Printed in Great Britain for the Proprietors and Publishers Data Publications Ltd., 57 Maida Vale, London, W9, by A. Quick & Co. Ltd., Oxford House, Clacton-on-Sea, Essex. *Is obtainable abroad through the following:* Collets Subscription Service, Continental Publishers & Distributors, Ltd., William Dawson & Sons Ltd. *Australia and New Zealand:* Gordon & Gotch Ltd. *South Africa:* Central News Agency. *U.S.A.:* Gilfer Associates. *Holland:* "Radio Electronica." *Scandinavia:* Intrapress. *Registered for transmission by Magazine Post to Canada (including Newfoundland).*

Volume 8
Number 5
DECEMBER
1954

The RADIO CONSTRUCTOR

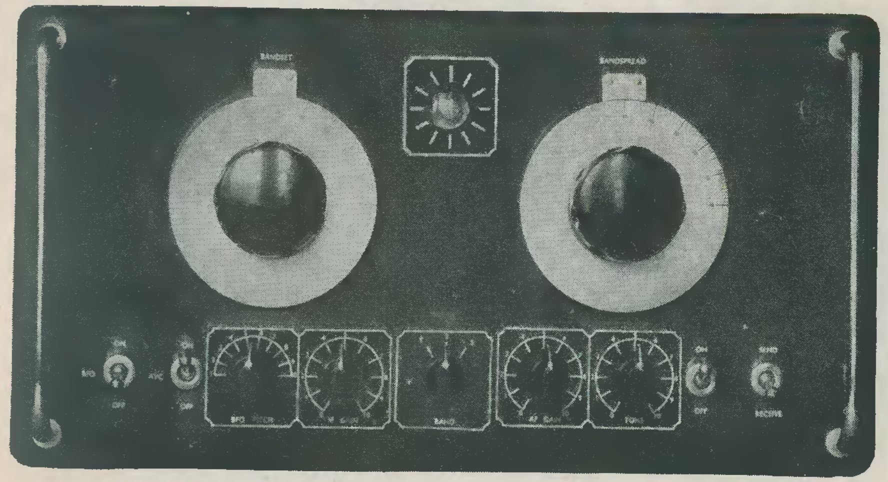
incorporating The Radio Amateur

for the Radio and Television Enthusiast

THE GLOBE-MASTER

Communications Receiver

MAINS HUM IN AMPLIFIER P 282

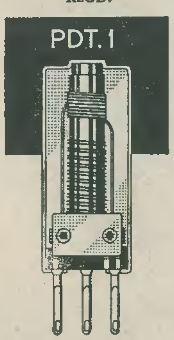


ALSO IN THIS ISSUE

1/6

MAXI-Q

REGD.

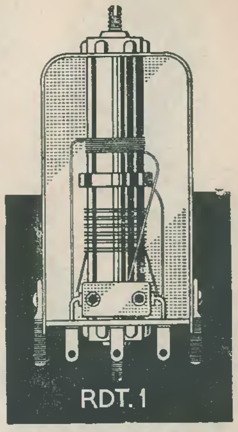


F. M. COMPONENTS

RATIO DISCRIMINATOR TRANSFORMER 10.7 Mc/s. Ref. RDT. 1
A 10.7 Mc/s. transformer for use in radio discriminator type circuits. Can size 1⅜in. square x 2½in. high. Secondary winding of bifilar construction. Iron dust core tuning, polystyrene former, and silver mica condensers. Price **12/6** each.

PHASE DISCRIMINATOR TRANSFORMER 10.7 Mc/s. Ref. PDT. 1
A miniature 10.7 Mc/s. transformer for use in frequency modulation detector circuits where the limiter/Foster-Seeley type of circuit is employed. Designed for carried deviation of ±75 kc/s. Qk.—1.5 Wound on black bakelite former, complete with iron dust slugs and two 6 B.A. threaded fixing holes on .532in. centres Screening can: 1⅞in. x 13/16in. square. Price **9/–** each.

I.F. TRANSFORMER IFT.11/10.7
A miniature I.F. Transformer of nominal frequency 10.7 Mc/s. The transformer is primarily intended for the I.F. stages of frequency modulation receivers and converters. The Q of each winding is 90 and the coupling critical. Construction and dimensions as PDT.1. Price **6/–** each.



I.F. TRANSFORMER IFT.11/10.7/L
As I.F.T. 11/10.7 but with secondary tap for limiter input circuits. Price **6/–** each.

Full constructional details for building an F.M. Feeder unit are given in our TECHNICAL BULLETIN (DTB.8). Price **1/6** each.

Send 1/– in stamps for General Catalogue. Obtainable from all reputable retailers or in case of difficulty direct from:

DENCO (CLACTON) LTD., 357/9 OLD ROAD, CLACTON-ON-SEA

Stop Press: "Osram" "912" high quality amplifier chassis, **14/6**. Front panel finished in bronze complete with control markings, **6/6**. "Mullard" "Five-Ten" amplifier chassis, **14/6**. Front panel, **6/6**.

90 DEGREE SCANNING

Please note that 90 degree scanning yokes are now available
These are interchangeable with our existing D.C.300C yoke

Scanning Yoke type DC/390C (90 degree), **42/–**.

Scanning Yoke type DC/300C (70 degree), **39/6**.

Line Output Transformer type L.O. 308, **40/–**.

Focus Coil type F.C.302, **31/–**

Frame Output Transformer type F.O. 305, **21/–**.

Width Control type G.L.18, **7/6**.

Linearity Control type G.L.16, **7/6**.

Smoothing Choke type S.C.312, **21/–**.

Mains Auto Transformer type A.T. 310, **30/–**.

Also available:

Output Transformer type O.P. 1320, **8/3**.

Heater Transformer type M.T. 1209, **10/6**.

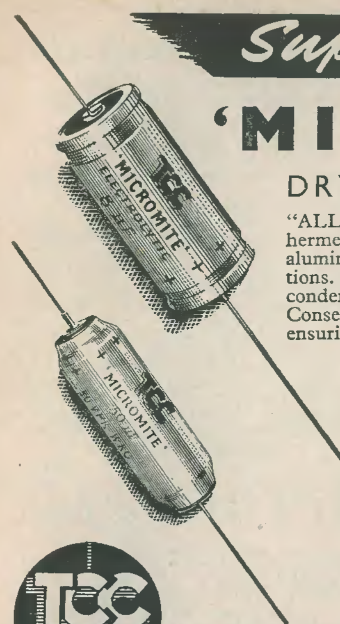
These two transformers are as specified for the Easi-Build

All the above are available direct from

ALLEN COMPONENTS LIMITED
Crown Works, 197 Lower Richmond Road, Richmond, Surrey
Telephone PRO 9013

Send 9d. and S.A.E. for recommended Wide-Angle Circuit Diagrams

Supreme in Service



'MICROMITE'

DRY ELECTROLYTIC CONDENSERS

"ALL-ALUMINIUM" non-corrosive construction with completely hermetic seal. Protective outer plastic tube eliminates risk of aluminium tube causing short-circuits. Colour-coded wire terminations. High-gain etched foil resulting in a small, extremely light, condenser.
Conservative voltage rating and usual T.C.C. **high quality**—ensuring long and trouble-free life.

Capacity in μF.	Peak Wkg. Volts	Surge Volts	Dimns. in Ins. Length	Dimns. in Ins. Diam.	Type No.	List Price Each
50	12	15	1⅝	13/32	CE87B	**2/9**
25	50	60	1 11/16	15/32	CE88DE	**3/-**
1	350	400	1⅝	⅜	CE86L	**2/6**
8	350	400	1 13/16	17/32	CE99LE	**3/3**
16	350	400	2 5/16	13/32	CE91LE	**4/-**
32	350	400	2 5/16	1 1/16	CE93LE	**6/-**
4	450	550	1 13/16	17/32	CE99PE	**3/3**
8	450	550	1 13/16	13/16	CE90PE	**3/6**
16	450	550	1 13/16	1 1/16	CE92PE	**5/-**
32	450	550	2 13/16	1 1/16	CE94PE	**7/6**

THE TELEGRAPH CONDENSER CO. LTD
RADIO DIVISION: NORTH ACTON · LONDON · W.3 · Telephone: ACOrn 0061

Have YOU seen these

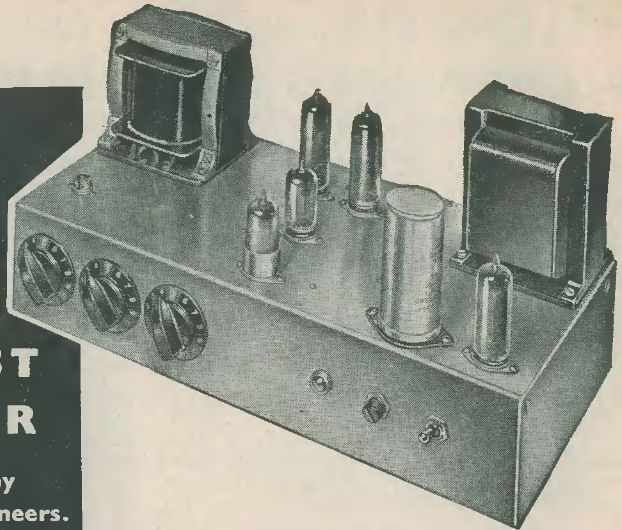
EDDYSTONE PUBLICATIONS?

EDDYSTONE CATALOGUE. The current illustrated Eddystone Catalogue provides comprehensive information on a wide range of radio components and accessories. A number of new items are included and generally the Catalogue is full of interest. Eddystone products are renowned for high quality and by choosing them you ensure PEAK performance and complete reliability. The Catalogue costs 1/– (plus 2½d. postage)

"145 Mc/s GUIDE." This booklet gives details of a three-valve converter using easily obtainable valves and capable of an excellent performance. It is intended for use with a receiver (of any-type) which can be tuned to 10 Mc/s. The companion transmitter is of efficient design, and operates conveniently from a single external 300 volt H.T. supply. Text, drawings and photographs are clear and make construction easy to follow. Price **1/6** (plus 2½d. postage).

"MAKING THE MOST OF YOUR RECEIVER." This interesting booklet assists the short-wave enthusiast and considerably improved reception can be secured by following the advice and suggestions given. Useful information is provided on aerials for short-waves, for general purpose and for shipboard use. Other sections deal with earths, electrical interference and kindred subjects. Price 1/– (plus 2½d. postage).

FROM YOUR EDDYSTONE DEALER, OR BY POST FROM
STRATTON & CO LTD, WEST HEATH, BIRMINGHAM 31



The

Radio Constructor

INCORPORATING *The Radio Amateur*

CONTENTS FOR DECEMBER

VOL. 8 NO. 5

ANNUAL SUBSCRIPTION 18/–

DECEMBER 1954

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9

Telephone
CUNNINGHAM 6518

Editor
C. W. C. OVERLAND, G2ATV

Advertising Manager
F. A. BALDWIN, AMIPRE

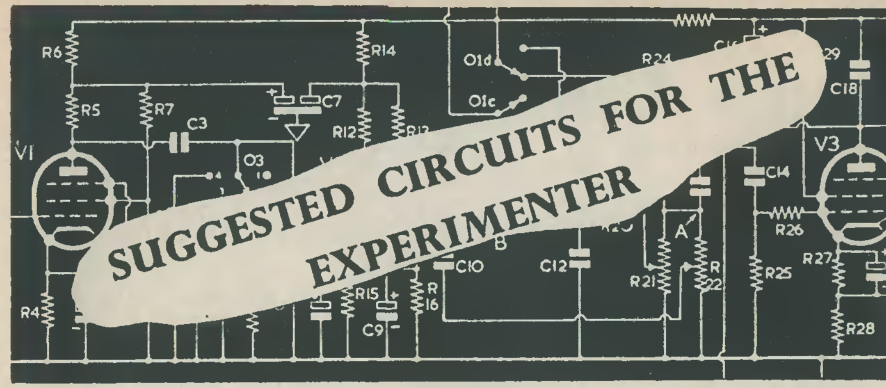
NOTICES

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

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

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

ALL CORRESPONDENCE should be addressed to THE RADIO CONSTRUCTOR, 57 Maida Vale, London, W.9 *Telephone* CUN. 6518



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

No 49 A RELIABLE BABY ALARM

ALTHOUGH, FROM TIME TO TIME, "BABY alarm" circuits have been printed in the technical press for the benefit of the home-constructor, few of these have been, in the writer's view, of a satisfactory nature. The shortcomings of these circuits have been, mainly, insufficient sensitivity, the too-prevalent use of AC/DC power arrangements, fiddling and "cut-price" circuitry, and unrealistic frequency response.

So far as lack of sensitivity is concerned, many "baby alarm" circuits appear to work on the assumption that only a limited degree of amplification is needed; the crying of the child when it requires attention being, of itself, sufficiently loud to overcome the shortcomings of the amplifier. This is hardly the correct approach to the problem. The baby alarm should be sensitive enough to pick up and amplify clearly all sounds near the child's cot, including the sound of its breathing. Trouble does not always manifest itself in crying, and the continual sound of the child's breathing has the comforting advantage of giving constant assurance that the amplifier is in working order.

Another of the bad points just mentioned is the use of AC/DC power supply circuits for the baby alarm amplifier. Apart from the fact that such circuits must almost inevitably generate more heat in the amplifier chassis after long periods of use than would be given by transformer power supplies, it is furthermore extremely difficult to ensure that the microphone wiring is *reliably* free from chassis potential and, therefore, the live mains voltage. Indeed, where children are concerned, it is almost reprehensible to take risks of this nature in order to save the cost of a mains transformer.

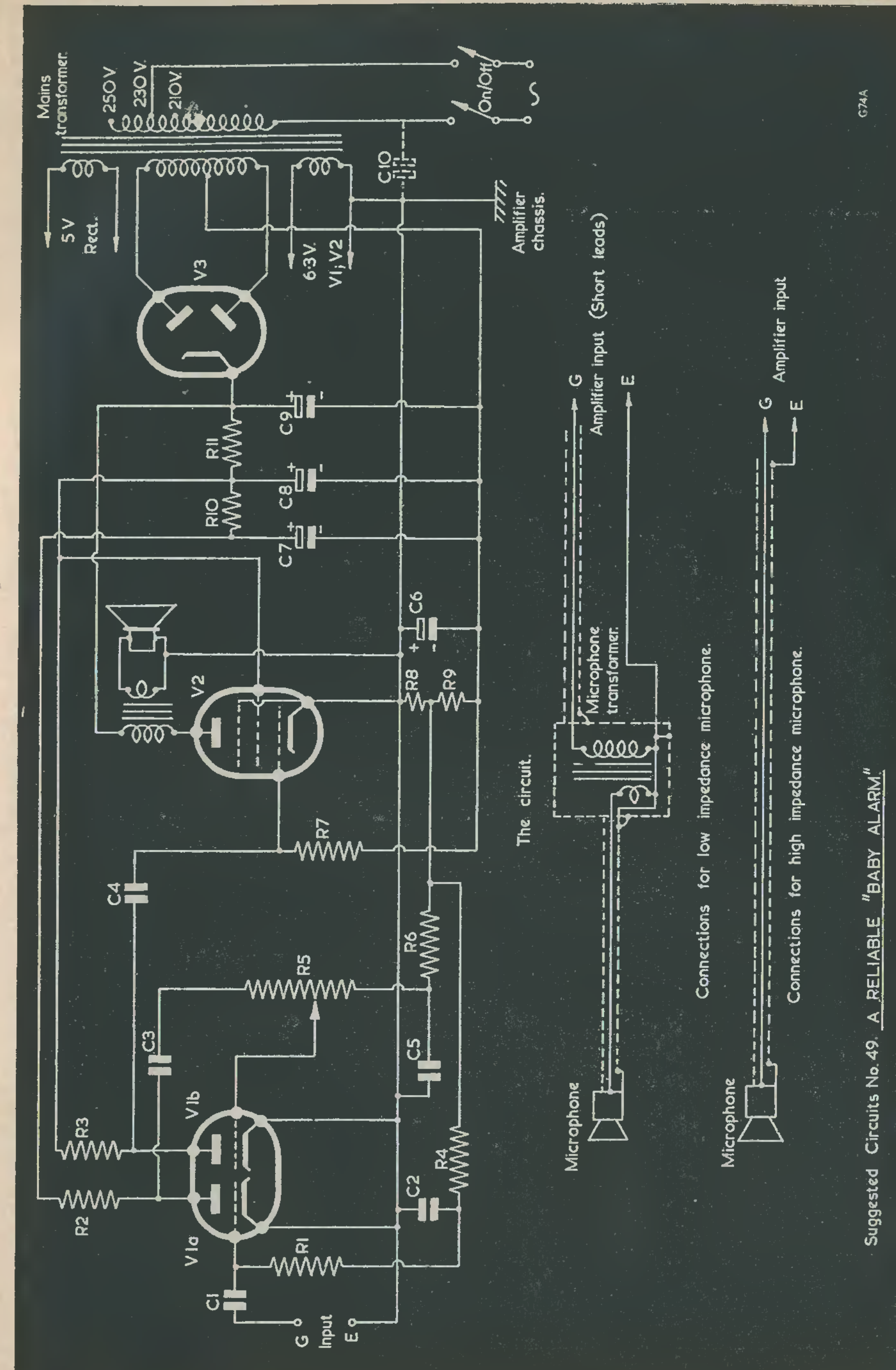
The questions of fiddling circuitry and unrealistic frequency response go, to a certain extent, hand in hand. Some circuits go out of their way in order to employ "surplus" valves and components; others provide frequency responses which ensure full gain down to 100 c/s and even lower. Provided that the breathing of the child can be heard continually there is little point in providing extensive bass response of this nature. On the other hand, an accentuated or even shrill "top" response is often advantageous; but this is rarely provided.

The Amplifier Circuit

This month's circuit gives details of a very simple but reliable amplifier for baby alarm purposes. Although a mains transformer has been included (for the reasons detailed above) the cost of the components otherwise needed should not be at all excessive.

Signal input from the microphone is applied (at high impedance) to the grid of V1a. V1a is biased by the auto-bias resistor R8, decoupling being provided by R4-C2. The output of V1a is passed to the volume control R5, and thence to V1b for further amplication. Final amplification is given by V2.

It will be noted that a double-triode has been used in the early stages of the amplifier instead of the more conventional high-gain pentode. This course has been adopted as it is possible to obtain a large degree of gain (around 200 times) from the double-triode without the necessity of having to pay excessive attention to bias and component



Suggested Circuits No. 49. A RELIABLE "BABY ALARM."

values. The double-triode provides high gain without difficulties. It has the further advantage of enabling the volume control to be connected in the grid circuit of the second triode, thereby minimising hum pick-up and layout difficulties.

It will be noted that the coupling condensers C1, C3 and C4 have lower values than is usual in the conventional AF amplifier. Such values have the advantage in this application of reducing bass response and of obviating, to a considerable extent, the effects of hum pick-up in the microphone leads. Top response is further accentuated by the omission of a tone-correction condenser across the speaker transformer primary winding.

In order to prevent the necessity of including an electrolytic cathode by-pass condenser at each cathode, an auto-bias arrangement is used. The bias decoupling condensers C2 and C5 should be mounted close to the grid leaks to which they are connected. It should be borne in mind, also, that the common return of the three electrolytic condensers, C7, C8 and C9, is not taken to chassis in this circuit. (When the electrolytic condenser can forms a common negative connection, it must be mounted such that it is insulated from chassis). A triple condenser (such as the TCC CE39P) can be used for these components; or separate condensers may be employed.

COMPONENT VALUES

Resistors (all ½ watt unless otherwise stated)

R1	250 kΩ
R2	100 kΩ
R3	100 kΩ
R4	2 MΩ
R5	250 kΩ (Volume control-preset)
R6	2 MΩ
R7	250 kΩ
R8	80Ω
R9	300 Ω ½ watt
R10	10 kΩ ½ watt
R11	3 kΩ 5 watt

Condensers (all 350V wkg unless otherwise stated)

C1	.001 μF
C2	.05 μF
C3	500 pF
C4	.001 μF
C5	.05 μF
C6	25 μF, 25V wkg.
C7	8 μF
C8	8 μF
C9	16 μF
C10	.01 μF, 1000V wkg.

