainly clucking loudly, and I must confess I began to feel a keen sense of pleasureable excitement. Visions of untold wealth swam before my eyes as I stumbled after Jones in the darkness.

That ground certainly *was* derelict. Burdocks and thistles grew there that were fully as high—I'll swear—as the TV mast at Sutton Coldfield, whilst the nettles seemed charged with high voltage electricity.

After we had proceeded about ten yards the detector suddenly went berserk. It produced sounds reminiscent of a poultry farm on the day before Christmas Eve.

"Switch off, for Pete's sake !" exclaimed Jones. "They'll think we're raiding a hen-roost !"

"Do we dig here ?" I enquired, obeying him.

"Yes," said Jones. "I'll slip back to the lorry, turn off the generator and fetch the picks and shovels."

He went and returned in a jiffy.

"Now," said Jones cheerfully, "I'll let you have the first dig, if you like. I know you're very fond of gardening !"

"I thought there was a catch in it !" I groaned, peeling off my coat. "Well, here goes. If ever there was a mug, it's me !"

Candidly, I've never seen such roots in my life as grew beneath the surface of that field. They reminded me of the switchboard junction at a telephone exchange. I hacked and swore, and swore and hacked, whilst Jones looked on and made cutting sarcastic remarks. At last, when I had got below the "root-line," so to speak, having reached a depth of about four feet, he kindly consented to relieve me.

"Must be nearly there now," he observed, jumping into the pit.

"How do you know ?" I asked suspiciously, mopping the sweat from my brow.

"Oh, just intuition !" he replied airily.

And, sure enough, five minutes later he uttered a delighted exclamation, stopped, and then handed me a small round object that glittered brightly in the torchlight. It was a gold ring.

"Whew !" I whistled. "Jones, old boy, you're a wizard !"

"You haven't seen anything yet !" retorted Jones, quickly producing a brooch and an earring from the bottom of the hole. "Aren't you glad now you came ?"

"You've said it !" I grinned. "Make way, there, old man ! I'm joining you !"

"There's not room !" Jones protested angrily.

"Don't be greedy !" I retorted. "Who dug the blessed hole, anyway ?"

So in I went. Jones was right, though; space *was* rather at a premium down there.

Together we groped and scrambled in the dirt. I found a beautiful diamond-studded pendant and a curious old silver coin. Jones kept on disinterring rings—enough to marry off the Dionne quins, I should say. But we were both handicapped by the darkness. I had put the torch in my pocket on jumping into the pit, and, really, it was a *very* dark night.

"Half a tick," I said, carefully putting away my findings. "Let's have the old gloom-chaser on again."

But Jones, for some reason, wasn't too enthusiastic.

"I shouldn't, if I were you," he advised.

"Why not ?" I demanded.

"Well, you see——"

I ignored his remonstrances and switched on.

I shall never forget the sight that met my eyes. For there, rolling about the pit under our very feet and grinning up at us now with simply frightful expressions on their fleshless phizogs were—*four large yellow skulls* !

"Alas, poor Yorick !" I gasped, almost falling down with fright. Then, recovering myself, I seized Jones savagely by the scruff of the neck.

"What place IS this ?" I roared, shaking him like a rat.

"Let go—you're hurting me !" burbled Jones. "I tell you, this gold doesn't belong to anyone ! These blokes have been dead for centuries ! Why, even their tombstones have disappeared !"

I don't know *what* I should have done to the silly ass if a police whistle hadn't sounded just then.

Together we bounded from the grave and raced for the lorry. I will say that for Jones—he *does* know how to drive in an emergency. Mind you, we had to jettison the generator somewhere on the Kingston by-pass; and even then the police car nearly overhauled us in Bloomsbury. But we got clear at last, abandoning the lorry in the neighbourhood of Gravesend.

And the trinkets—believe it or not—were *pinchbeck* !*

*Pinchbeck: An alloy of 83 parts copper with 17 of zinc. Named after its inventor.

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 2d. per word, minimum charge 2/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 1/- will be made. Terms: Cash with order. All copy must be in hand by the 10th of the month for insertion in the following month's issue.

PRIVATE

EDDYSTONE S640 perfect £20/10/- Require HRO 40-80m coils.—G2ABK, Hundleby, Spilsby, Lincs.