Valves

V1, V2	See text.
V3	5Y3 or 5Z4 (see text)

The power supply circuit is quite conventional. The mains transformer should have an HT secondary current rating of 60 mA or more, and give a voltage between the limits 180-0-180 to 250-0-250. A 5-volt rectifier is shown in the circuit; but this can be replaced, if desired, by a 6.3-volt type (e.g. the 6X5) using the same 6.3-volt heater line that is employed by V1 and V2.

The condenser C10, which is shown in dotted outline, need only be fitted if there is evidence of mains modulation. When this condenser is used, a good earth connection to the amplifier chassis should be provided. Indeed, an earth connection is advisable in any event, since the microphone wiring will always be at chassis potential.

Microphones

It will be possible to use the amplifier with both low and high impedance microphones.

When low impedance microphones are employed it will be necessary to include a microphone transformer, as shown in the inset. This transformer should be mounted in a shielded can and carefully positioned in order to prevent hum induction from the mains transformer. The leads from the microphone transformer primary to the microphone itself may be of any length up to 60 feet or so, provided that the ohmic resistance of the connecting wire is not too high. The inset illustrates the use of single screened cable, the screening being earthed to the amplifier chassis. In some localities it may be possible to use unscreened twin lead without incurring too high a degree of hum pick-up. Most inexpensive commercial moving-coil microphones will give the top reponse required here. Alternatively, a small moving-coil loudspeaker could be used as a microphone. Army "surplus" moving-coil microphones, unless modified, would not be satisfactory.

A high impedance input circuit is also illustrated. This has the disadvantage of limiting the lead from the amplifier to the microphone to approximately 20 feet. Screened lead will be essential.

In many cases it will be found that a single high-resistance headphone (2,000 ohms) makes an excellent microphone for the purposes required here. Such a headphone should, of course, be connected as a high impedance microphone. The use of "surplus" low-resistance headphones is feasible also, but these would require a microphone transformer to step up their output to the necessary grid impedance.

Valves

The valves employed in the amplifier do not involve any critical choice. The output valve, V2, may be any tetrode or pentode output valve whose combined anode and screen-grid currents do not exceed 50 mA at 250 volts HT. Types 6V6, 6BW6, N78, EL41, EL42, etc., etc., would be perfectly in order. V1 should be a 6SN7, 12AU7, or ECC40.

IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest based on Letters from Readers and his own experience

READERS MAY HAVE NOTED THAT, EVERY now and again, *In Your Workshop* covers a number of different items instead of being devoted to a single main subject all, or most of the way, through the article. Such a state of affairs seems to have become necessary once more this month, and I had better waste no time, therefore, before getting down to the first topic.

The Fonadek

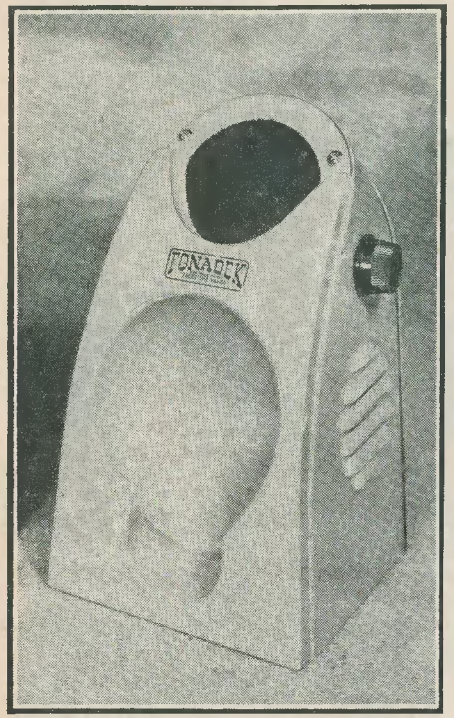
Some time ago I devoted a few paragraphs to the question of telephone amplifiers. This was in response to several queries I had received on this matter, one of which dealt with the possibility of a telephone amplifier for a person who was deaf; the others being more concerned with amplifiers which would feed a loudpseaker or headphones, thereby allowing the telephone user to keep his hands free.

No sooner had the article appeared in print than the London engineer of a firm which specialises in equipment of this nature called at *The Radio Constructor* offices in Maida Vale to demonstrate a telephone amplifier which fulfilled perfectly the requirements of those readers who had written to me.

This instrument is known as the Fonadek, and it is made by Fonadek (Branson) Ltd., of Knightsdowne House, Vivian Road, Birmingham 17. An idea of its general appearance can be obtained from the photograph which accompanies this article.

The Fonadek is brought into operation by taking the conventional telephone handset from its hook, and placing it on the case of the Fonadek such that its receiver rests on the top part of the front panel. The microphone then fits snugly into the bottom of the concave bowl underneath. Inside the Fonadek is an amplifier which drives an internal lousdpeaker. The grilled opening for this speaker is visible at the right of the case. A gain control, also visible on the right, completes the Fonadek's external features.

The concave bowl against which the microphone rests has been acoustically designed to channel external speech directly into the microphone itself. With its aid, therefore, it is possible to speak into the microphone from quite a considerable distance without causing any diminution of volume at the receiving end. The input to the Fonadek amplifier is provided by an induction pick-up, thus obviating any acoustic distortion which would be given by the use of a microphone. The volume obtained from the loudspeaker of the instrument is more than adequate for normal purposes, and it is possible to use an extension loudspeaker if the ambient noise level is very high.



The Fonadek telephone amplifier.

The Fonadek is made in two models, these being for battery or mains operation. In the battery version, both HT and LT are switched on automatically as the handset is placed on the instrument; whilst, in the mains model, HT only is switched on.

I have had the opportunity of hearing the Fonadek in action, and I must say that I was most impressed with its fidelity and sensitivity. With its aid the telephone becomes, indeed, a loudspeaking intercom system; without, incidentally, the irritating necessity of having to operate speak/listen switches. I can definitely recommend it to those who are interested in telephone amplifying instruments of this type.

Fitting an Output Meter

A problem came my way recently which should be of interest to readers, and which is much easier of solution than is usually realised.

The job consisted of fitting, as a permanent addition, an output meter to a more-or-less conventional sound receiver, with the least possible expenditure of components. Fortunately, the meter did not have to give an extremely linear interpretation of the AF voltages appearing in the output stage since it was to be used mainly for "peaking" purposes. (The sound receiver was intended, incidentally, for the quick testing of some aerial tuning circuits I was working on at the time).

The simplest circuit for a job of this sort is illustrated in Fig. 1. Although the arrangement shown here uses hardly any components at all, it gives excellent results in practice. The meter employed may be of any type up to 10mA FSD, and almost any rectifier capable of carrying the full scale current will cope. The value of the series limiting resistor is best discovered by experiment, since it will vary for different rectifiers and different degrees of sensitivity. If necessary, two resistors could be used, these being switched as shown in Fig. 2 to provide different meter sensitivities. There is no need to connect a protective condenser across the meter unless there is any risk of RF reaching it.

In my own case, I did not have a metal rectifier immediately to hand, and so I used a valve diode instead. This required a small biasing voltage to prevent its space

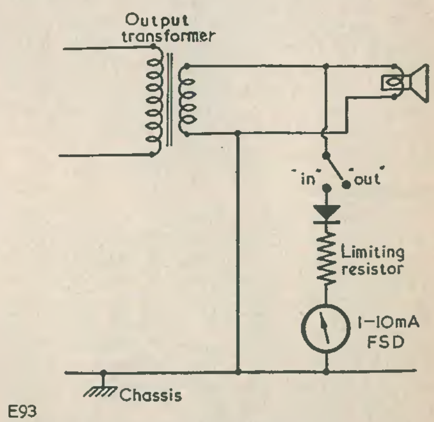


Fig. 1. A very simple method of fitting an output meter to amplifier or sound receiver.

charge from giving the meter a continual deflection. The circuit I finally used is shown in Fig. 3, and it will be seen that the biasing voltage was obtained by connecting a fixed potentiometer across the output valve cathode bias resistor. As a matter of interest, the component values employed in this particular instance have been included in the diagram.

A simple circuit of this nature is particularly useful if an existing amplifier has to be pressed into service for recording purposes. If desired, the output meter can be made to give peak, slow-decay, readings by connecting a high capacity low voltage condenser into the circuit as shown in Fig. 3. A capacity of 500μF or so should cope in most cases, and condensers of this value are still obtainable fairly cheaply on the surplus market.

In Search of Perfection

My wanderings the other day took me to Brunel Road, East Acton, W.3, and especially, to a factory which is employed in turning out quality amplifiers for the discerning listener. I refer, of course, to H. J. Leak and Co., who make what is now the world-renowned Leak "Point One" series of high fidelity reproducing equipment.

Mr. H. J. Leak is, himself, very well known to high fidelity enthusiasts, since he is always happy to advise in individual installations, no matter how large or how small they may be. As readers will be aware, he has recently introduced the TL10 amplifier; this being a follow-up to the TL12, and using the same size output transformer and circuit specifications.

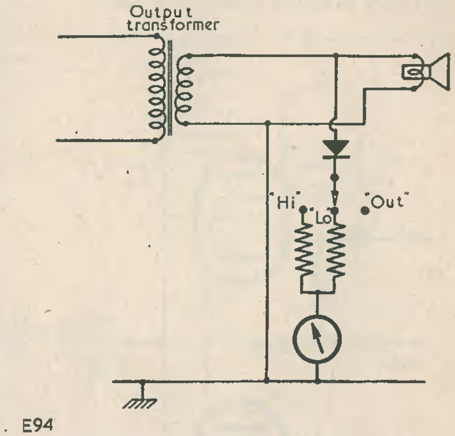


Fig. 2. The output meter of Fig. 1 may be made more versatile by fitting a switch, as shown here.

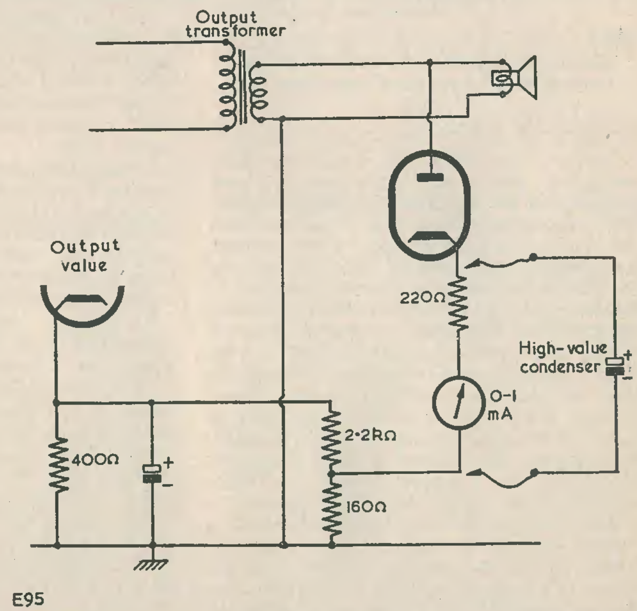


Fig. 3. A practical, tested circuit, showing typical component values. The high value condenser may be connected in circuit, if desired, to provide slow-decay readings.

Shortly to appear in the Leak range is an FM tuner unit designed expressly for high fidelity reception of the new transmissions on VHF. It is interesting to note that this will employ a phase discriminator instead of the more popular limiter-saving ratio circuit. Mr. Leak considers that the phase discriminator is by far the best solution to the problem of combining distortionless detection with complete rejection of AM.

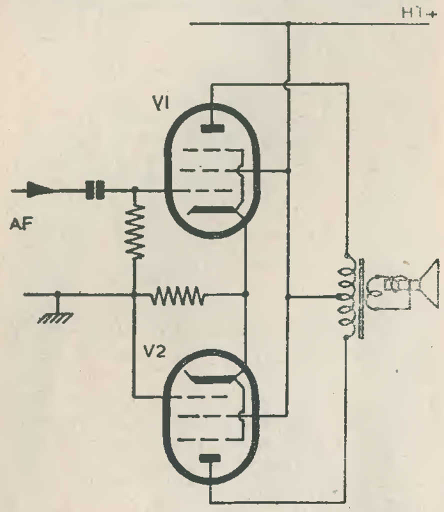


Fig. 4. *An output circuit which has been claimed to give push-pull operation (see text).*

Whilst I was there, Mr. Leak was good enough to give a demonstration of a new loudspeaker which he has under development. The speaker was housed in a cabinet containing two cavities joined by an acoustic compliance, this being of the type used by the BBC (and described some time ago in *Wireless World*); and we heard it reproducing several discs, including a particularly interesting guitar recording which had a very high complement of transients. Reproduction was incredibly truthful. I don't think, in fact, that I have ever heard anything as good. If this loudspeaker was only a development model, the finished product should be practically the complete answer to reproduction which is identical to the original.

Mr. Leak does his final loudspeaker testing "under open-air conditions" in the open-air itself! In fact, he takes his equipment to the centre of a large grassy field, so that there can be no artificial conditions whatsoever to affect his measurements. Such pains can be described as searching for perfection, indeed.

25 Years' Service

Another figure, and one who is also very prominent in the amateur and commercial radio sphere, deserves special congratulations this month. The figure is Colin H. Gardner, and the occasion for congratulations is that of his completion of 25 years' service with Mullard, Ltd.

C. H. Gardner's position at Mullard is that of handling technical and commercial liason with Mullard dealers. In the last 25 years he has also been very much to the fore in amateur and home constructor circles as well. In 1922 he was the first person to transmit a radio message from a racing car which was engaged in breaking the 24 hours world speed record. He has been a Fellow and Past President of the Incorporated Practical Radio Engineers, and is always prominent in the affairs of that Institute. Other aspects of his colourful career have been high-lighted in a series of articles written by himself some time ago for a contemporary.

We of *The Radio Constructor* have been continually grateful to C. H. Gardner; not only on account of the assistance and advice he has rendered us on numerous occasions, but also because of his readiness to go out of his way to smooth the passage of any new design which is being prepared for publication.

"Mystery Circuit"

Do you remember the circuit shown in Fig. 4? This was first published in *The Radio Constructor* on page 77 of the September issue, when I described it as a "Mystery Circuit" which was presumed to give "push-pull" working merely by adding an extra output valve.

I had anticipated one or two letters concerning this circuit and these were not long in arriving. The most interesting came from a reader of Herne Bay, Kent; and he gave me considerable food for thought. Here is his letter (I have added only diagram numbers and equation references).

"I disagree with your statement in the September issue of *The Radio Constructor* about your 'Mystery Circuit.'

"The circuit that you give is known as a 'Long Tailed Pair' and has been in use in electronics for quite a time.

"To understand the general operation, consider the circuit given (in Fig. 5a). Suppose the input causes Vg1 to rise; Ia1 rises, causing Va1 to fall. Also, the rise of Ia1 through Rk raises Vk. Since the grid of V2 is tied to earth, the rise of Vk is equivalent to a fall in Vg2, which makes Ia2 fall and Va2 rise.

"Thus, Va1 and Va2 move in opposite directions. The action is, however, complicated by the fact that the rise of Ia1 is accompanied by a fall in Ia2, both currents affecting the voltage Vk.

"The ratio of the outputs can be obtained in the following way. Suppose that the input to V1 changes so that Vk rises by one volt.

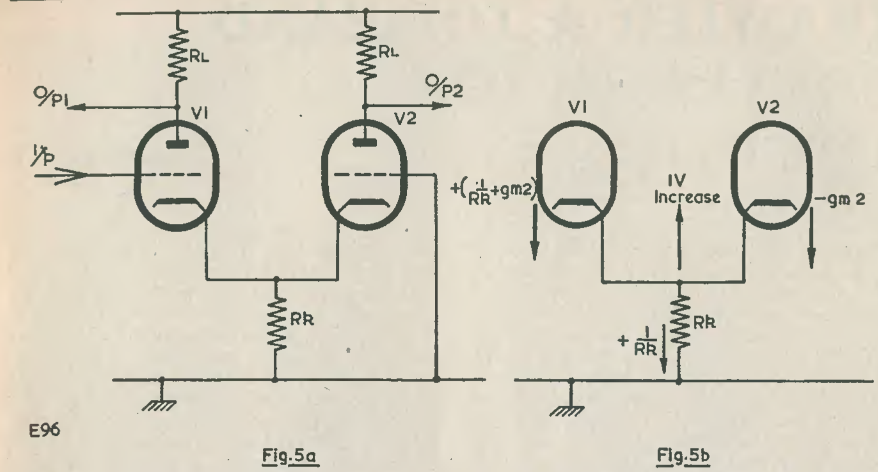


Fig. 5 (*a*). *Equivalent circuit of Fig.* 4. (*b*). *Current relations in the cathode circuits for an increase in cathode voltage of* 1 *volt.*

(See Fig. 5b). This is equivalent to one volt fall in Vg2, which causes Ia2 to fall by gm2, where gm2 is the mutual conductance of V2. But the increase of total cathode current (Ia1 plus Ia2) through Rk to produce a one volt rise of Vk is $\frac{1}{Rk}$. Hence, Ia1 must have increased by $\left(\frac{1}{Rk} + gm\ 2\right)$ ....(1)

The ratio of the current changes is, therefore,

$$\frac{Ia2}{Ia1} = \frac{gm\ 2}{\frac{1}{Rk} + gm\ 2}$$

$$= \frac{1}{1 + \frac{1}{gm2 \times Rk}} \quad ......(2)$$

"This ratio approaches unity if gm2 and Rk are large. Increase of Rk reduces effective HT, causing the maximum undistorted outputs to fall; a compromise must be found. As the gm values of output valves are usually large, it will be seen that the two outputs are very nearly balanced. In the case of, say, a 6V6 with a gm of 4.1 and a typical Rk of 470 Ω, the ratio of currents becomes

$$\frac{1}{1 + \frac{1}{4.1 \times 470}}$$

or very nearly 1 : 1.0005 .... (3)

"Thus, it will be assumed that the two outputs are, for general purposes, equal."

It seems fairly conclusive, doesn't it? But there's one little snag.

My correspondent, in his finding (1), states that "Ia1 must have increased by $\left(\frac{1}{Rk} + gm2\right)$".

This is correct. However, we must not forget that the expression $\frac{1}{Rk}$ represents a current increase in terms of amps. To avoid muddling our units, therefore, we must consider gm in terms of amps as well.

Now the gm of a 6V6 is, as stated, 4.1 mA per volt; or, in terms of amps, 0.0041 amps per volt. Thus, if we substitute the correct figures in equation (2) we find that the ratio between the changes in anode current **is not** nearly unity but is as follows:

$$\frac{\text{Change in Ia2}}{\text{Change in Ia1}} = \frac{1}{1 + \frac{1}{0.0041 \times 470}}$$

$$= \frac{1}{1.5}\text{, nearly.}$$

However, there is another point worthy of attention, and that is given by the fact that 470 ohms is rather high as a common

[*continued on foot of next page*

TRAWLER & TOP-BAND CONVERTER FOR THE R1155

By **C. NOALL**

ONE VERSION OF THE POPULAR EX-RAF 1155 receiver—the "N" model—covers the important 100–200m. wave-range; but this set is comparatively rare and expensive. The ordinary common or garden types of the 1155 have, in place of this waveband, an extra LF range of 1,500–4,000m., which is practically valueless from the ordinary listener's point of view. On the face of it, it would seem to be a comparatively simple operation to replace the coils for this unwanted range by those for the much more valuable "trawler band" included in the "N" version; but unfortunately this is not the case.

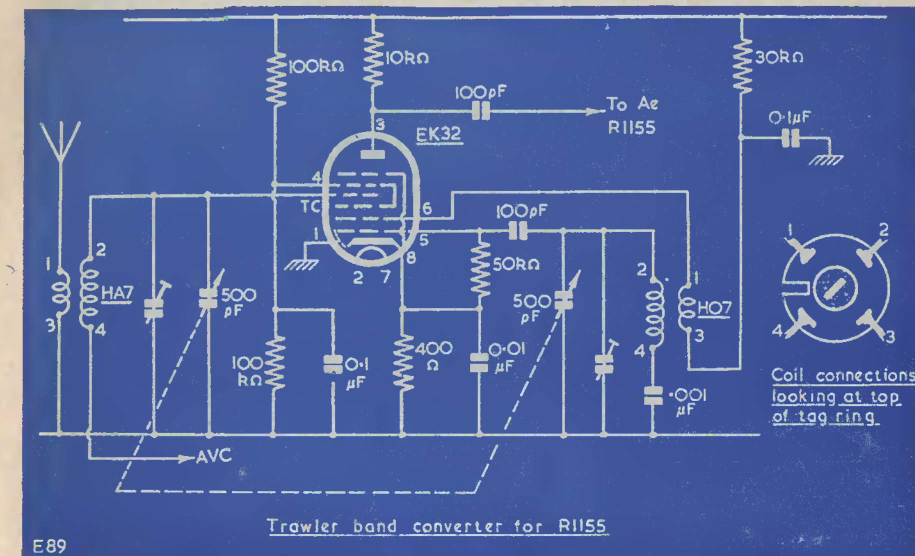
To start with, the 1155's IF is 560 kc/s, which means that standard coils designed to work with conventional 465 kc/s IF's cannot be used with it; nor am I aware of any source from which suitable inductances can be obtained, short of the expedient of having them specially wound. Moreover, the receiver's coil pack is a complicated and truly formidable affair which, in the writer's view, is best not meddled with save in case of necessity. The only practical method by which the wanted band can be reached, therefore, is by invoking the principle of the double-superhet. With the 1155, this solution is very easy to apply, for band 4 on this set covers 500–200 kc/s, thus enabling the standard 465 kc/s IF to be "tuned-in" with ease by the main tuning control.