TAYLOR 90A METER, complete. Recent makers overhaul £10. R107 Multivibrator 230AC circuit £2/10/-. Doz. SP61 1/6 each. Doz. EF50 2/6 each. Others available. Guaranteed.—Needham, 34, Maple Avenue, Upminster, Essex.

HALLICRAFTER S.20 perfect, 43mcs-550kcs, £15, offers ideal S.W.L. 1155 fully modified 6v6 S.meter, sprayed £8. RX115 300-600mcs bandspread G.G. RF stage, £8/10/-. BC348, unmodified, 10 metre converter, £13. 2 metre converters. TV kits built. S.A.E. first.—Taylor, Shoemaker, Lake, I. of W.

EXCHANGE—any or all 34 Wireless Worlds, 1946 to 1949, also some Americans for components, valves, etc.—G. O'Reilly, Porters End, Kimpton, Hitchin, Herts.

MARCONI Type 6 amplifier with pre-amplifier and power pack unit. Pre-amp. contains oscillator 2PX255 MHL4 ML4 rectifier delayed HT current meter. Perfect £8. Would exchange for W1191 wave-meter complete with crystals. BC453 £1/10/0. ZB3 4 acorns £1/10/0.—Box A122.

ECR60 CRT, 20/-; EMI 4/1 CRT, 10/-; VCR517 CRT 15/-; EHT Transformer, 1700V at 2 mA, 2V at 2A, 4V at 1A, 6.3V at 2A, 230V 50 cps input, 25/-. 4ft Fluorescent Light, lamp, choke, starter and BI pin holders, working, 30/-. 5.5 kV Hazlehurst RF EHT coil, 15/-—R. Carter, 24, Alexander Street, Bayswater, W.2.

TRADE

PERSONAL PORTABLES. This new book by E. N. Bradley contains full constructional details of five different circuits. Book 2/6d. post free. We can supply all the necessary components from stock.—M. Watts & Co., 8, Baker Street, Weybridge, Surrey.

QSL's and G.P.O. approved log books. Samples free.—Atkinson Bros., Printers, Elland, Yorks.

G6MN for the "best" QSL's and approved log books, send for samples: G6MN, Bridge Street, Worksop, Notts.

1155s A or B. Brand new in packing cases. £9/7/6 carr. paid. APN4 units less valves, new, carr. paid 19/6.—G. A. Taylor, 125, Manchester Road, Denton, Manchester.

HAMTUNE Communication Receiver CC150. It will pay you to write for technical information about this finest of modern receivers. Price and specification list for 6d. stamp.—Hamtune Communication Receivers, 10, Elm Street, Wellingborough, Northants.

BOOKBINDING. Volumes of Radio Constructor and Short Wave News fully bound in cloth, Gold lettering, Sprinkled edges. 7/6 post free. Rates for other publications on application.—G3AGR, 19, Helmsdale Road, Streatham, S.W.16.

USE THIS FORM FOR SMALL ADVERTISEMENTS

PRIVATE RATE 2d. PER WORD Minimum 2/-

Terms cash with order. Payment should be made either by P.O., M.O. or cheque, crossed and made payable to ALDRIDGE PRESS LTD.

TRADE RATE 6d. PER WORD Minimum 6/-

To the Advertisement Manager **'Radio Constructor', Aldridge Press Ltd**
15 Charterhouse Street, London, E.C.1

Please insert this advertisement under the heading..................for..............insertions

I enclose remittance..............s..............d.   If Box No. required?..................(1/- extra)

NAME..

ADDRESS..

USE BLOCK LETTERS

"INEXPENSIVE TELEVISION" is the title of a booklet describing how to make a Televisor for the London or Birmingham frequencies using ex Govt. Radar Material. Now reprinted. Send only 2/9 to cover cost and postage for a copy, and also price list of material required.

RECEIVERS R.1355. As specified for above Televisor Complete with all valves and a copy of the booklet. ONLY 55/- (carriage 7/6).

INDICATOR UNITS TYPE 6. The Indicator unit specified for above, this being complete with the Cathode Ray Tube VCR97 and all valves. BRAND NEW IN MAKER'S CRATES. ONLY 90/- (carriage 7/6)

TRANSFORMERS for the above TV have been specially made as follows: Time Bases and Vision Transformer, 350-0-350V 160mA, 5V 3a, 6.3V 6a, 6.3V 3a, ONLY 36/-. Sound Receiver Transformer 250-0-250V 100mA, 5V 3a, 6.3V 6a, ONLY 30/-. EHT Transformer for VCR 97 Tube 2500V 5mA, 4V 1.1a. 2-0-2V 2a, ONLY 27/6 (postage, etc. 1/6 per transformer).