If we are to add on the "front end" of a conventional superhet in this fashion, a number of extra components are called for, including a 2-gang tuner and a frequency-changer valve. It may be queried whether this gear can be fitted comfortably on the receiver chassis, or whether a separate converter unit would be more satisfactory. It is really a question of personal choice; but there should be no difficulty in applying the first alternative, which has the merit of being the less complex and troublesome. The frequency-changer could occupy the valveholder of one of the discarded D/F valves; the octal-based EK32 has been purposely chosen to facilitate this substitution. The additional tuning-gang might appear to present some difficulty in view of the crowded front panel of the set; the answer here is to use a miniature component and to mount it below the main tuning dial, or perhaps at the top right-hand corner after removing redundant controls, etc. A simple reduction drive should also be fitted without much difficulty.

All the main components should be effectively screened. The valve chosen as the frequency-changer has a metallised cover which, together with the aluminium can, should give adequate protection. When the trawler band is not in use, it will become desirable to suppress the EK32's output; this may be done quite well by cutting off its HT power supply by means of a switch.

If required, the converter's range could be extended to cover additional ranges as well, but the extra switching involved might then make it more desirable to build the converter in a separate cabinet. An RF stage would appear scarcely necessary, in view of the great amplification supplied by the 1155 itself, but might have some advantages as regards the suppression of noise.

Suitable coils may be obtained from the Teletron Co., who advertise in this magazine. The tag connections for these are shown in the circuit diagram. Type numbers are: Aerial coil, HA7; Oscillator coil, HO7. The approximate waverange covered is 60 to 220 metres, when tuned with a 500pF condenser.



Trawler band converter for R1155

In the writer's opinion, this simple conversion will add considerably to the usefulness of this popular receiver—particularly to people like myself, who enjoy listening occasionally to the very salty conversations that may be heard just below 200m.! I think it is not generally realised what exciting things can be heard on this particular waveband, especially following the transmission of a distress call.

[END

IN YOUR WORKSHOP

continued from previous page

cathode resistor for two 6V6's. A more practicable value would be something like 220 ohms. With this figure, the anode current change ratio would become:

$$\frac{1}{1 + \frac{1}{0.0041 \times 220}} = \frac{1}{2.1} \text{ approx.}$$

I still say that this circuit does not give push-pull working!

CLUB NEWS

ROMFORD AND DISTRICT RADIO SOCIETY

In addition to the programme of Junk Sales, "On the Air" evenings and discussions, there is to be a lecture on December 14th by Louis Varney, A.M.I.E.E. (G5RV) dealing with TVI suppression. This is certain to be informative and interesting, and any visitors will be welcome.

The weekly meetings are held on Tuesdays at 8.15 p.m. at R.A.F.A. House, 18 Carlton Road, Romford, Essex. Hon. Secretary: N. Miller, 18 Mascells Gardens, Brentwood, Essex.

CLIFTON AMATEUR RADIO SOCIETY

A series of Basic Radio lectures has been started by Mr. D. Reed for the benefit of the newer members.

Mr. H. Atkinson has built a new 160/80 metre transmitter for the Society, and this is in operation on several Friday evenings during each month with the call sign G3GHN.

Meetings are held every Friday evening at 7.30 p.m. at the clubrooms, 225 New Cross Road, London, S.E.14. Details of membership can be had upon application to the Hon. Secretary.

Hon. Secretary: C. H. Bullivant, G3DIC, 25 St. Fillans Road, Catford, S.E.6.

"THE WIRRAL AMATEUR RADIO SOCIETY"

Meetings are held at the Y.M.C.A. at Whetstone Lane, Birkenhead on the 1st and 3rd Wednesdays of each month, 7.45 p.m. Short-wave listeners and novices are particularly welcome.

Secretary: C. Wattleworth, 17 Iris Ave., Claughton, Birkenhead.

WARRINGTON AND DISTRICT RADIO SOCIETY G3CKR

Hon. Secretary: G. H. Flood, 32 Capesthorne Road, Orford, Warrington.

Meetings are held on the first and third Thursdays in each month, at the King's Head Hotel, Winwick Street.

SOUTH MANCHESTER RADIO CLUB

Future Meetings:

Dec. 3 "Receivers" Recorded Tape lecture of the R.S.G.B.

Dec. 17 Instruments used in the Electrical Engineering Industry. By M. Denny G6DN.

Dec. 31 No meeting will take place, and the first meeting in the New Year for lectures will be Jan. 14.

Hon. Secretary: M. Barnsley G3HZM, 17 Cross Street, Bradford, Manchester 11.

NORWOOD AND DISTRICT GROUP R.S.G.B.

The Annual Ann Cup and Trophy Contest will take place during the meeting on December 18th, commencing 7.30 p.m, at Windermere House, Westow Street, Crystal Palace.

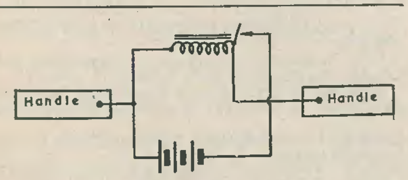
THE LITTLE SHOCKER

By **J.W.B.**

NOW THAT THE FESTIVE SEASON IS DRAWING near, the reader may be interested in a simple little gadget which is guaranteed to liven up the party in more ways than one. Simple to construct, it only needs a few hours work, with parts supplied by the "junk box," to emerge as quite an efficient little shocking coil powerful enough to give even the hardened ham a tingle or two.

The main parts which will be needed are as follows:—a $\frac{3}{4}$" square section of wood 10" long; one $2\frac{1}{2}$" french nail, a few yards of 32 swg enamelled wire and some odd bits of 28 swg brass strip. A bar of chocolate will supply the silver paper which is used to cover the handles of the device.

The coil is formed by first winding a layer of cellotape round the shank of the nail for



Wiring details

E97

a length of $1\frac{1}{2}$" from the head. After this, some 850 turns or so of wire are wound on in 9 layers. The number of turns per layer is progressively reduced in order to avoid turns dropping at the end of the coil. It is advisable to apply a thin coating of polystyrene varnish to keep the winding in place.

A hole is now made in the wooden bar 4" from one end and the nail is gently driven down for a depth of $\frac{1}{2}$", after which it should be bent at right angles to lay parallel to, but not touching the wood. The reader may prefer to carry out this operation before winding the coil, although, with a little care, no trouble should be experienced.

The handles are formed by gluing a 3" length of silver paper to the extreme ends of the wooden bar. While these are left to dry, the battery clips can be made from two lengths of brass strip 2" long by a $\frac{1}{4}$" wide. These are bent into a U shape to fit around the wood. The vibrating reed is also made from a length of brass 3" long and $\frac{1}{2}$" wide, with a $\frac{1}{4}$" step in the centre. To give the coil something to pull on, a $\frac{1}{4}$" wide strip of tin is clamped firmly around the end of the reed that overhangs the head of the nail.

The upper contact seen attached to the right hand battery clip is formed from a length of steel wire or a thin nail and should be sharpened at each end with the aid of a file. One end makes contact with the brass reed, while the other is forced into the wood via the battery clip.

The components may now be assembled using small brads or wood screws, the wire from the coil being bared and wound round the appropriate points. The gap between the reed and the nail head should be adjusted to approximately $\frac{1}{8}$" and the battery suspended from the two brass clips by its lugs.

The upper contact, which also acts as the On/Off switch, is then swivelled down to just touch the reed and the little shocker will buzz into life.

THE DESIGN, CONSTRUCTION CALIBRATION and use of SIGNAL GENERATORS

Part 4. **Conclusion.** *By* **R. J. STEPHENSON**

FIRST, RENDER THE AVC AND LOCAL oscillator inoperative. This can be done by shorting out the AVC decoupling condenser in the last IF valve grid circuit and by shorting out the oscillator section of the tuning condenser (if there is any HT voltage on the fixed vanes of the tuning condenser, an 0.1μF condenser should be connected across it instead of shorting out the vanes). An output meter should be connected across the output of the receiver and the volume control turned to maximum to avoid overloading the detector. If the maker's instructions are available, these should be followed—but if not, the following instructions will enable the receiver to be aligned.

In the early stages, a fairly large signal generator output will be required to give an audible output; the input should be reduced as the receiver becomes more sensitive and the signal is fed through more valves. The generator output should be kept as low as possible, consistent with a reasonable audio output from the receiver, and a modulated RF signal should be used. Feed the test signal to the grid of the IF valve and set the generator to the intermediate frequency of the receiver (usually 465 kc/s). Tune the secondary and primary (in that order) of the last IF transformer to give maximum output.

Transfer the output of the generator to the signal grid of the frequency changer, and tune the first IF transformer in exactly the same way as the second.

The oscillator section should be aligned in the order Long, Medium and Short wavebands. With the modern superhet, where the oscillator section of the tuning condenser is exactly the same as the others, exact alignment can only be obtained at three places on each range. At all other points the tuning is not exact, but the selectivity of the preceding tuned circuits is broad enough for this not to be noticed. The discrepancy will be greater if the intermediate frequency is not that for which the receiver was designed.

The three frequencies at which exact tracking can be obtained are at a quarter, a half, and three quarters of the maximum tuning condenser capacity. For practical purposes, these three points can be taken as the same proportions of the scale reading. Of these, the centre one (half the scale reading) is fixed by the coil design, and we can only align at the quarter and three-quarter points on the scale.

Assuming that the Long waveband tunes from 1,000 to 2,000 metres, the quarter and three-quarter scale readings will be 1,250 and 1,750 metres respectively. After removing the short circuit from the oscillator, feed a signal of 240 kc/s (1,250 metres) into the signal grid of the frequency changer and set the receiver to 1,250 metres. Adjust the oscillator trimmer for maximum output. Next, set the generator and receiver to 171.4 kc/s (1,750 metres) and adjust the padder for maximum output. These two processes should be repeated several times until no further improvement can be noticed. Repeat similarly for the Medium and Short wavebands.

I suggest frequencies of 1.2 Mc/s (250 metres) and 600 kc/s (500 metres) for a Medium waverange of 200 to 550 metres, and 12 Mc/s (25 metres) and 6.67 Mc/s (45 metres) for a Short waverange of 16 to 50 metres.

On the Short wavebands, two or more points of adjustment of the oscillator trimmer and padder may be found, i.e., two positions will give any one signal. If this occurs, the position of least capacity should be used, since the other (maximum capacity) is a "second channel" response.

On Short waves, too, the percentage differences in frequency between the RF and oscillator frequencies is so small that the adjustment of the padder is less critical than at lower frequencies. For this reason, some manufacturers fit a fixed condenser as a padder. In this case, the oscillator trimmer should be adjusted for maximum output at about the centre frequency of the waveband. Again, some makers use adjustable iron dust cores in the coils for tracking purposes. In this case the procedure should be exactly the same, but the cores should be adjusted instead of a padder.

Having adjusted the oscillator, we can now tackle the aerial circuits. To do this, the signal from the signal generator should be fed to the aerial socket via a dummy aerial, and the trimmers should be adjusted for maximum output at about centre scale reading. If the aerial circuits have adjustable cores in addition to trimmers, the alignment procedure is exactly the same as that for the oscillator.

Finally, if the receiver is fitted with an "IF trap," a signal from the generator at the intermediate frequency should be fed into the aerial socket via the dummy aerial and the IF trap adjustment (coil core or condenser) should be varied for maximum attenuation, and the short on the AVC line removed.

The Editor and Staff

wish all our Readers

a very Merry Christmas

and a

Happy and Prosperous

New Year

Sometimes a receiver develops a whistle which varies in pitch as the receiver is tuned. This is usually due to parasitic oscillation in the IF stage, or a signal reaching the oscillator grid at the intermediate frequency. It is beyond the scope of this article to suggest cures, but the signal generator can be used to identify both these faults.

If an unmodulated RF signal is fed into the signal grid of the frequency changer, and the signal generator tuned through the intermediate frequency, a beat note will be heard in the speaker if the IF stages are oscillating. If the whistles are due to signals at IF reaching the frequency changer signal grid from the aerial, it can be checked in the following manner. A modulated RF signal should be fed into the aerial socket via the dummy aerial, of the same frequency as the IF of the receiver. No audible output should be heard. If there is a response in the speaker, some improvement may be effected by adjusting the IF trap if fitted, or by the fitting of such a trap. There may, of course, be a fault in the RF tuned circuits, or these may have been badly designed in the first place in which case nothing can be done short of fitting a new coil system.

Another fault for which the signal generator is invaluable is modulation hum. This sort of hum occurs in the presence of a carrier. It makes speech sound "throaty" and has a similar effect upon music. Once heard, it is easily distinguished from hum introduced into the audio stages. Modulation hum is mains hum introduced into the RF, frequency changer or IF stages, and it is beyond the scope of this article to list the faults that can cause it, or to suggest cures, but it will be shown how the signal generator can be used to identify the offending stage.

First, the local oscillator should be rendered inoperative (in the same way as for lining up the IF stages) and the signal grid of the frequency changer shorted to earth, or chassis in the case of AC/DC receivers. The generator should be switched to give an unmodulated RF output at the intermediate frequency of the receiver. The test signal should be fed into the grid of the IF valve. Modulation may be switched on to ensure exact tuning, but is not needed for the test. When an unmodulated RF signal is fed into the IF stage, no hum should be audible in the speaker. Of course, the smoothing of the generator power supplies must be beyond reproach for this test. If hum is heard, it indicates a fault in the IF

section; if not heard, it indicates a fault before the IF valve grid.

If the IF stage is not faulty, remove the short from the oscillator section and feed the unmodulated test signal into the signal grid of the frequency changer, tuning the generator to the same frequency as that to which the receiver is set. If hum is heard, it indicates a fault in the frequency changer or its associated circuits, but not the grid circuit. If hum is still not heard, feed the unmodulated signal into the aerial socket via the dummy aerial. Hum indicates a fault in the grid or the aerial circuits.

Perhaps the fault has still not shown, in which case either or both of the following may be at fault, usually both. Either the aerial is picking up an excessive amount of hum, or the aerial circuit is incapable of rejecting it. It may be noted in passing that, to my knowledge, one commercial coil pack is very susceptible to modulation hum.

No mention has yet been made of the servicing of television receivers. The ordinary signal generator cannot be used for checking the performances of the timebases. For this, a pulsed form of modulation must be employed. Signal generators using pulsed or square wave modulation are usually referred to as pattern generators.

However, the ordinary signal generator having a sinusoidal modulation can be used to check the operation of the pre-detector stages in the same manner as for those of the ordinary receiver, provided some means of measuring the output is available. One must keep in mind that the frequency is much higher and the bandwidth much wider. The signal generator can also be used, of course, to check the sound side of a television receiver.

When working at these higher frequencies, it may be advisable to use the second or third harmonic of the signal generator, since the instrument may be more stable when working at a lower fundamental frequency.

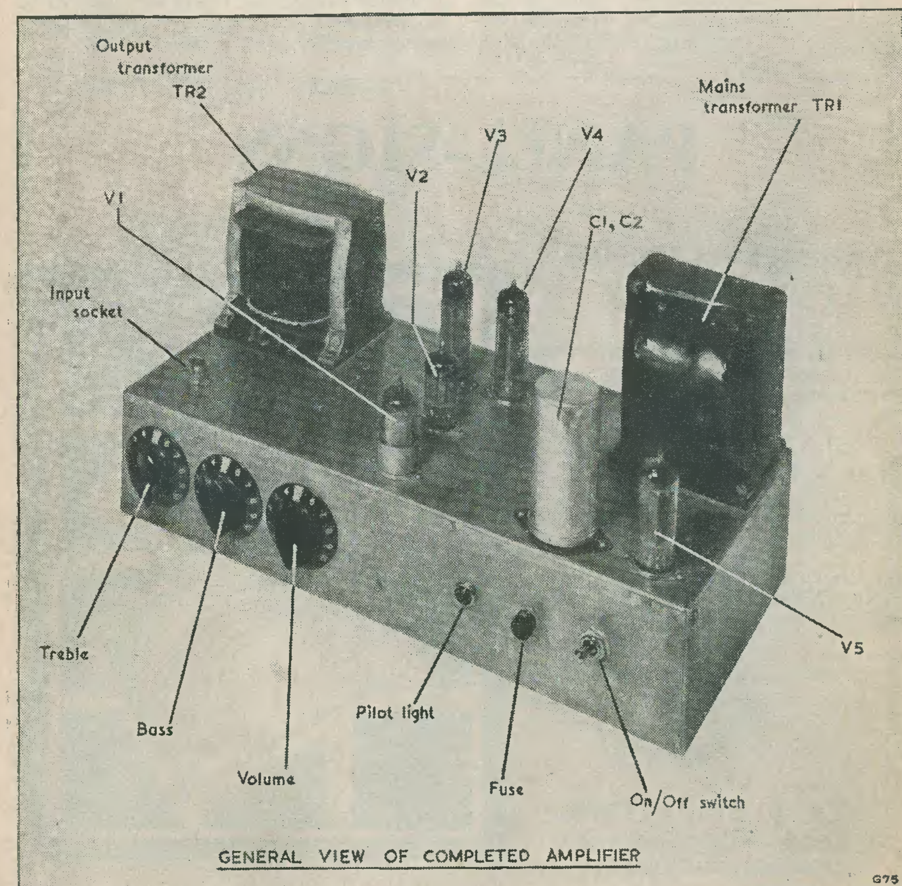
Once the technique of using a signal generator is acquired, it will be found to be an invaluable instrument for the designer, service engineer, and experimenter alike.

The MULLARD 5-valve 10-watt HIGH QUALITY AMPLIFIER

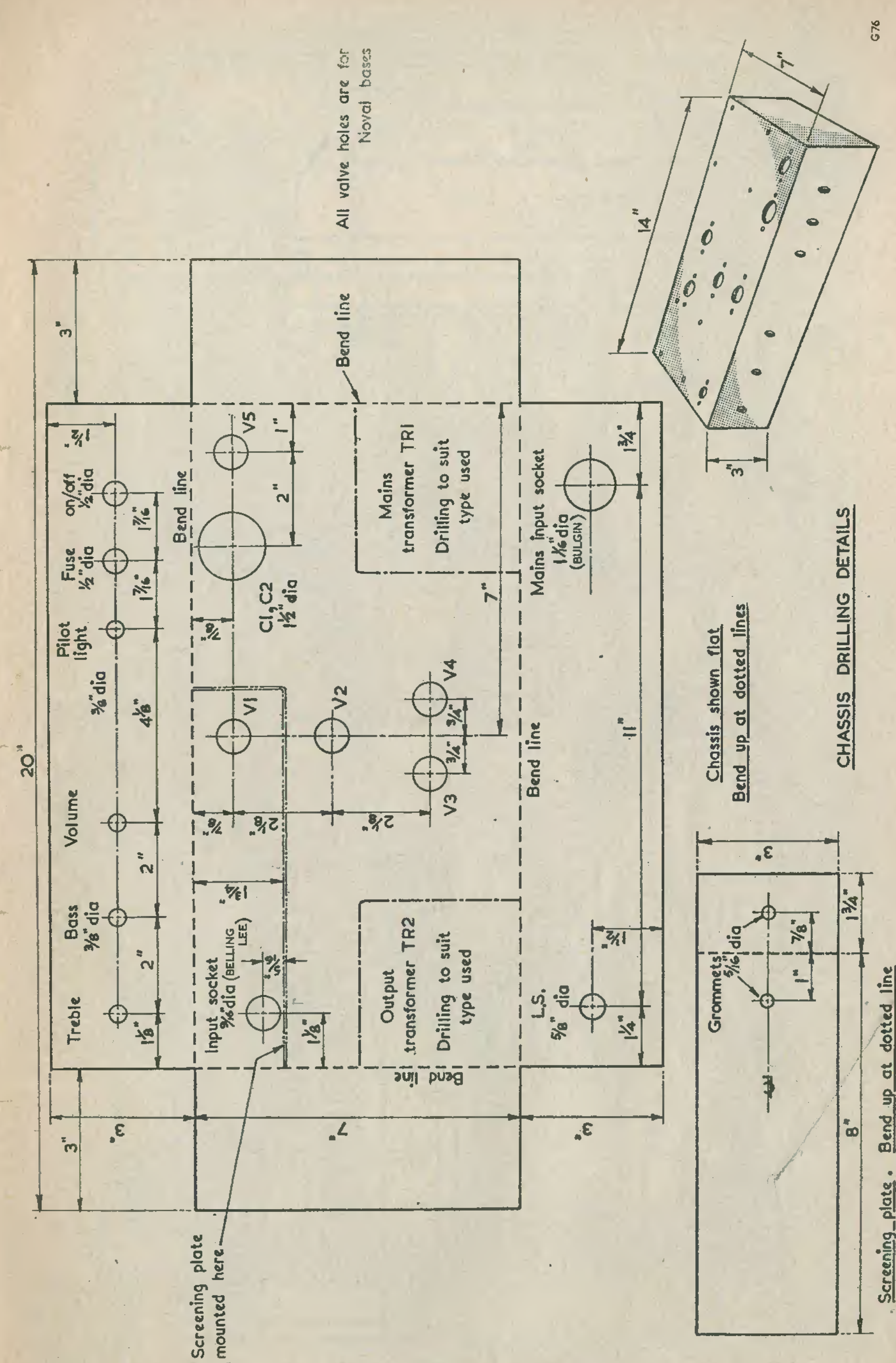
WE HAVE RECEIVED MANY REQUESTS FROM readers for practical details, such as drilling and chassis dimensions, point-to-point wiring, and so on, of the Mullard 5-Valve 10-Watt High Quality Amplifier, following upon the otherwise comprehensive article which appeared in the August issue of this magazine.

Mullard Ltd. very kindly made available to us one of their prototype models, from which the information contained in this article was prepared. Furthermore, they were also good enough to check the finished drawings from which the blocks were made.

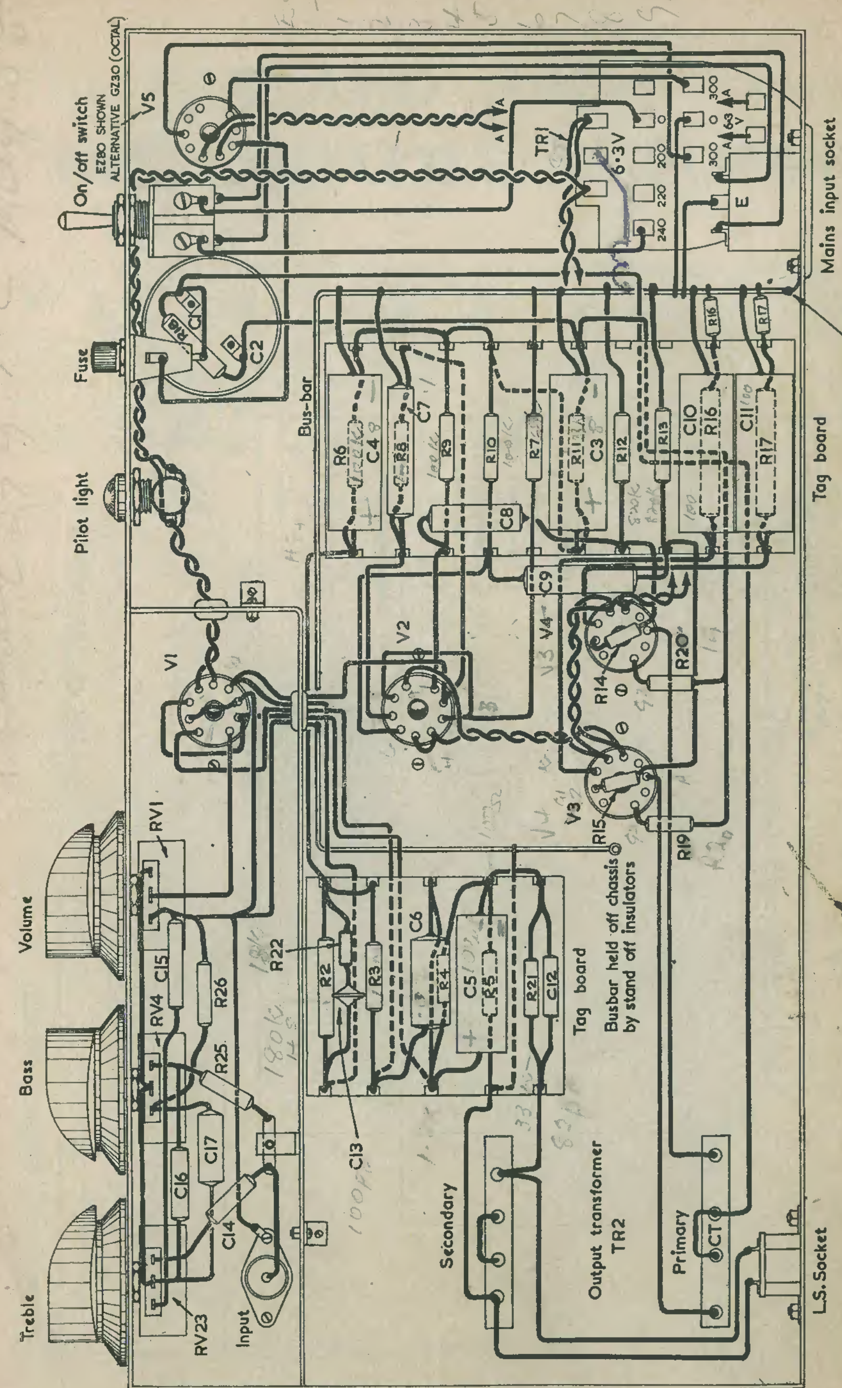
With the aid of these two articles, the construction of a really first-class amplifier is now brought within the capabilities of all our readers.



GENERAL VIEW OF COMPLETED AMPLIFIER

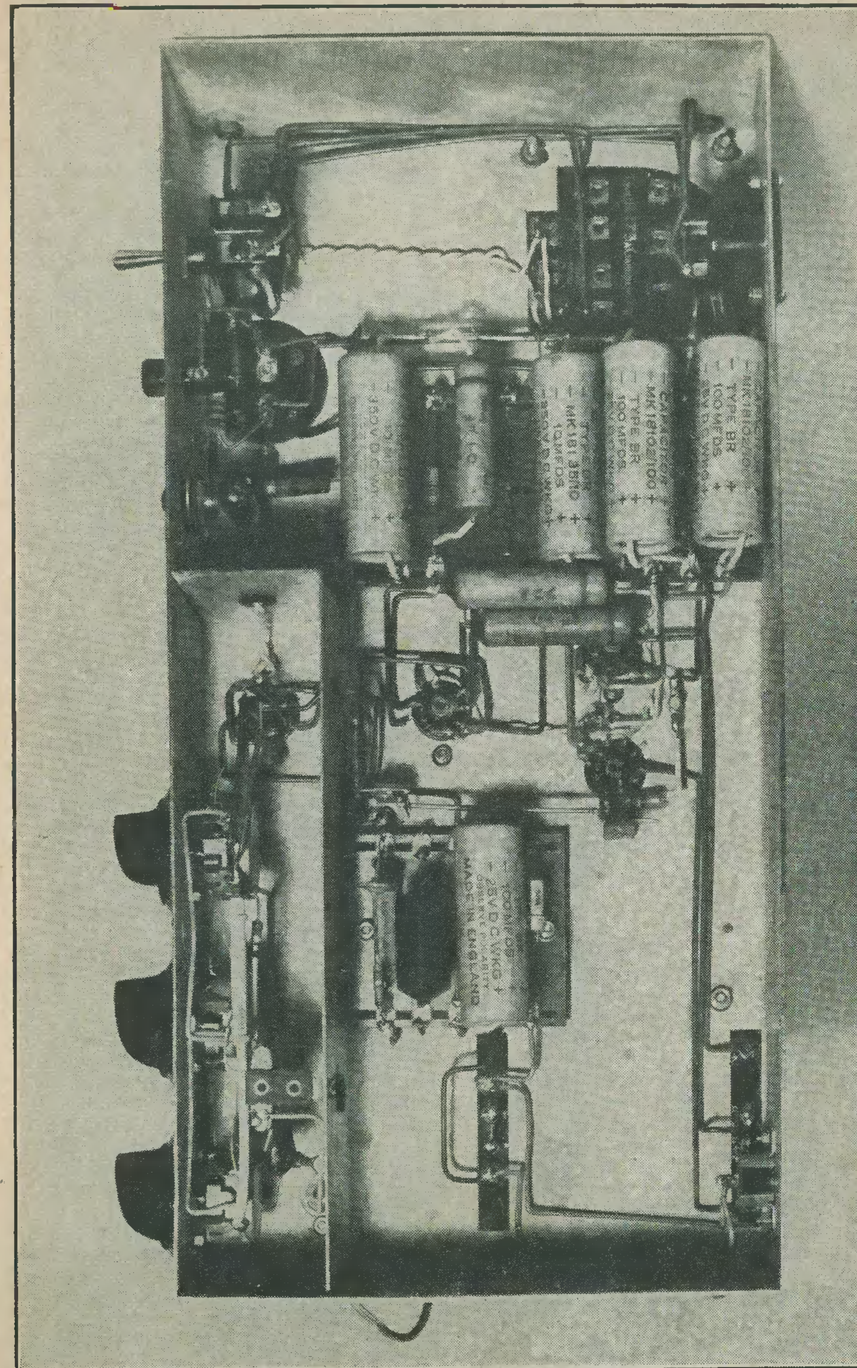


CHASSIS DRILLING DETAILS



POINT–TO–POINT WIRING DIAGRAM OF AMPLIFIER

Busbar connected to chassis



Below chassis view of complete amplifier, showing screening of control section

MAINS HUM IN AMPLIFIERS

By **W. E. THOMPSON,** A.M.I.P.R.E.

MAINS HUM CAN BE ANNOYING IN A high-quality amplifier even if there is only a slight trace of it to be heard in the absence of an input signal voltage, and its removal can sometimes prove to be a difficult task. A brief survey of some of the usual methods of reducing hum may not come amiss in the course of leading up to a simple filter circuit that the author has used with success over a long period.

Ripple voltage on the HT feed can usually be dealt with by increasing the values of decoupling and smoothing capacitors, and is invariably the first line of attack on the problem. This however, cannot always be resorted to indiscriminately, particularly in the case of pentode voltage amplifiers where the value of screen decoupling often has an important bearing on the frequency response of the stage. Where a voltage-dropping resistor exists in an HT feed, the associated decoupling capacitor can be increased in value advantageously, for the characteristics of the RC filter so formed will be improved. The same applies to choke-capacitor filters, of course. The values of rectifier circuit reservoir capacitors should not, as a rule, be increased, since a departure from the specified value may result in the rectifier valve being damaged due to excessive pulse-currents to charge the reservoir.

It may be possible in some cases to improve the RC filter characteristics by increasing the value of the decoupling or voltage-dropping resistor, where circuit conditions permit of a lower HT voltage for the valve or valves fed from the HT line concerned. Where HT voltage is so critical that it cannot be further reduced, the insertion of a small iron-cored choke can produce the desired result.

Induced hum requires different treatment. It usually enters the early stages of the amplifier via the grid circuit components and/or wiring. A common source is heater feeds being run close to grid circuits, and it can be overcome by twisting the heater leads, dressing them into the corner of the chassis so that they are removed as far as possible from grid wiring and at the same time secure a certain amount of shielding by the close proximity of the metal chassis. Screening of grid leads, and in some cases the anode circuit wiring, may be necessary. In some difficult instances it may even be essential to place certain grid-circuit components in a small screened compartment of their own, especially if the input is from a high-impedance source such as a crystal microphone.

Earth loops can cause induction hum, so they should be avoided. An earth loop can be formed by making the earth connections for components associated with a particular stage at several points on the chassis. They can be avoided by adopting the practice employed in RF amplifiers, where all components are earthed at one point for the stage only. A common form of earth loop that is not always appreciated is produced when the screening of a top-cap grid lead is joined to a common earth point, but is not insulated where it passes through the chassis. A grommet should be used to isolate the screened lead from the chassis, and if the lead passes up the inside of a valve screening can it should be insulated with sleeving so that it does not touch the valve can and nullify chassis isolation elsewhere. The screening should be earthed at one end only, usually that end nearest to the actual earth point.

Magnetic hum induction occurs when transformers and chokes are positioned so that linkage of their fields takes place. The remedy here is to re-position them by trial and error until hum is at a minimum. This may involve mounting an iron-cored component at some odd and unexpected angle. Magnetic screens made from sheet iron can reduce very small magnetic fields, but mumetal shields are necessary if other than small fields exist. Microphone transformers are typical examples where mumetal screens are often necessary, some commercial types having as many as two or three separate screens fitted to them.

The use of a sheet iron chassis usually increases the chances of magnetic hum transference from, and between, iron-cored components even if they are placed a fair distance apart. Aluminium does not suffer from this characteristic; hence its popularity, as distinct from its ease of working.

If leads carrying raw AC are placed near to iron-cored components, hum may be induced, so they should be twisted to reduce the stray field, screened if necessary, and dressed so that they are well away from such components. Heater leads and the lead carrying the mains to the primary of the mains transformer should be treated in this way when required. For similar reasons, it is sometimes wise not to gang the mains on-off switch with the gain control, since it brings the mains lead with its relatively high stray field-strength very near to a grid circuit which is often at the input end of the amplifier. The use of a separate on-off toggle switch remote from the gain control can often remove a difficult hum problem.

It is not unknown for valve electrodes to become magnetized. Voltage amplifying pentodes seem to be particularly prone to this trouble, and once the electrodes have become magnetized it is extremely difficult, if not impossible, to effect a cure. As the electrodes are often made of nickel or a nickel alloy, which are magnetic materials, care should be taken not to place high-gain valves where they can be affected by fairly strong magnetic or electrostatic fields.

In the foregoing, several of the hum-induction sources that are most often encountered have been briefly mentioned. There is, however, a source of hum that cannot be removed by the methods described, and so needs different treatment. The heaters of the valves are, of course, carrying raw AC, and even with indirectly-heated valves some hum can be traced to the heater circuit despite the thermal inertia of the cathodes. Some schools of thought attribute this to very slight vibration of the heater hair-pin inside the cathode causing changes in the internal capacitance between heater and cathode. This theory has some foundation when it is found that placing a positive potential on the heater reduces the trouble considerably, and indeed invariably completely eliminates hum due to this source. Experience has shown that biasing the heaters to some 40 or 50V DC positive above chassis seems to be an optimum condition, especially in the earlier stages of power amplifiers and pre-amplifiers.

A means of doing this is illustrated in Fig. 1. The resistors R1 and R2 form a potential divider across the HT supply, the voltage at their junction being in direct proportion to R1/R1+R2 and of the order of 45V. The actual values of R1 and R2 may be dictated by current drain from the HT supply where there is little current to spare, in which case a series resistor chain should be designed to draw a matter of a few milliamperes only. Assuming that the HT supply voltage is 300V and 5mA can safely be passed through the potential divider, the value of R1 and R2 in series will be $R=E/I=300\times 1{,}000/5=60k\Omega$. R1 will therefore need to be 45/300ths of this value, that is, $45\times 60{,}000/300=9k\Omega$. R2 will thus be $R-R1=60k\Omega-9k\Omega=51k\Omega$. This latter is a standard value, and R1 can be made up from two 18kΩ resistors in parallel. The wattage rating of R1 will be $45\times 5/1{,}000=\frac{1}{4}W$ nearly, so the two 18kΩ resistors can

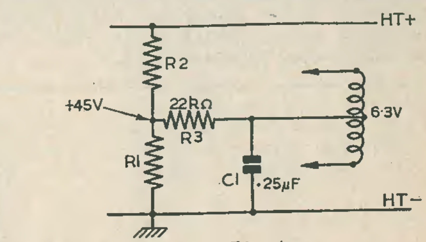


Fig. 1

E90

each be $\frac{1}{4}$W components. R2 will dissipate $300-45\times 5/1{,}000=255\times 5/1{,}000=1.275W$, so a 2W resistor should be used. This method of calculation will apply to other HT voltages or current values chosen by the reader.

The resistor R3 and capacitor C1 form a simple filter to keep hum voltage out of the HT supply, the values not being very critical. C1 need not be rated for a high voltage, 250V working being far more than adequate. This circuit is usually employed with a centre-tapped heater winding, so that the heater circuit is balanced to earth. If the heater winding is not centre-tapped an artificial centre-point can be secured, hum-dinger fashion, with two $\frac{1}{2}$W resistors as

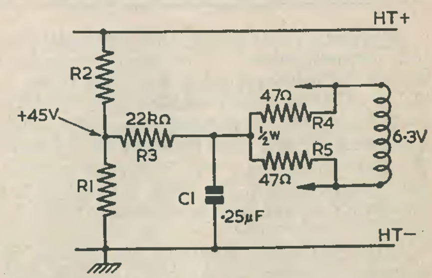


Fig. 2

E91

shown in Fig. 2. These resistors, R4 and R5, should preferably be closely matched so that the centre-tap is as near the electrical centre of the circuit as possible. With the value of 47Ω chosen the additional current drain on the heater winding amounts to only 70mA, and the calculated wattage rating of the resistors is ¼W each, but ½W components are specified to reduce the chances of them running warm. Where possible, and especially if the heater winding can accommodate a higher current drain, lower values for R4 and R5 can be chosen. Closely matched resistors of low value are easier to obtain than those of higher value, the manufacturing tolerance becoming of less importance as the resistance value decreases. Components having a wattage rating about twice the calculated value should be used.

It is then only necessary to use the filter resistor and capacitor R3-C1 as shown in Fig. 3. The filter is shown in heavier lines to distinguish it from the cathode-bias circuit of the Williamson which is included for reference. Thus, two additional components only are required where a centre-tapped heater winding is used. If an untapped winding feeds the heaters, the artificial centre-tap of Fig. 2 can be applied.

The effect of this very simple modification has to be heard to be believed, if one is prepared to accept the paradox that an absence of hum can be 'heard'! An example

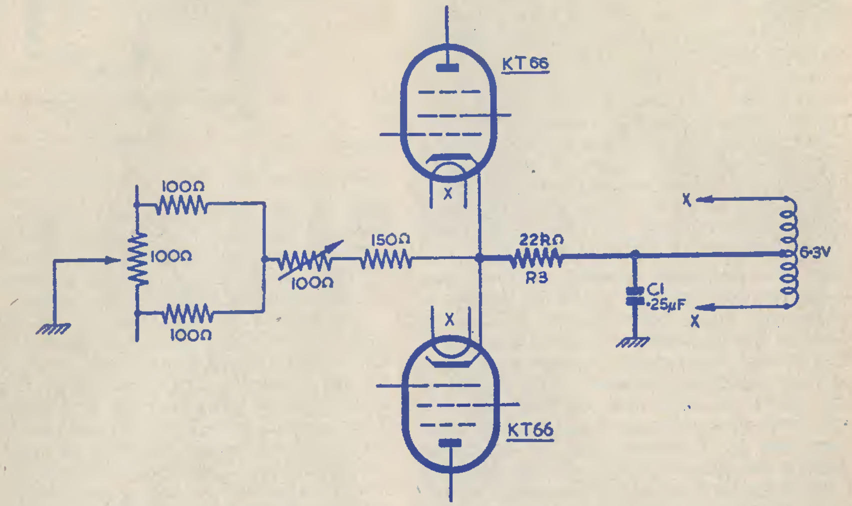


Fig. 3

E92

Suppose, for example, that 20Ω resistors are contemplated. The total resistance across the heater winding will be R4+R5= 40Ω. The current through them will be I=E/R=6.3/40=0.16A approx. The watts dissipated by the two resistors is therefore W=E.I=6.3×0.16=1W. As each resistor will dissipate half the total, its calculated dissipation is ½W, so 1W resistors should be used.