MAGNIFYING LENS for 6 inch C.R. Tube. Brings up the picture size to approximately that given by a 9 inch tube. A new contract enables us to price them at ONLY 25/- (postage, etc. 1/6).

RECEIVERS R.3585. An ideal unit for conversion to TV in the London Service Area, as it contains a "PYE" 45 Mcs. I.F. Strip, and valves as follows: 7 of EF50, 4 of SP61, 8 of EF36, 1 of EB34, 1 of EF39. BRAND NEW, ONLY 90/- (carriage, etc. 7/6).

TELESCOPIC AERIALS as used on Canadian Walkie Talkie. 15 in. in length extending to 103 in. Completely enclosed in metal case with dust cap. ONLY 12/6 (postage, etc. 1/-).

C.W.O. Please. S.A.E. for lists.

U.E.I. CORP.

The Radio Corner, 138 Grays Inn Road, London, W.C.1.
(*Phone: TERminus* 7937)
(Open until 1 p.m. Saturdays, we are 2 mins. from High Holborn (Chancery Lane Stn.) and 5 mins. by bus from King's Cross.

Henry's **Radio Component Specialists**

A SIGNAL TRACER at minimum cost. An easy-to-build unit that can be used for R.F., I.F. and Audio signal tracing, without any switching or tuning. Highly sensitive, easy-to-build, responds to signals picked up from an ordinary receiving aerial. The circuit is that of a high-gain, 3-stage resistance-coupled audio frequency amplifier, with a 5in. speaker in the Output of the Power Amplifier stage.

We shall be pleased to supply a complete kit for the construction of the above, right down to the last nut and bolt, for the low price of £3/18/6. Concise instruction and circuits are supplied. If preferred, circuit and instructions only can be supplied for 1/6 post free. All items may be purchased separately. This is a highly efficient instrument, and a MUST for every radio man.

5 HARROW ROAD, W.2 PADdington 1008/9

ADCOLA (Regd. Trade Mark)
SOLDERING INSTRUMENTS

Reg. Design No. 860302

Designed for wireless assembly and maintenance. Supplied for all volt ranges from 6/7v to 230/250v. **High Temperature Quick Heating, Low Consumption Light Weight.**

3/16" Dia. Bit Standard Model 22/6
1/4" Dia. Bit Standard Model 25/0
3/16" Dia. Detachable Bit Type 30/0
British and Foreign Patents

Sole Manufacturers: **ADCOLA PRODUCTS LTD.**
Registered Offices:—
Alliance House, Caxton Street, S.W.1. (MAC 4272)

'GLOBE' 'JONRAD' SHORT-WAVE 'KING' REGD.

'The World at your fingertips' ★ *Real LONG DISTANCE Radio Reception* ★

Send for **FREE** *Copy of Catalogue (enclose 1d stamp postage)*

PROBABLY THE SMALLEST ONE VALVE SHORT-WAVE RADIO IN THE WORLD USING STANDARD PARTS WITH BANDSPREAD TUNING DEVICE.

COMPLETE "Easy Build" Kit —COSTS ONLY **49/6d**

★ MONEY BACK GUARANTEE

SENT ON APPROVAL

TRADE & OVERSEAS ENQUIRIES INVITED Write to:—

JOHNSONS (Radio Specialists) MACCLESFIELD CHESHIRE (ENGLAND)

"The World Radio Handbook for Listeners"
(Latest Edition)
is now available
PRICE 6s. 9d.
POST PAID
The Amalgamated Short Wave Press LTD.
57 Maida Vale, London, W.9

Short Wave News

is a monthly journal which deals with all aspects of short wave radio. The constructional side describes short wave receivers, transmitting equipment, aerials, test apparatus, etc. The amateur and broadcast bands are covered in separate articles, each contributed by an enthusiast in each sphere, and there is usually an illustrated description of an amateur or commercial station. Internationa Short Wave League activities are exclusively recorded in this magazine, and a number of competitions are run for the benefit of readers. Now in its fourth volume, Short Wave News is obtainable from local booksellers at 1/3, or may be subscribed for at 16/- annually.

The Amalgamated Short Wave Press Ltd.
57 Maida Vale, London, W.9