If the particular amplifier has a point in it which is some 40 to 50V positive with respect to chassis, it is possible to dispense with the potential divider R1-R2 of Fig. 1. An instance of this is the output stage of the Williamson amplifier, where the cathodes of the two KT66 valves in the push-pull output stage are run at about 38V positive above chassis, which happens to be very convenient for the purpose under discussion.

of this desirable hum-free operation is exemplified in the author's amplifier. This is a Williamson with its associated power pack built on to one chassis measuring 15″×9″×3½″ deep, made of 18 swg sheet iron. It is chiefly used with a high-gain preamplifier employing a 12AT7 voltage amplifier and cathode-follower stage, input being a crystal microphone; the input impedance of the first triode stage is therefore high-impedance. With the chassis disconnected from earth, microphone disconnected from the pre-amplifier, and the gain control turned up to maximum, only the slightest trace of hum can be detected by placing one's ear close to the speaker, which is a Goodman's Axiom Twelve in a bass reflex cabinet. The low-frequency cut-off of this speaker and enclosure is of the order of 30 c/s, so 50 c/s or 100 c/s hum would be

only too readily reproduced if they existed to any marked extent.

It also happens that a further advantage accrues in the case of a Williamson amplifier if the heater circuit is given a positive bias. Due to the value of the cathode load resistor in the phase inverter stage, the cathode assumes a positive potential well in excess of 100V. This potential also appears between cathode and heater, which is practically at earth potential, and for the type of valve generally used for this stage the heater-cathode potential as recommended by the makers should not exceed 90V. The author knows of several instances where heater-cathode insulation gradually fails in the phase inverter valve due to this excessive potential difference, the usual symptoms of failure being a gradual increase of residual hum.

With the biasing circuit described in this article, the difference of potential between heater and cathode is reduced to a value lower than the maximum specified by the makers of the valve, and the trouble rarely occurs. At least, no instances of failure of cathode insulation have come to notice under these conditions, and amplifiers that have given hum trouble when the phase inverter ages have remained hum-free when a new valve and the hum filter have been fitted. This point is well worth bearing in mind for other amplifier circuits which use a similar type of phase inverter circuit which places the cathode at a relatively high positive potential with respect to the heater.

RADIO COMPONENT SHOW 1955

As a result of a ballot for space in the Radio Component Show, to be held at Grosvenor House from April 19 to 21, 1955, 131 stands have been allotted and 11 more will be allotted shortly, a record total. A preliminary list of exhibitors shows seven newcomers to the exhibition. The Ministry of Supply will again be exhibiting, although no stand is yet allotted.

An innovation this year is that instead of circulating admission tickets, application cards will be issued, one to be filled in and forwarded by each intending visitor, in return for which he will receive a ticket if his application is approved. Prospective overseas visitors, however, will receive their tickets as in previous years without application.

Considerable overseas interest in the exhibition is again expected, the exports of British radio and electronic components in the first nine months of 1954 having shown an increase in value of 30 per cent as compared with 1953.

The full title of the exhibition is the Twelfth Annual Private Exhibition of British Components, Valves and Test Gear for the Radio, Television, Electronic and Telecommunication Industries. It is organised by the Radio and Electronic Component Manufacturers' Federation, 22 Surrey Street, Strand, London, W.C.2.

MINIATURE AND SUB-MINIATURE PRECISION POTENTIOMETERS

Two new precision potentiometers have been added to the range recently introduced by Salford Electrical Instruments Ltd. They comprise linear miniature and sub-miniature types, and have been developed for use in applications where space is particularly limited, as in some computing devices, time base generators and electronic control systems.

The miniature potentiometer, the D.2., though it weighs only 15 gm. and is only 1⅛ in. in diameter, covers a resistance range from 1,000 to 90,000 ohms and has a power rating of 1 watt. The maximum resolution obtained is 6 turns/degree and the standard electrical angle is 340°. There are two taps on the standard model, each being made to a single turn of wire. The housing is fitted with a keyed locating spigot and this allows up to three units to be ganged on a single shaft.

The torque with plain bearings is approx. 5 gm. cm., but ball bearings can be fitted if necessary and the torque is then of the order of 2–3 gm. cm.

The sub-miniature potentiometer, known as the S.D., features a special resistance card and clamp ring assembly. The complete potentiometer weighs only 4 gm. and measures only ⅝ in. in diameter by ½ in. in length; the latter measurement is taken from the front of the case to the rear of the housing, and does not include terminal or spindle projection.

The resistance range covered by this instrument is from 200 to 8,000 ohms. The maximum resolution is 2 turns/degree and the power rating ¼ watt. There are two taps and the electrical angle is 280°. The sub-miniature potentiometer cannot be ganged, and is essentially a "trimmer" and unsuitable for servo application. It can, however, be supplied with a ½-in. long shaft or with a screw adjustment as required. [END

The

GLOBE-MASTER

AN 8-VALVE COMMUNICATIONS RECEIVER

Described by **F. A. BALDWIN** A.M.I.P.R.E.

THE ADVENT OF A NEW COMMUNICATIONS receiver design is not an everyday occurrence, and when one appears on the horizon, most radio enthusiasts are inclined to view the project with some interest. For those interested in receivers of this type, the choice now available is somewhat limited, and varies between ex-Government surplus items or a brand new manufactured receiver. Whilst the latter are undoubtedly first class instruments and well worth the price, it is none the less a fact that many enthusiasts find the cash outlay beyond their means at the present time. The surplus equipment also falls far short of the ideal, for the most part being designed for purposes other than that which provides satisfactory reception under present day conditions. As received, such units must be submitted to extensive modifications in order to achieve the desired results—not altogether an easy proposition or satisfactory state of affairs.

The home constructor must therefore turn to his workshop bench and construct his own receiver—"rolling one's own" has many advantages over other methods of acquiring first rate equipment. Firstly, one is able to incorporate all those features most desired by the user, secondly, servicing becomes very much easier when one knows how it is built, and thirdly, the actual construction may proceed in stages as and when the components come to hand. All that is really required by the average hobbyist is a proven design, and the ability to obtain all the parts and components fairly easily. In the design about to be described, all these considerations have been taken into account. A glance at the component list will show that all of the items are identified with the supplier or maker of the parts used in the prototype. The design itself has few frills—it is perfectly straightforward, and the valves used are those easily obtainable at any radio dealers; indeed, many of these types may already be available in the average workshop—hence the use of these as opposed to the miniature valves.

From the illustrations shown, it will be seen that the front panel has a most pleasing appearance and is well laid out. The use of "Panel-Signs" has considerably enhanced both the usefulness of the pointer type knobs and also the general eye appeal of the completed equipment. In this respect, the treatment of the Magic Eye aperture should be noted, as, in the writer's opinion, this has greatly improved the appearance over the old method of just having a rather blank looking hole cut in the panel. The positions of the various panel controls may be seen from the photograph.

The chassis layout follows standard practice and the employment of screening cans should be noted, the use of these considerably reducing interaction between the various stages. Fig. 1 shows a diagrammatical layout (not to scale) of the underside of the chassis for those who intend to construct this receiver. Detailed measurements of this are not given as it is felt that the home constructor capable of building this receiver may well wish to include some components other than those specified, thereby having to contend with differing physical sizes etc. The positions of the main condensers and resistors are shown and this layout should be adhered to if maximum performance is to be achieved. The inset to Fig. 1 shows the positioning of components associated with the Magic Eye.

For those who wish to closely follow the layout shown, both the chassis and cabinet are available from Roding Laboratories completely drilled and punched. All of the components are also available direct from the same company, from whom all of the prototype components were obtained and from whose laboratories the design originated.

The Circuit

This is shown in Fig. 2, from which it will be seen that it consists of a Mixer Oscillator stage (6K8G), two IF Stages (6K7G), Detector, AVC and AF Amplifier stage (6Q7G), Audio Output Stage (6V6G), Rectifier (5Z4G), Magic Eye (EM34) and BFO (6C5G). In itself, this circuit is a sound and well proven design, the Mixer Oscillator functions extremely satisfactory whilst the gain from the two IF Stages is more than adequate for the average den. The BFO is, of course, an essential part of any communications receiver, and the Magic Eye is as good a method as any of comparing received signal strengths. Basically this is, then, the well-tried 'four-plus-one' circuit with the added refinements of an extra IF stage, BFO and Magic Eye. For those who do construct this excellent receiver but

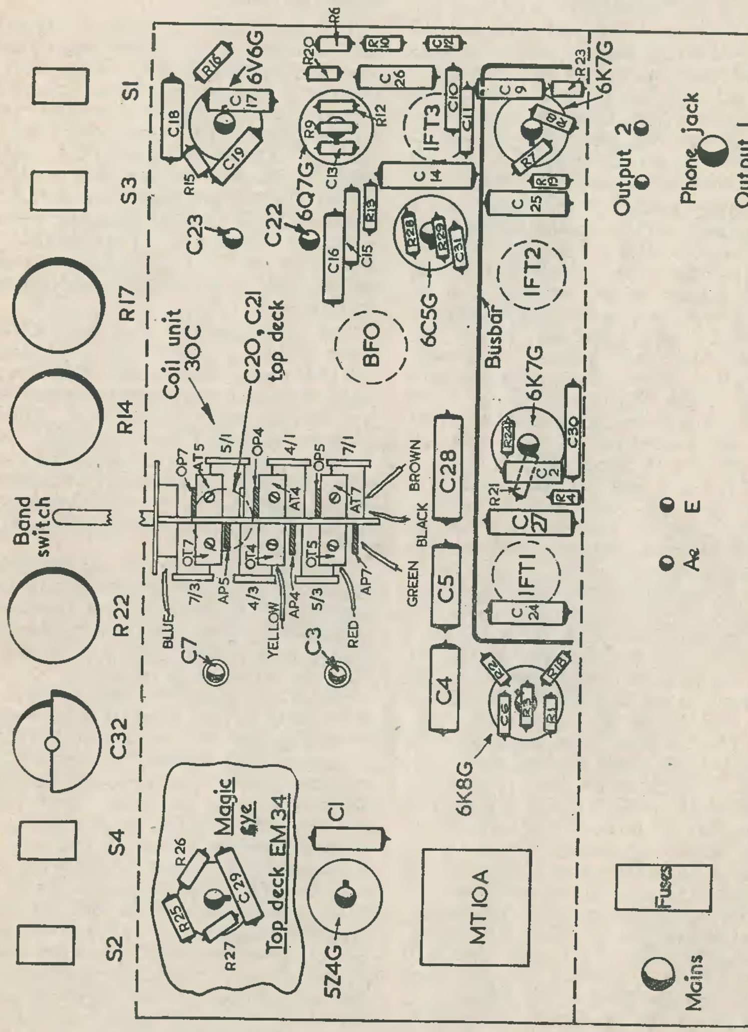


Fig. 1. Main Component positions—the panel controls are mounted on the front of the cabinet

would also prefer an RF stage, it may be of some interest to know that Roding Laboratories are to shortly market a Pre-Selector to match.

The Aerial and Oscillator coils are supplied as a complete pack, pre-aligned by the manufacturer, as indeed are the IF's, but of course some small adjustments will be required by the constructor to allow for the small variations in capacity occasioned by slightly differing layouts, etc. For this reason, full lining up details are given later. Only six external connections are required to wire in the coil unit; these are given on the circuit diagram. In addition, the actual coil tag numbers are also shown as are the valve base connections (International Octal).

The Mixer-Oscillator functions in a standard circuit; AVC is applied to this stage via R4-C2. The tuning condenser (C3) is operated in conjunction with the bandspread condenser connected in parallel with it. The 6K8G works very well in this inductively coupled tuned grid oscillator circuit provided the component values are closely followed. The output from this stage is via a short length of co-ax cable, the metal braiding of which should be earthed, from the first IF transformer to the top cap (grid) of the first IF Stage (6K7G).

The 6K7G is a vari-mu RF pentode of the remote cut-off type and as such is eminently suited to operation in an IF stage. The IF gain control is incorporated in this stage only, the second IF stage being operated at near maximum gain consistent with stability. The actual gain control is R22 which is connected in series with the fixed cathode bias resistor R21. The screen HT supply is via R24 and is decoupled by C28. Anode supply is via R19 and the IF primary winding, C25 being the decoupling component. These values have been carefully chosen to provide both efficient and stable operation. The second IF stage is also constructed around the 6K7G, and it should be noted here that the input to this valve is also via a short length of screened cable.

The output from this stage is taken to one diode of the 6Q7G, which provides the functions of 1st AF amplifier and AVC, as well as demodulating the applied RF signal. AVC is taken from the diode load R10 via R6 into the 2nd IF stage, via R23 into the 1st IF, and via R4 into the Mixer. C2, C9 and C27 are the decoupling condensers. The AVC diode is fed from the anode of the 2nd IF valve via the small coupling condenser C12, this system effectively obviating the "threshold-shriek" usually obtained when AVC and AF are derived from a common source. The AF gain control is R14. Grid bias for the triode section, and incidentally a delay voltage for the AVC, is provided by R11 in the cathode return of the 6Q7G. No bias is applied to the detector as the diode load R9 is returned to the cathode, and not to the HT– line as in the case of R10 and R14. The AF output from this stage is fed via C17 and the Phone Jack —the latter so arranged that insertion of the Phone Plug will break the continuity—into the output stage.

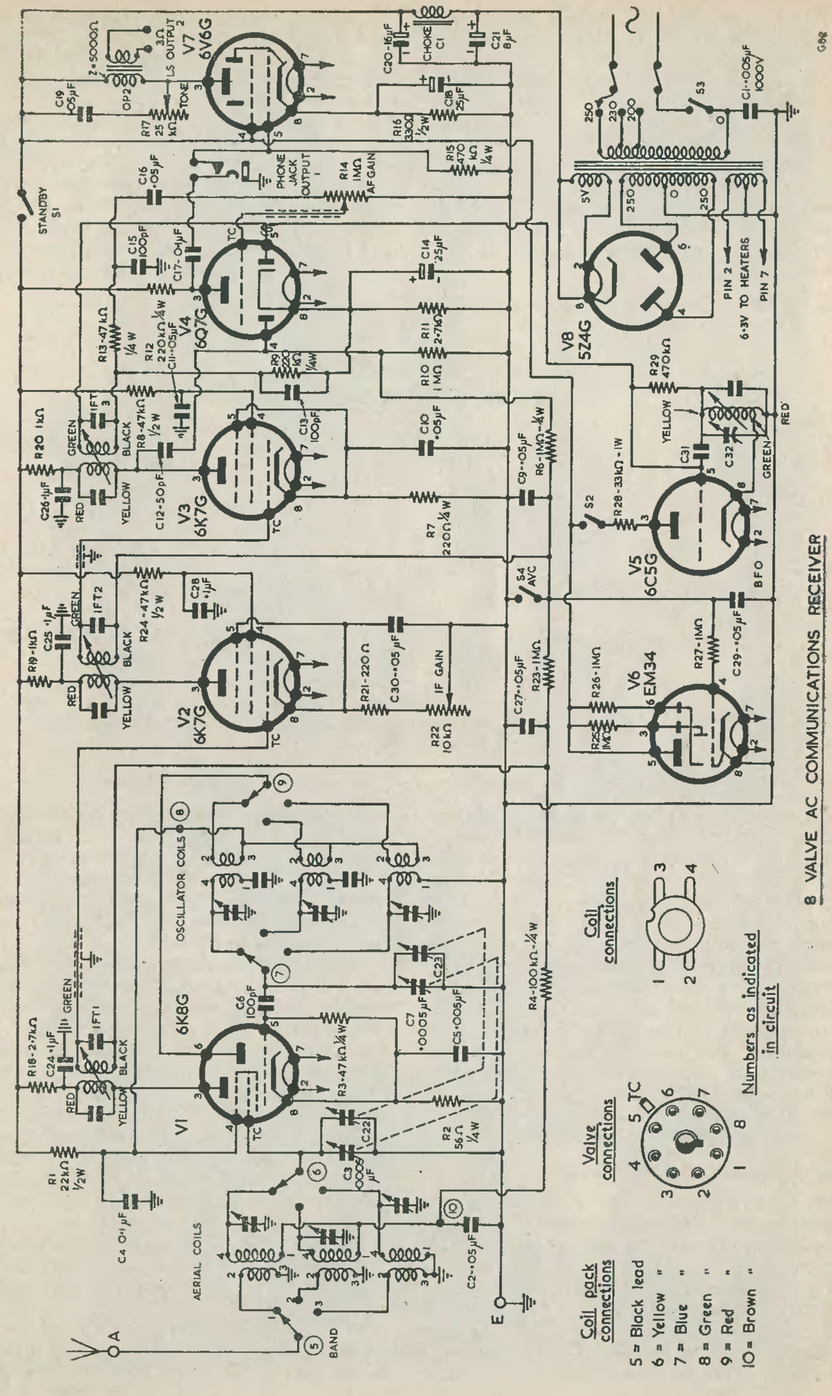
This last stage is designed around the well known 6V6G output beam tetrode. The Tone control is R17 which, with C19, is wired across the output transformer primary, giving a good degree of top cut when required. The transformer used is the Roding Laboratories type OP2, which is specially designed for use with a 6V6 type valve. The primary impedance of this transformer is some 5,000Ω, and some 4 watts of audio is obtainable. The speaker itself should be of the 3 ohms type in order to obtain correct matching and optimum performance.

The power supply uses the 5Z4G full-wave rectifier together with an Elstone type MT10A mains transformer. Various mains input voltage tappings are provided on the transformer, these being 200V, 230V and 250V respectively. The choke C1, together with the reservoir and smoothing condensers C21 and C20 adequately smoothes the voltage supply. A list of voltage readings taken at various points in the circuit is given later.

Note should be made of the Stand-by switch. In the stand-by position this cuts the applied HT potential to the Detector and all preceding stages, thus muting the receiver during transmission periods or whenever a break in reception is required.

The Mullard EM34 "Magic Eye," or as it should be termed, Electron Beam Indicator, is perhaps the best of its type available on the present day market. It provides for two separate indicator portions, one for powerful local signals and the other for the distant, and therefore weaker, transmissions. This is a decided improvement over the single indicator types so prevalent on the surplus market. As mounted on the front panel, it is so arranged that the portion used for the weak signals—that with the wide shadow —is at the bottom, while the other indicator is, of course, placed at the uppermost position. Particular note should be made of the connection point to the AVC line, i.e., between R6 and R23, if the best results with regard to visual performance are to be achieved.

The BFO valve is a 6C5G triode, one of the general purpose types which perform well in circuits of this type. That shown is of the ECO type using the Roding BFO type R465S coil. The BFO On/Off switch



is located in the HT supply line. Coil connections are given in the circuit diagram, from which it will be seen that these are colour coded in order to facilitate easy construction and to avoid errors in connections. The output from the oscillator is taken from the grid to the signal diode of the Detector stage, where some two to four turns should provide sufficient coupling. Some experiment here may, however, be necessary in order to determine the best injection level which will provide satisfactory CW reception.

difficulty in lining up the completed receiver (instructions for which are given later), but this can always be undertaken by the local radio service engineer, and should not cost more than a few shillings.

Coil connections are shown on the circuit, as are the valve base numbers. These latter connections are also shown around each valve so that the connections to each pin number is clearly shown. The IF transformers are colour-coded to avoid errors in wiring up the IF stages, and indeed, the whole assembly has been made as simple as

TABLE 1

VOLTAGE READINGS

Measured on 750V Range, AVO Model 7

Valve	Pin 1	2	3	4	5	6	7	8
V1	272V	—	265V	100V	—	95V	—	2.5V (15V Range)
V2	272V	—	270V	210V	3-29 (150V Range)	270V	—	As pin 5
V3	—	—	260V	130V	3.3V (15V Range)	272V	—	As pin 5
V4	—	—	85V	—	—	272V	—	1.25V (15V Range)
V5	—	—	180V (BFO On)	—	—	—	—	1V (15V Range)
V6	—	—	35V	—	272V	18V	—	—
V7	—	—	260V	272V	—	—	—	13.3V (15V Range)
V8	—	295V	—	258V (AC)	—	258V (AC)	—	295V

230V AC in. Heaters 6.3V. Total DC current 72mA under no signal conditions. AF gain at minimum and IF gain at maximum settings. DC current 42mA with "Standby" switch in Off position.

As with all BFO oscillators, it is the frequency stability that is most important. Should this for some reason vary, then it will immediately produce an alteration in the pitch of the beat note. In the circuit shown, provided the circuit values are as stated, this fault will not be apparent—the whole idea of the finalised version, i.e., that shown, being to produce an output substantially free from harmonics and an input at the Detector diode somewhat equal to the signal level. Much will depend on the degree of coupling applied, but once the best injection is found, the turns around the diode lead should be given a coat of "Durofix" to prevent any movement.

The Circuit — General Notes

As much information as possible has been given in the circuit diagram, it being felt that the constructor capable of building this receiver prefers matters this way. It is perfectly possible, of course, for all enthusiasts to begin constructing this set, particularly as the cabinet and chassis are available already drilled and punched. The not-so-far-advanced hobbyist may possibly find some

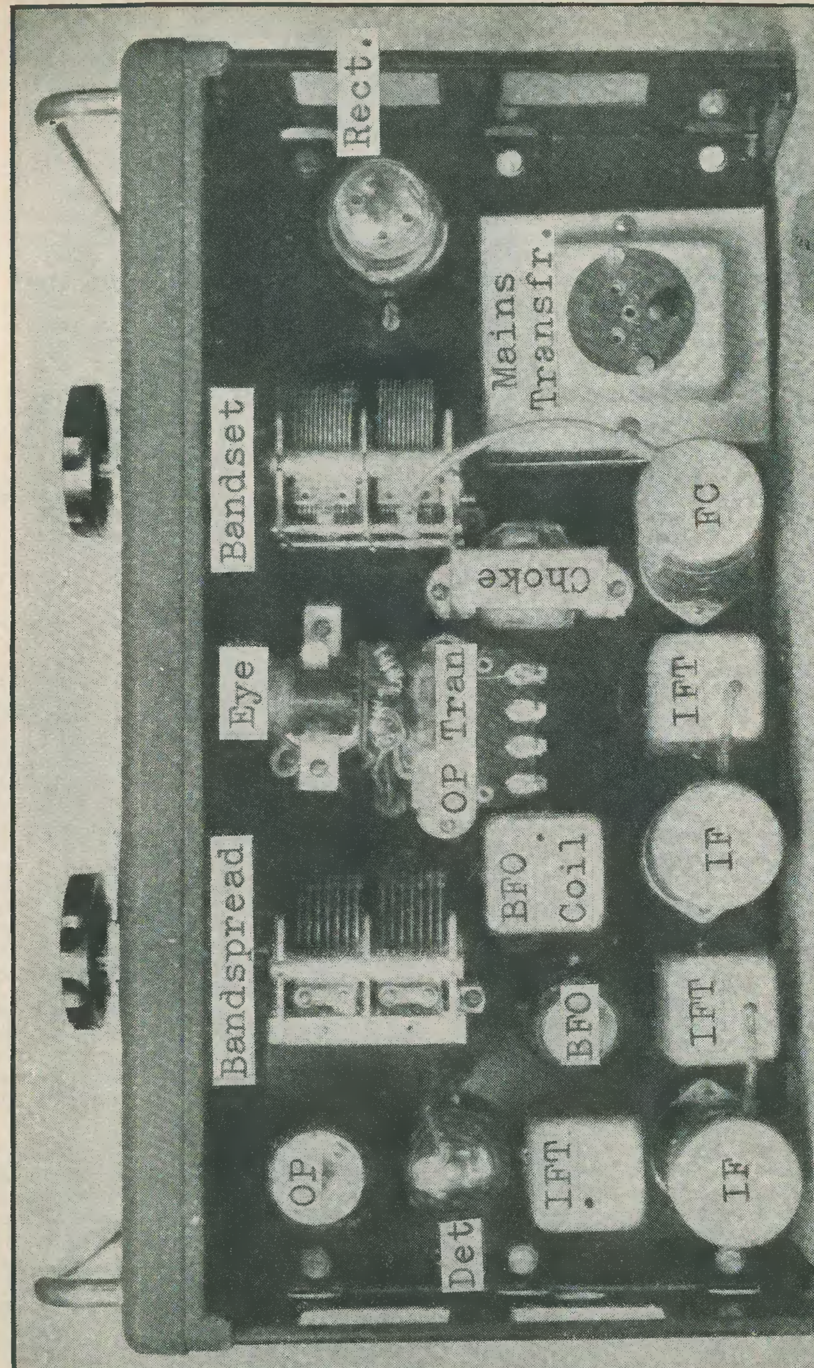
is possible in a multi-stage receiver of this type. All resistor and condenser numbers and values are shown and the valves have been designated. With this information it is felt that the vast majority of constructors could confidently commence to build the set with little or no difficulty.

The valve heater winding is centre-tapped to earth and the actual heater wiring should consist of lengths of twisted lead to each valve heater connection. This method considerably reduces the chances of induced hum pick-up from the heater AC supply.

The tuning range of this receiver is 1.5 Mc/s to 28 Mc/s in three bands. The table gives readings of frequency points against Bandset Dial readings obtained with the prototype (Bandspread dial at zero). With the aid of these, it is perfectly possible for the constructor to line up the receiver.

The coil unit (Roding Laboratories type 30C), is shown in Fig. 1; the individual coil designations, air trimmers and padders being shown.

The chassis backdrop is utilised for the phone and speaker outputs (see Fig. 1), Aerial and Earth inputs and also the mains



Layout of Components on Top Deck

input. The fuse tag board is also secured to the inside of this chassis wall. Comparison of Fig. 1 with the photograph of the chassis top will considerably assist in obtaining a clear picture of the method of assembly of the main components.

ganged condensers fully open. Throughout the alignment operations leave the Bandspread dial at Zero. On all bands the 500μA meter should show a reading from 10 to 300μA, indicating that the oscillator is functioning satisfactorily.

BANDSET DIAL READINGS
(BANDSPREAD AT ZERO)

Band	Mc/s	Dial	Mc/s	Dial	Mc/s	Dial	Mc/s	Dial
1 ..	1.5	100	1.75	80	2.0	65	2.25	53
	2.5	43	2.75	35	3.0	28	3.25	22
	3.5	17	3.75	12	4.0	8		
2	3.75	100	4.0	90.7	4.5	77.3	5.0	66.5
	5.5	57.7	6.0	50	6.5	43	7.0	36.6
	7.5	31	8.0	25.5	8.5	20.9	9.0	16.4
	9.5	12.3	10.0	8.7				
3	11.8	66	11.0	58	12.0	50	13.0	44
	14.0	38	15.0	33	16.0	29	17.0	25
	18.0	22	19.0	19.5	20.0	17	21.0	15
	22.0	12	23.0	9	24.0	6	25.0	4
	26.0	2	26.5	0				

Alignment Instructions

Switch to Band 1 (1.5 to 4 Mc/s). Set Bandset at 100 and Bandspread at Zero. Stop oscillator working by shorting Blue lead of coil unit to chassis. Set modulated signal generator to 465 kc/s and inject at top cap of V3. Adjust dust cores of IFT3 with insulated trimming tool (be careful not to break the cores), for maximum output on output meter. Always keep output from the generator low, and switch off AVC. Keep the IF and AF gain controls towards maximum.

Attach Signal Generator lead to top cap of V2 and adjust cores of IFT2, reducing output of the generator. Disconnect top cap lead from ganged condenser to V1 and attach Generator lead to top cap, with a 500kΩ resistor to chassis to complete the grid circuit; adjust cores of IFT1. A very low output from the Generator will be required for this operation. Leave the Generator lead attached to V1 and readjust, if necessary, the dust cores of IFT3 and IFT2. Disconnect the Generator lead and replace V1 grid lead. Remove short from the oscillator section.

Disconnect R3 from junction of C5 and R2 and insert a 500μA meter. Attach Signal Generator leads, via a suitable dummy aerial, to the aerial and earth input sockets. Ensure that both the Bandset and Bandspread dials are set at Zero with respective

Switch to Band 1 and set the Bandset dial (hereinafter termed the dial), to 93.4 degrees. Set the Signal Generator (modulated) to 1.6 Mc/s and adjust OP7 and AP7 (see Fig. 1), for maximum output. Set dial to 17.0 degrees and inject a 3.5 Mc/s signal; adjust trimmers OT7 and AT7 for maximum output. Repeat several times for optimum results.

Repeat as above for the other Bands, viz., Band 2—Dial at 77.3 degrees, inject signal at 4.5 Mc/s and adjust OP5 and AP5. Set dial at 12.3 degrees, inject signal at 9.5 Mc/s and adjust OT5 and AT5. Repeat several times. Band 3—Set dial at 62.4 degrees, inject signal at 10.5 Mc/s and adjust OP4 and AP4. Set dial at 12 degrees, inject signal at 22 Mc/s and adjust OT4 and AT4. Repeat several times. A low reading on the meter will be shown for the 62.4 degree dial setting.

In the past few weeks, the "Globemaster" receiver has been subjected to some fairly stringent tests and results have been most encouraging. For those readers who wish to avail themselves of a sound design and a good all-round performance in a communication type receiver, this equipment is to be recommended. The mechanical construction is rigid, and the receiver is not only pleasing in appearance but is also a first class performer.

PROTOTYPE PARTS LIST

for the Globemaster 8-valve Communications Receiver

Mains lead, Roding Labs.
Solder, Roding Labs.
Grommets, Roding Labs.
Screened wire, connecting wire and sleeving, Roding Labs.

Resistors: All ¼W unless stated otherwise.

Erie:
- R1—22kΩ ½W
- R2—56Ω
- R3, 13—47kΩ
- R4—100kΩ
- R6, 10, 23, 25, 26, 27—1MΩ
- R7, 21—220Ω
- R8, 24—47kΩ ½W
- R9, 12—220kΩ
- R11, 18—2.7kΩ
- R14—1MΩ variable, log. law
- R15, 29—470kΩ
- R16—330Ω ½W
- R17—25kΩ variable, log. law
- R19, 20—1kΩ
- R22—10kΩ variable wire wound Colvern, CLR4003/85
- R28—33kΩ 1W

Condensers: Hunts or similar. Paper tubular 350V unless stated otherwise.
C1—0.005μF 1,000V
C2, 9, 10, 11, 16, 19, 27, 29, 30—0.05μF
C3, 7—0.0005μF J.B. 2-gang type E. without trimmers.
C4, 17, 24, 25, 26, 28—0.1μF
C6, 13, 15, 31—100pF silver mica
C5—0.005μF
C12—50pF silver mica
C14, 18—25μF 25V electrolytic
C20, 21—16/8μF 450V electrolytic (short type) 1⅜ can
C22, 23—75pF J.B. 2-gang type E. without trimmers
C32—50pF J.B. Air-tune.

1 Coil unit type 30C, Roding Labs.
IFT's 1, 2 and 3 type C (IFT1 with red spot), Roding Labs.
2 slow motion dials and knobs type 843, Eddystone.
1 Cabinet and chassis Eddystone type 787 (undrilled), or Roding type CCA (prepunched as prototype).
2 Handles for Cabinet Eddystone 608 or Roding HC2.
Valves: 6K8G, 2-6K7G, 6Q7G, 6V6G, 5Z4G, 6C5G Brimar, EM34 Mullard, or similar.
8 I.O. valveholders, Ariel Pressings.
Mains transformer Elstone MT10A. 250/0/250 100mA 6.3V 4A, 5V, 3A.
Output transformer OP2 5,000/3, Roding Labs.
BFO unit type R465S, Roding Labs.
8" P.M. loudspeaker, Elac, W.B., etc.
Smoothing choke C1, Roding Labs.
2 sockets 2-pin type, Clix.
4 SPST switches, Arcolectric T600
8 5-way tagboards with centre earth, Ariel Pressings.
4 IO grid clips, Clix.
3 Valve screening cans, Decca type.
2 Electrolytic clips 1⅜", Hunts.
5 knobs type 841, Eddystone.
1 twin fuseholder, Clix.
2 1 amp. fuses, Standard 1¼".
Mains connector type P.350, Bulgin.
2 Universal couplings., Jackson Bros.
Phone jack and plug J.12, P38 Bulgin.
Transfers: Panel-Signs Set No. 1, Data Publications.
Strip and clip, for holding Magic Eye, Roding Labs.
Nuts, bolts, solder tags, etc., Roding Labs.

Errata

Electronic Enlarger and Exposure Timer, pp. 224/227 November issue. Owing to the unfortunate use of a draft diagram instead of the finalised version, the following errors occurred in the circuit of Fig. 1. A connection should have been made between the cathode of V2 (pin 8) and the side of the primary winding of **T1** which goes to the enlarger lamp. The pilot lamp PL1 should be fed from the 0.3A winding and not the 1.5A one. The pilot lamp PL2, etc., and the heaters of V1 and V2, should be fed from the other winding, which should be rated at 1.5A. In the text it was stated that the charging of the condenser bank was done by V1 and V2 in series: actually, it is done by V1 only.

It should also have been mentioned that the timer was based on one designed by E. W. Yeomanson, G3IIR, and described by him in the September 28 and October 5 issues, 1949, of *Amateur Photographer.*

IMPROVING THE PI NETWORK TANK CIRCUIT

By **O. J. RUSSELL,** B.SC. (HONS) G3BHJ

THE PI NETWORK TANK CIRCUIT (FIG. 1) IS now the most popular device for PA tanks. This is because of its high reputation as an anti-TVI arrangement. As usually employed to feed into a low impedance coaxial cable link to an aerial tuner, it is true that the Pi network tank will give a high degree of TVI harmonic reduction. However, this freedom from TVI effects is not necessarily obtained if the Pi tank is used to feed "any odd length of wire" *without* an aerial tuner. That is to say the connection of any random length of wire directly on to the end of a Pi tank circuit may not give any TVI protection. However, used correctly as a match into a low impedance coaxial line, and thence to an aerial tuner, good TVI suppression may be secured.

For multi-band use, the Pi network is usually switched as shown in Fig. 2. This bandswitching by means of shorting out the unwanted section of the tank coil is often regarded doubtfully by many hams. Their doubt is, to some extent, justified, as it is well-known that a "shorted turn" will reduce the Q or efficiency of a tuned circuit. It is felt that this aspect of the Pi tank circuit as popularly used is one that should be ventilated more often. This mistrust of the carefree "shorting out of turns" is, in fact, well founded. Under some circumstances the short-circuited turns can cause an appreciable loss of efficiency. As might be expected, the worst effects are encountered when almost all the coil is shorted out, e.g. for operation on the 10 metre band.

One way around this difficulty is encountered in many designs of Pi network tanks. This is the use of a separate coil for 10 metre operation. The arrangement shown in Fig. 3 is self-explanatory. The virtue of this dodge is that the separate coil is not coupled appreciably to the main coil, so that little current is induced in the shorted turns when operating on 10 metres. On the next tap up (say 15 metres), the small part of the main coil switched in *is* coupled to the rest of the main coil, but the majority of the tuning inductance is still concentrated in the "outboard" 10 metre coil. On 20 metres, more of the main coil is in circuit, of course, so that operation is rather a compromise.

One solution would be to use separate coils for each band, and a commercial Pi Network Tank unit is sold using separate coils. To cover 80 to 10 metres requires five coils, and it cannot be denied that they occupy a considerable space. On the other hand, the high frequency coils require somewhat different design for optimum efficiency than the low frequency coils, so that the use of taps on one big coil is not too happy a solution. The solution, however, may be found in the circuit shown in Fig. 4. This enables most requirements to be met by using only two coils. The "main" coil L_1 is for 80 and 40 metres, being appropriately tapped for the 40 metre position. The second coil L_2 is for operation on 20 metres, 15 metres and 10 metres, being again tapped for the 15 metre and the 10 metre position. Thus each coil—the LF coil, and the HF coil—may be designed for optimum operation on the frequency bands which it covers. As will be seen, the switching is somewhat unusual, as on the HF bands the main coil is in *parallel* with the HF coils. But this is quite in order, as firstly—unlike the "shorting" method—the current in L_1 can never be very high. Secondly, the Q of the HF coil should not be greatly affected as L_1 is a high Q coil, and in any case it only passes a fraction of the current flowing in the HF coil when on the HF bands. Also, any adjustment of the HF coils—such as altering tap positions—will not throw out the tuning positions on the LF bands. Once the inductance required for 80 metre operation is set, and it should obviously be the band set first of all, all the rest of the taps for the other bands may be adjusted. Thus in operation, taps 1 and 2 give 80 metre and 40 metre operation. Then on tap 3 we have 20 metres, tap 4 is 15 metres and, finally, tap 5 gives us 10 metres.

This is a rather different approach to the problem of Pi Network bandswitching to those usually seen. However, it is free from some of the objections to the wholesale "shorting" system, and does enable the LF and HF inductances to be separately designed. It is possible, of course, to merely cover, say, 15 metres and 10 metres on the HF coil with 20 metres taken as a tap on the main coil. There is only one possible snag to the arrangement, and that is if the main coil happens to resonate by self capacity in the HF part of the spectrum. Even if this happens, however, the only effect will be to slightly alter the required inductance of the HF coil section, and no loss of power should occur. The simplicity of this scheme, and the advantages over the usual Pi network switching system, make it a useful modification to be tried on an existing Pi Network Tank. All that is necessary is to disconnect the taps for the HF bands, and substitute the separate HF coil in the arrangement shown in Fig. 4. Try it and see!

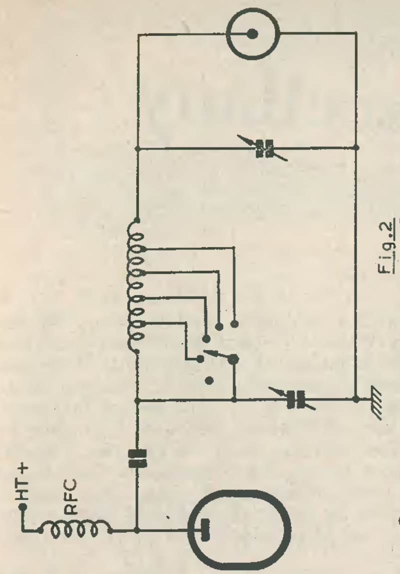


Fig.2
One method of bandswitching the Pi-tank. Not recommended due to losses at the high frequency end

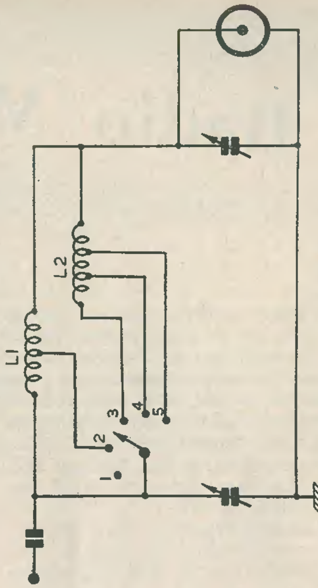


Fig.4
An alternative arrangement allowing of separate tank coils for the LF & HF band sections. This has some advantages over the fig.3 arrangement.

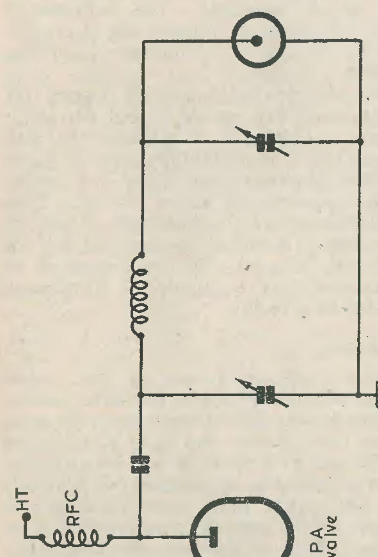


Fig.1
Essential details of a Pi-network tank circuit

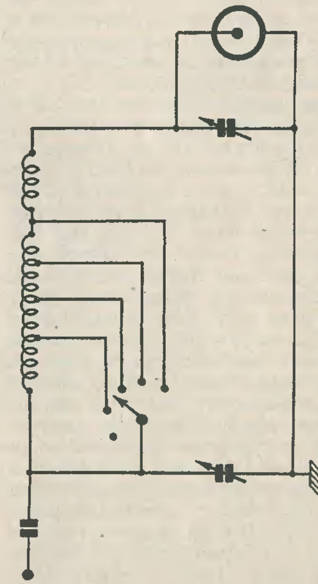


Fig.3
An improved form of multi-band Pi-tank circuit. An independent coil is used for ten metres and losses are much less than with the circuit of fig.2

Radio Miscellany

THE SUCCESSFUL EXPERIMENTS BY BRITISH amateurs using a sun-powered transmitter, reported in our October issue, has occasioned rather less excitement than one might have supposed. Is it that we have become so accustomed to scientific progress that nothing can astonish us, or did the original demonstration at the Murray Hill Bell Laboratories, New Jersey, in April last take the edge off the news?

I rather think it must be the former—even Space Travel is taken for granted nowadays—and in any case the Bell experiments were not widely reported in the British press.

At the Bell Telephone Laboratory demonstrations, silicon solar batteries were used to power transmitters, line repeaters and a toy Ferris Wheel. Surprising enough only a very small percentage of amateurs I have spoken to knew anything about it!

The idea of using power from the sun is far from new, but we are only now gradually learning how to convert it into energy or to store it. While what has already been done is, in itself, a great achievement, the amount of power harnessed is only a tiny fraction of that available. It is the fact that we are beginning to break through the fringe of the problem that is eventful. All scientific progress has grown from puny beginnings—often with false steps and by roundabout paths. A visit to any Science museum reveals the fumblings of pioneers, who with the right ideas prove their theories with what subsequently looks to be the crudest means. Much of the early electrical experimental gear appears laughable to us nowadays, but we have only moved further along from the point where inspired genius guided us, and whatever progress we make comes only after climbing upon the backs of the great men of the past. So in the harnessing of solar energy, history repeats itself.

Fiction to Fact

Men have long dreamed of putting the enormous energy given off by the sun into service, and gradually we shall grope our way to the means of using it efficiently. So far, according to the Laboratory figures, fifty watts of power have been produced from a surface of a square yard. The open circuit voltage of about 0.5V drops under load to about 0.3V. The energy falling on an area of a few square yards of the earth's surface should, when we can *fully* convert it into power, be adequate to drive a car for some hundreds of miles. Nor need it necessarily be bright sunlight; even cloudy days would provide ample power for many uses.

The solution of this problem is of vital importance to many expansive territories which have neither minerals, petroleum or water power available. The promise of success will certainly interest many governments to the extent of heavily subsidising experimental work.

Photo-electric devices are, of course, old, and have already proved useful for many purposes. This was, I believe, the first occasion that a significant quantity of power had been obtained from light. As further secrets are wrested from Nature, these figures will be greatly improved. Then the wrist-watch transmitter so beloved by the writers of Scientific Fiction (powered by a photo-cell and a couple of transistors) will become a reality.

Neighbourly

It has happened to me at last. Most readers will have heard of such cases—but here it was right before my very eyes!

Like many others who have a reputation for "knowing something about wireless," I often get asked by neighbours (who scarcely know me at any other time) to look at a receiver which has unaccountably stopped working. They always start by telling you there is nothing much wrong with it really, just some trifling thing which they flatteringly suggest you can put your finger on in a jiffy. With a knowing wink they usually add that they don't trust dealers, and recount experiences they have heard about someone's set from which an unscrupulous dealer pinched all the best parts. Nor was he satisfied with pinching the parts—he presented them with a tidy bill. All for the sake of a silly little fault which might have been remedied by a knowledgeable handyman!

Bitter experience has taught me never to touch anyone else's set. If it goes OK they harbour a suspicion that it doesn't sound "quite like it did before." And worse, the next time it goes wrong they come straight back to you, reproachfully hinting that they never had any trouble at all until you did something to it!

This time it was a new approach. All they wanted was for me to look at the thing and tell them in which order the valves went back. The inside of the set was awfully dusty (aren't they all?) and to clean it properly the valves had been removed. Now the set wouldn't work at all; nothing really wrong with it, of course, except that the valve sequence was wrong, they urged.

CENTRE TAP	*talks about*	POWER FROM THE SUN DO NOT TOUCH! RARITIES AND SUCH

A Loose Yes

With all my experience I should have known better, but the trap had been carefully laid by sending over a couple of baskets of fruit and other garden produce in the preceding two or three days. I could hardly refuse such kindly people without being downright unfriendly, could I?

Before I could think of any good reason why I shouldn't, I found myself putting the valves back in their right order and switching on. Nothing happened, so I tested them all. Perfectly OK. Then I checked all the voltage points. All potentials were found to be reasonably correct.

Again I enquired whether anything at all was touched when they cleaned it. No, nothing, they averred, there was no need to, it had been going perfectly although there was nearly an egg-cupful of dust swept out of it.

After another check-over my suspicions grew. Only persistent questioning revealed that they had found a few of the "screws" loose. These they had carefully tightened. It wasn't worth mentioning, they said, it couldn't make any difference except to prevent loose parts from falling off.

Couldn't make any difference, indeed! Every trimmer in the set was screwed down tight! Despite what we have heard previously, it isn't always easy to believe anyone could be so dumb, but as I said, it *has* happened, right before my very eyes.

Limbo of the Lost?

It is not unusual for some point touched upon in this column to arouse particular interest for a few readers, but on occasions an item raises quite a spate of correspondence. One such occasion seems to have occurred last month when I referred to "wireless" cigarette cards and the early popular radio periodicals. These references have stirred up half-forgotten memories of some of our older readers, and set a few of the younger ones asking questions.

It is early yet to judge the full extent of the interest as owing to other commitments and an early "Press" date, I often have to prepare *Radio Miscellany* within a day or two of the appearance of the preceding month's issue. This month is no exception, and I have already been asked about the cigarette cards depicting radio components (variometers, crystal holders, filament rheostats, etc.). I must admit I can recall very little about them. They were given with a brand of cigarettes—the name eludes me—which for a period had a fairly wide sale, but later disappeared from the market. The period of issue as far as I can remember would be about 1924. If any reader with a more exact knowledge can let me have further details I shall be glad to pass them on. Perhaps someone has a cartophilist friend?

Regarding the early copies of the popular radio periodicals, I have, unfortunately, no copies to lend to those readers who are curious to see what they were like. Nor have I seen one for a great many years. Despite the fact that they sold in tens of thousands, most of them must have gone for salvage years ago. Those still in existence are probably real rarities and are accordingly treasured by their lucky owners. If, however, any reader has copies which he is prepared to risk being passed around to those eager to see specimens, there are already quite a number who would appreciate his kindness.

---

commencing next month

THE PARAGON TAPE RECORDER

Query Corner

A *Radio Constructor* Service for Readers

Frequency Changer Noise

I recently completed a superhet tuning unit, which functions reasonably well apart from a rather high noise level. The noise is particularly pronounced on weak signals when it appears as a continuous rustling sound, or more in the form of a hiss when a stronger station is tuned in. What are the steps which should be taken to improve the signal-to-noise ratio?

D. Butterworth, Glasgow

There is always a certain amount of noise associated with any electronic device and, of course, the radio valve is no exception. Because of its multi-grid construction, the frequency changer is likely to have a slightly higher noise factor than the simpler type of valve. Also, from the point of view of reducing noise it is more sensitive to small changes in operating conditions. The circuit associated with the frequency changer, therefore, requires careful design to achieve the optimum signal-to-noise ratio.

The tuning coils play a most important part in the operation of the frequency changer, and it is important that each coil is capable of being accurately tuned up and that optimum coupling is used. These features should not cause trouble if the coils are correctly designed, and for this reason, only the products of reputable manufacturers are to be recommended.

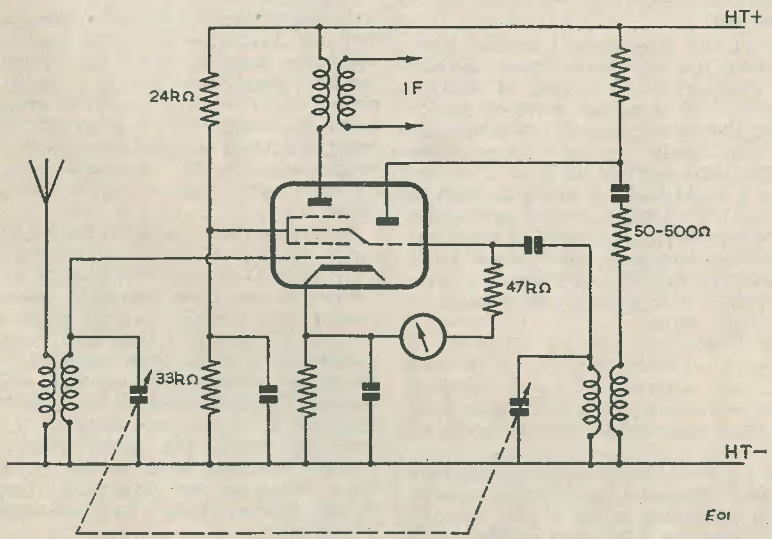


Fig.1
Method of measuring oscillator grid current

There are two valve voltages which most affect the noise performance, namely the heterodyne voltage supplied by the local oscillator section and the screen grid voltage applied to the mixer section of the valve.

Dealing first with the oscillator voltage, there is an optimum value at which both the conversion conductance is high and the noise at a minimum. For valves of the triode hexode class such as the Mullard ECH35 and ECH42, and the American type 6K8, this optimum occurs when the oscillator voltage at the grid of the triode section is in the region of 8V RMS. Fortunately, it is not necessary to possess a valve voltmeter to measure this voltage, as the current flowing in the grid resistor is an equally good indication of the voltage across it. As it is standard practice to employ a 47kΩ grid leak a current in the region of 200μA may be considered to be optimum. Naturally this current will alter slightly from one end of the tuning range to the other, and providing it falls within the limits 150–300μA all is well. Should the current be too high it is an indication that the coupling between the windings of the oscillator coil is too tight, and the trouble may be corrected by the addition of a resistor in series with the feedback winding. Reference to Fig. 1 indicates the point at which the grid current should be measured with a 0–1mA meter, and also the position for the feedback limiting resistor.

Turning now to the screen grid voltage of the mixer section of the valve, this voltage affects the partition noise and has an optimum value in the region of 100V. It is most advisable that this vo[illegible] is kept constant as the AVC voltage fed to the valve changes. For this reason it is usually obtained from a low resistance divider network connected across the HT supply. Suitable values for the two limbs of the divider are shown in Fig. 1. Attention to the points discussed will go a long way towards eliminating the rustling and hissing noise which can be troublesome in badly adjusted circuits. It must be remembered, however, that the noise level of a valve will be high if it has a poor vacuum, and if this cause is suspected the valve should be tested for gas.

Query Corner

RULES

(1) A nominal fee of 2/6 will be made for each query.
(2) Queries on any subject relating to technical radio matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like. Queries relating to ex-W.D. surplus or commercial equipment cannot be accepted.
(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 a more general interest will be reproduced in these pages each month.

Modulation Hum

I am experiencing some very serious hum which occurs on my superhet receiver as soon as a signal is tuned in. A circuit of the receiver is enclosed, and I would welcome your suggestions on a cure for the trouble.

F. Mathews, Ayr

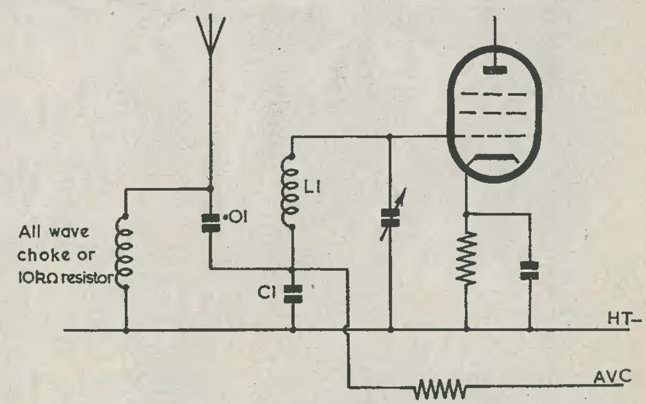


Fig.2
Bottom capacity coupling showing connection for shunt choke or resistor

Examination of the circuit of the set reveals that the aerial is bottom capacity coupled into the first tuned circuit and this would suggest a possible cause for the fault. This part of the circuit is reproduced in Fig. 2. With this arrangement it will be seen that the signal voltage is developed across the capacitor C1, and is magnified by the use of a high Q tuning coil L1. Unfortunately, C1 has quite a high reactance at the mains supply frequency of 50 c/s and any hum voltage picked up on the aerial thus appears across this capacitor where it can modulate the required signal voltage. The solution lies in offering a low impedance shunt path to earth for the hum voltage, and this is achieved by connecting a 10kΩ resistor, or an all-wave choke, across the capacitor as shown in Fig. 2. Of these two arrangements, the choke offers the most complete cure for modulation hum.

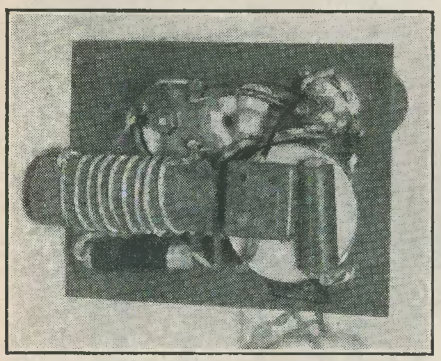
Direct Coupled Amplifier

Recently I encountered the term "direct coupling" when applied to an audio amplifier. What is the significance of the term, and is it an arrangement which can assist in obtaining an improved frequency response from the amplifier? S. Edwards, Lincoln

In the resistance capacity coupled amplifier the anode of the first valve is at a high potential compared with the grid of the second valve into which the signal has to be fed. To pass on the signal and at the same time block off the anode voltage of the first valve the coupling capacitor is added to the circuit. Now this capacitor and the grid leak of the second valve form a potential divider. When the reactance of the capacitor is low compared with the grid leak resistance there is little or no attenuation of the signal frequency. However, as the signal frequency falls the reactance of the capacitor rises and with a normal arrangement the signal is progressively attenuated from 100 c/s to zero frequency . . . the amplification being negligible when the frequency is very close to zero. In other words, there is no amplification to a DC voltage.

To make the circuit function as a DC amplifier the coupling capacitor must be omitted, and some arrangement added to ensure that the bias on the second valve is correct in spite of the higher voltage on its grid. When this is done the amplifier will be sensitive to changes in DC voltage on its input terminals. For example, if the input is changed from –1 to –2V, the output may change from 50 to 100V DC.

DC amplifiers are sometimes employed in oscilloscopes, and some attempt has been made recently to introduce them to audio amplifiers to improve the very low frequency response.



NOTES ON RADIO CONTROL

2: AN XFG1 RECEIVER

By **QUENCH COIL**

In the first article in this series, we dealt with the type of valves and relays suitable for the radio control of models. Having reviewed the characteristics of these essential components, we can now pass on to the description of two typical receivers; one using the gas-filled triode type of valve, the XFG1 made by Hivac; and the other built around a typical hard valve circuit, the valve being a type 3A4. In this article we will describe the first of the two receivers, the second one being dealt with in the next instalment in this series.

The Circuit and Layout

The circuit is shown in Fig. 1 and a suggested layout in Fig. 2. For the benefit of the newcomer, a point-to-point wiring diagram is given in Fig. 3. This latter shows very clearly just how the various components should be wired together. The photograph illustrating this article gives a clear indication of one arrangement of the various components, but a few comments may help the prospective constructor.

The actual size of the paxolin panel will depend on the amount of room available

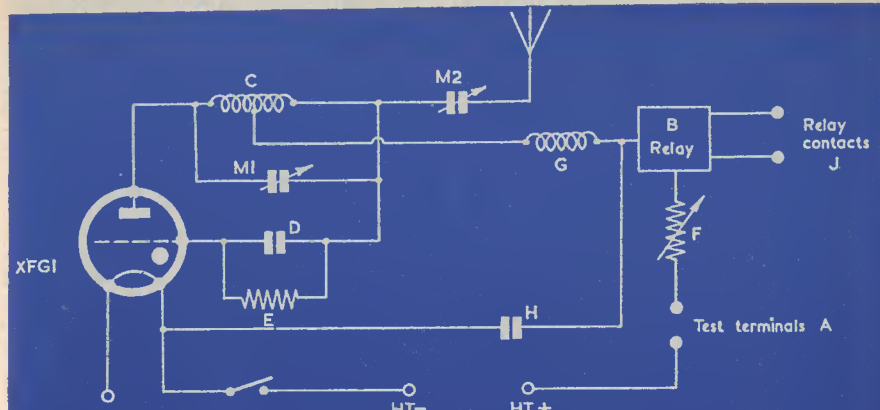
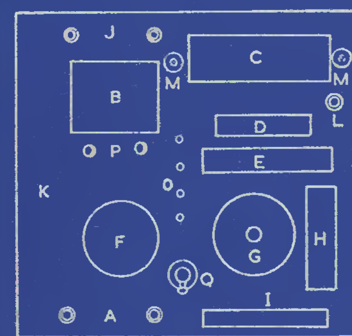


FIG. 1.



A – Small terminals wired in HT+ lead
B – Relay fitted on top of panel
C – Coil. D – 100pF condenser
E – 3-5 MΩ resistor
F – 50kΩ minature variable resistor
G – RF Choke
H – 0·05μF condenser. I – Solder tag strip
J – Small terminals for relay connection
K – Panel. L – Aerial socket
M – 3-30pF trimmers – tuning and aerial
O – Tinned copper wire pegs
P Holes for relay leads. Q – on/off switch

FIG. 2. SUGGESTED COMPONENTS LAYOUT

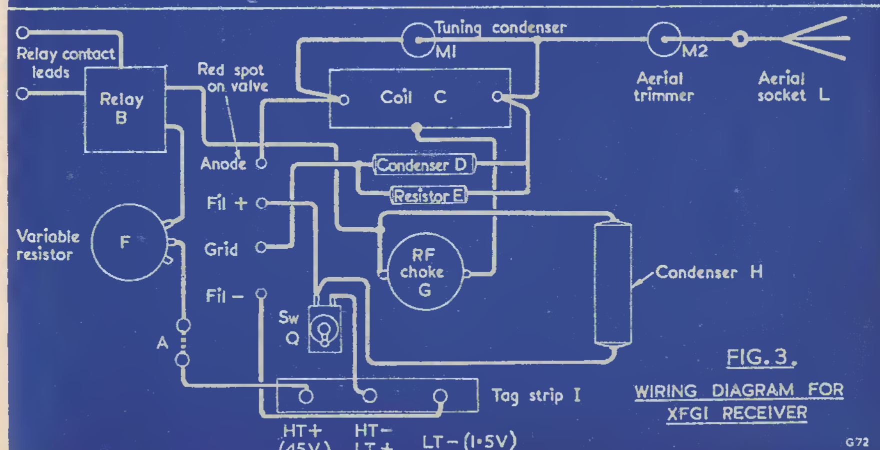


FIG. 3. WIRING DIAGRAM FOR XFGI RECEIVER

in the model. Where space is at a premium the components must be placed as close together as possible, but wherever possible, allow as much room between the various items as you can. Fit the valve and relay last, making these the final items to wire up. The coil should preferably be constructed on some type of former to prevent it from becoming distorted and thus altering in electrical characteristics; and also because, if so mounted, it becomes easier to change from one coil to another during tests. Where considerations of weight are critical the self-supporting type may have to be used; otherwise, mount on a former. The coil is wound from 18 swg tinned copper wire and is 1″ long and 1″ in diameter with a centre tap in the middle. Make it as rigid as possible and mount close to the tuning condenser. The turns must, of course, be clear of each other; and to assist rigidity, dope with polystyrene solution. A small variable resistor of 50,000 ohms value (F in diagrams) is fitted in the anode circuit in order to adjust the optimum operating point by controlling the HT supply. Two small terminals should be wired into the HT positive lead, so that a meter can be temporarily connected into the circuit to measure the anode current. When the meter is disconnected, these terminals should, of course, be joined by a short piece of wire.

Wiring Up

Follow the wiring diagram carefully, and wire with 22 swg tinned copper wire. Sleeve with coloured sleeving—this simplifies the checking of the circuit before connecting the batteries. Solder with great care and avoid overheating the condensers and resistors. Always use resin-cored solder and watch for that dry joint! This, together with overheated components, can be the cause of many troubles. When soldering the valve, condenser and resistor leads, it is a good plan to grip the leads with a pair of pliers, thus reducing the heat conducted to the components themselves. Once the wiring is completed, fit the relay and valve and also fit some form of legs or a bracket to the panel, so that the receiver can be conveniently placed on the bench for testing. A suitable arrangement is clearly shown in the photograph.

Bench Testing

Carefully check all wiring and then, if correct, connect up the batteries. Also connect up an aerial, which should be about 36″ long and suspended from a hook on the wall or picture rail etc. Before switching on, connect a 0–5mA meter into the HT+ lead —via the terminals already mentioned—and make sure the variable resistor is turned to its full position—i.e., position of maximum resistance. Now switch on and note the current reading. This should be about 1mA or less. Adjust the variable resistor until a current reading of about 1.5mA is obtained. The receiver should now operate on a signal from the transmitter. If the current reading cannot be reduced to under 2mA, switch off at once and check the wiring. If all is correct, change the value of the fixed resistor and check the variable resistor.

The current reading for correct operation will vary from receiver to receiver. One of the writer's receivers takes 1.8mA, which is within the safety limits of this type of valve. Should the valve show an intense blue glow, switch off at once and check all components, etc., as otherwise the valve will be damaged.

The length of the aerial will play a big part in the current taken by the receiver. It can vary from 36″ to 45″; trial and error methods should be carried out until the most satisfactory results are obtained. Another factor which must be borne in mind is that as the valve gets older, some alteration in aerial length may become necessary; but once the valve has settled down, no further adjustment should be needed. The aerial length will, too, be somewhat dependent on the type of model and the position of the aerial. In one of the writer's models, the aerial takes the form of a hand rail on one side of the boat. In this case, the length was almost six feet. In such cases, adjustment of aerial coupling can be made by means of the aerial trimmer condenser.

Tuning Receiver to Transmitter

Adjust the receiver to the correct current reading, switch on the transmitter, and tune the receiver by means of the variable tuning condenser. When the signal is picked up, the receiver current reading will drop to almost zero, and will rise again when the transmitter is switched off. The transmitter should have at least half its aerial fitted during these tests. Final adjustments must be made with a full length aerial on both receiver and transmitter. If it is found that the receiver current rises after the trimmers have been adjusted, reduce to the correct reading by means of the variable resistor.

On switching on the receiver, the relay should close, opening on receiving the signal. If this does not happen, try slightly adjusting the relay screws. Always adjust the trimmers with an insulated tool, never with a screwdriver. A good trimmer tool can be made from a short length of paxolin rod with a short brass blade inserted in one end. A point to note is that the transmitter must never be adjusted to the receiver, as this may well put the transmitter frequency outside the allocated frequency band permitted by the GPO for radio control purposes.

Range Tests

At this stage, we can make range tests. These should take place out in the open well away from trees, houses, etc. Make tests every 50 feet or so until the limit of the range is reached. It may be found that a slight adjustment to the trimmers will be needed during these tests. When the correct setting is found, it should remain constant. Whilst doing this, it is a wise plan to check the tuning and frequency of the transmitter from time to time.

When these tests have proved satisfactory, the receiver can be fitted in the model and tested for operation. This will be dealt with later in this series.

As a point of interest, the writer has operated a receiver of this type, with a two-valve transmitter, over a range of 1,000 yards.

Let's Get Started . . .

18: NEGATIVE FEEDBACK

By **A. BLACKBURN**

THAT PHRASE AGAIN! WHAT *DOES* IT MEAN? We've seen it repeated over and over, throughout textbooks and papers, ever since the search for perfection in the quality of amplifier reproduction began. We've seen it, remembered the bare fact of its existence, and impressed by its complexity, decided to find out what it is. And at this point we often draw a blank. Not because there isn't any information to be had about it. On the contrary, and paradoxically, there's been too much. Too many learned gentlemen have been delighted to publish their findings on the subject of negative feedback, with the unhappy result that few laymen either understand it, or are attracted by it. Baulked by ponderous explanations and disheartened by the interminable amount of maths. that seem to be a necessary part of it, the average seeker after knowledge regretfully abandons the search, and goes back to the twiddle and adjust method for improving reproduction.

Such methods have, undoubtedly, served their purpose, and the results so obtained in many cases have been equal to those obtained by more orthodox means. But, of course, the chances against getting improved reproduction in this manner are too great for it to be recommended as an approved alternative to the more theoretical approach. Theoretical is, perhaps, a misleading expression. It implies a deep and exhaustive knowledge of radio theory, whereas, in fact, negative feedback needs only a comprehensive grasp of certain principles, and some sound common sense. Since the reader can be safely relied upon to provide the latter, this article will attempt to set out the principles as simply and concisely as possible, as well as touch upon some of its uses and limitations.

Frequency Response

Of course, it's all very well to talk airily of improving amplifier reproduction, but we shall be working in the dark unless we find out what it is in the amplifier that requires improvement to give the ultimate result. Unfortunately, it isn't any one thing which gives poor reproduction, but a combination of many. One of them is frequency distortion. No amplifier provides the same gain at all frequencies, because of the effect of the circuit capacities. A typical coupling circuit, between two stages of an amplifier, and complete with stray capacities, is shown in Fig. 1a.

We examined in detail the low frequency behaviour in last month's article, in which we saw that as the frequency decreased, the reactance of C1 increased. It follows that the signal reaching the grid of V2 decreases as the frequency decreases, and, at the same time, the phase shift between the voltages across R1 and R2 increases. The capacities Cac and Cgc are the inter-electrode capacities of the valves. Their value is too small to have any effect at low frequencies.

At the high frequency end, however, these capacities develop great importance, although the reactance of C1 dwindles so low that it may be ignored. Which has the advantage of allowing us to regard Cac and Cgc as being combined in parallel, and we can denote Cac + Cgc by C2. At high frequencies, the circuit in Fig. 1a looks like 1b. With the rise

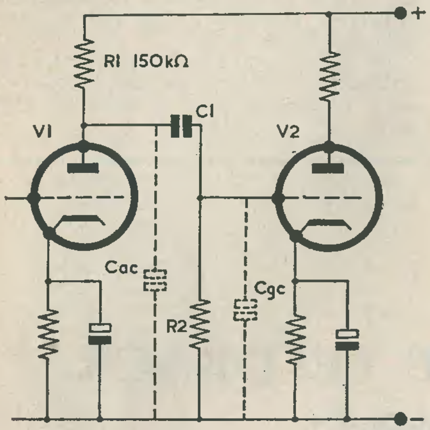


FIG. 1.(a)

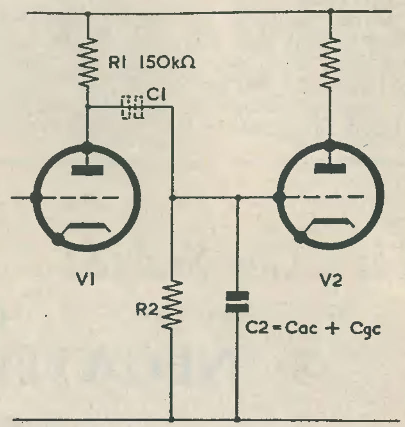


FIG. 1.(b)

in frequency, the reactance of these capacities becomes smaller, until their effect, in parallel with the anode load of the valve, becomes noticeable. This can best be illustrated by a practical example.

We will assume that the anode load of V1 is 100kΩ, and the shunt capacity C2 is 50 pF.

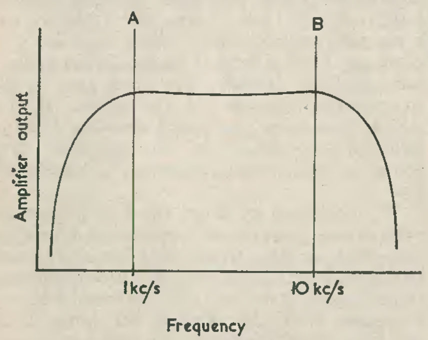


FIG. 2. Typical shape of amplifier frequency response curve

Then at a frequency somewhere in the middle of the audio range, say 5 kc/s, the reactance of C2 is approximately 1.0MΩ. The effect of this reactance in parallel with the anode load is qiute small, obviously, and can be safely written off as negligible. At 20 kc/s, however, the reactance of C2 has dropped to 300kΩ.

The gain of V1 will also drop because its anode load consists of the resistor R1 and C2 in parallel. The gain will be reduced to 0.7 of its value at middle frequencies, when the reactance of C1 is equal in value to R1, and occurs at approximately 60 kc/s, which is, of course, well out of the audio range. We must remember, however, that this is occurring in every stage of the amplifier. If two similar stages were used in the amplifier, at 60 kc/s, the gain would drop to half its value at middle frequencies.

All this boils down to the fact that the gain of the amplifier varies over the audio range, and if we plot the gain against frequency, a curve like Fig. 2 would result. The flat section in the middle covers the middle frequency range. The drop in gain at low frequencies is caused by the series coupling capacitor (and grid leak), and the fall at the high frequency end by the shunt stray capacities. These, by the way, include the capacity of the wiring to chassis.

This curve is known as the "frequency response" of the amplifier. The effect produced by changing gain with changing frequency is called "*frequency distortion.*"

Other Limitations

Frequency distortion is one limiting factor in amplifier performance. Another serious form of distortion is caused by non-linearity of the valve characteristics. That does, perhaps, sound a little highbrow, but Fig. 3 should help to define it. Fig. 3a shows the Ia/Vg characteristic of the valve. The vertical dotted line is the bias voltage about which the

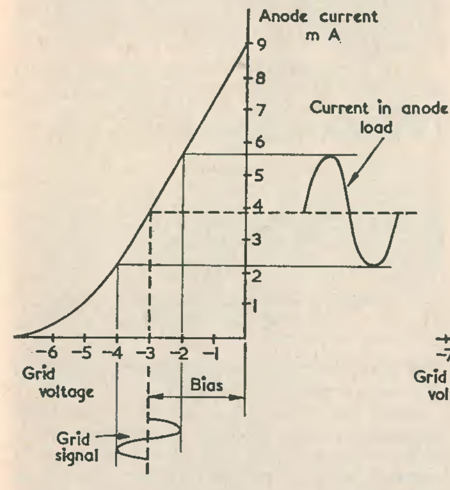


FIG. 3.(a)

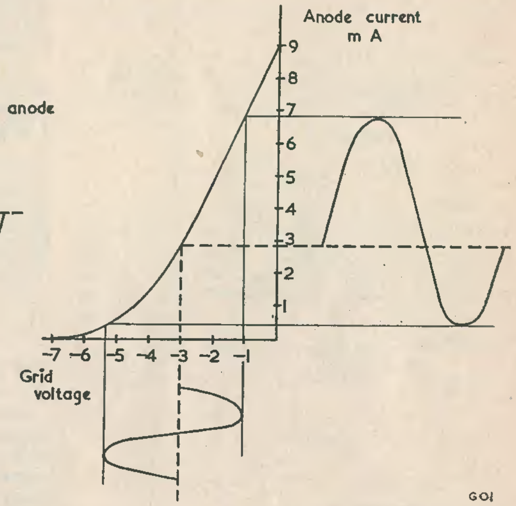


FIG. 3.(b)

signal fluctuates. A small signal is reproduced quite accurately, as can be seen from the figure, but if a larger signal is applied, Fig. 3b, the negative-going part of the signal swings into the curved section. This results in a considerable distortion of the waveform reproduced at the anode, and is called "*harmonic distortion.*"

Obviously, the distortion increases if the amplitude of the signal is greater than that illustrated in Fig. 3b. Eventually, of course, if the signal were large enough, it would swing the grid beyond cut-off, and even to those to whom quality is a very secondary consideration, the resulting distortion would be unbearable.

These are the two major amplifier pitfalls. There are others, but I think these are enough for us to contend with for the moment.

Effect of Feedback

Application of feedback to an amplifier consists of feeding a fraction of the output voltage to the input. This definition, however, must be qualified: the phase relationship between the fed-back voltage and the input voltage must be such that the two voltages tend to cancel.

An amplifier with a potentiometer R1 and R2 connected across the output is shown in Fig. 4. A fraction of the output voltage, βVo, is obtained from the potentiometer and fed back to the input. Now, if βVo and the input voltage E were in phase, the addition of βVo and E would be amplified, and a fraction returned again add amplified. If the gain were sufficiently high, the result might be oscillation.

If βVo were out of phase with E, however, the actual input voltage, e, to the amplifier would be equal to E− βVo. The amplifier would not then oscillate since, if the output voltage tried to increase, a larger voltage would be fed back, producing a corresponding decrease in input voltage. That is one of

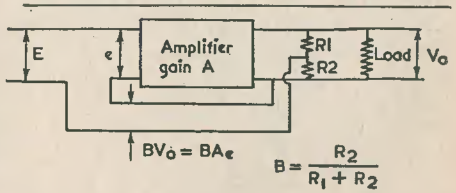


FIG. 4.

the comforting features of negative feedback —that it tends to stabilise the gain. It will probably have been realised by now that whereas negative feedback involves out-of-phase connection, in-phase connection of output to input is called positive feedback.

The real importance of negative feedback can now be revealed.

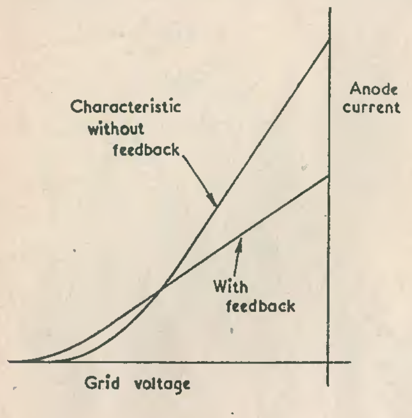


FIG. 5.

Gain and Distortion

There would be little point in trying to explain the complexities in income tax by offering your enquirer a ready-reckoner and a discourse on Government extravagance. Some simple sums would be essential. Similarly, a certain amount of calculation is necessary in order to understand this subject. If they do nothing else, at least I hope the following expressions will help to illustrate the points I have been trying to make.

In Fig. 4 the output voltage, Vo, is equal to Ae, where A is the gain of the amplifier. But the input voltage *to the amplifier*, e, is equal to $E - A\beta e$,

or, $E = e(1 + A\beta)$,

or, $e = \dfrac{E}{(1 + A\beta)}$

and as $Vo = Ae$,

or, $e = \dfrac{Vo}{A}$

$$Vo = \frac{AE}{1 + \beta A}$$

and the new gain, N, with feedback,

$$N = \frac{Vo}{E} = \frac{A}{1 + \beta A} \quad \ldots\ldots\ldots(1)$$

This means that the gain with negative feedback will always be less than the gain without feedback. For example, if A = 100, and β = 1/50, the gain with feedback,

$$N, = \frac{100}{1 + 1/50 + 100} = 33.$$

Such a loss of gain may appear to be a disadvantage, but this is outweighed by other properties of the principle. It is equally true that distortion is reduced by the same amount as the gain.

If a harmonic distortion voltage Eh is present in the output, then the application of feedback will modify this voltage to

Distortion voltage with feedback = Vh = $\dfrac{Eh}{1 + A\beta}$

So if an harmonic content of 1 volt is present in the output and, as before, β = 1/50 and A = 100, . .

$$Vh = \frac{1}{1 + 1/50 \times 100} = 0.33V.$$

The harmonic distortion has been reduced by the same amount as the gain.

Now we saw earlier on that harmonic distortion occurs through a curvature of the valve characteristic. If the distortion is reduced, we may regard the characteristic as being straightened, and this is shown in Fig. 5. There are two changes to notice in this diagram, as compared with Fig. 3. One is that the slope of the line has been reduced, which means that there is less anode current change for a given grid voltage change than before. And that accounts for the loss of gain we have already mentioned. The second difference is that the curve cuts the Vg axis more abruptly, with the disconcerting result of causing distortion to occur more suddenly with feedback than without it.

Another, and perhaps more comforting, way of looking at this is that, with feedback, distortion will not increase so rapidly with increasing signal amplitude, but severe distortion will set in at a more critical level than in a straightforward amplifier.

More Advantages

We have already mentioned stabilisation of the gain. The extent to which this effect may be carried can be illustrated if we make an assumption in expression (1). If we give βA in the expression a very large value, then 1 in the denominator may be ignored.

i.e., if $N = \dfrac{A}{1 + A\beta}$, and βA is considerably larger than 1,

$$\text{then, } N \simeq \frac{A}{\beta A} = \frac{1}{\beta} \quad \ldots\ldots\ldots\ldots\ldots(2)$$

For example, if $\beta = \frac{1}{2}$, and A = 1000, βA = 500, which is close enough to 501 for us not to worry about the extra 1. With these values, then, from (2)

$$N = \frac{1}{\beta} = \frac{1}{\frac{1}{2}} = 2.$$

The gain of the amplifier depends now upon β only, and β depends only upon the values of the two resistors R1 and R2 in Fig. 4, where $\beta = \dfrac{R2}{R1 + R2}$ Changes in valve characteristics, etc., will have no appreciable effect upon the gain.

It is not, of course, necessary to apply feedback as drastically as this. A gain of two is not particularly useful for normal purposes, but stabilisation of the gain against changes in heater voltage, HT voltage, and valve characteristics always occurs when negative feedback is applied. The extent to which it occurs depends upon the value of β. We are back again to frequency response, with the added consolation that response improves in proportion to the loss of gain.

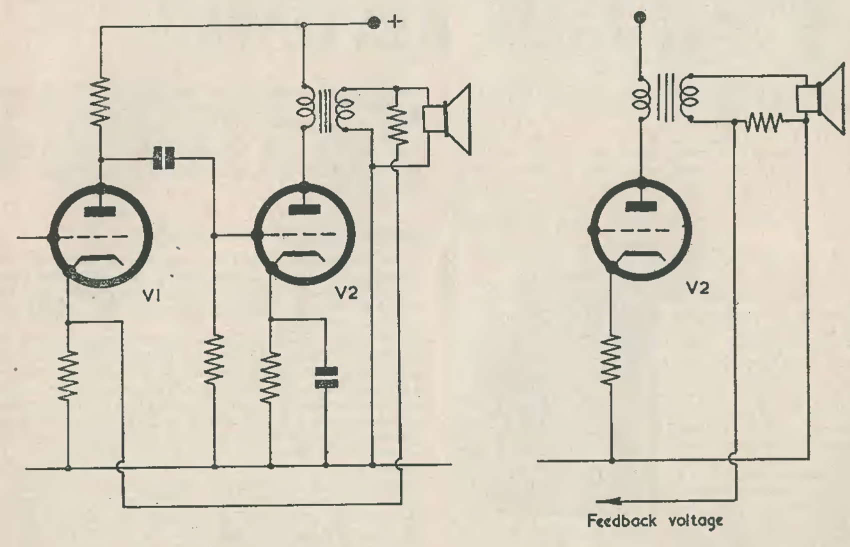


FIG. 6. (a) FIG. 6. (b)

It may, therefore, be regarded as being allied to the gain stabilisation. If the general level of the output voltage changes, the feedback network has no way of knowing why the change has occurred. All it knows is that something has happened in the amplifier, with the result that a drop in gain caused by poor frequency response in the amplifier proper is treated in exactly the same way as a drop in gain produced by a drop in HT volts.

Spurious signals, such as hum, introduced in the amplifier are also reduced by the application of feedback, where once again the reducing factor is $\dfrac{1}{1 + \beta A}$

Suppose hum is introduced somewhere in the amplifier and 0.1V appears in the output. Then application of feedback will reduce this to

$$\frac{0.1}{1 + 1/50 \times 100} = 0.003V.$$

where β = 1/50 and A = 100, as before. Remember, however, that feedback can only help in cases where the unwanted effect occurs in the amplifier itself. Distortion, hum, etc., arising in the input signal, are unaffected by the feedback.

Voltage and Current Feedback

So far we have only talked about the action of feedback applied to an amplifier contained in a box. We have not considered the number of stages on the conditions within that box. Feedback may be applied over any number of stages, provided that the phase conditions are correct. Fig. 6a shows a small amplifier in which feedback is applied from the output transformer secondary to the cathode of the input stage. The transformer must be connected in the correct sense, however, to ensure that the cathode of V1 is in phase with the input signal at the grid of V1.

In this circuit, the voltage fed back is proportional to the output voltage, and is therefore labelled *voltage feedback*. An alternative method is shown in Fig. 6b. This shows the output stage of the amplifier in Fig. 6a, except that the feedback voltage is now derived from the *current* flowing through the speaker load. And this, naturally enough, is called *current feedback*. Whether current or voltage feedback is used does not impair the advantages we have already discussed. The feature of the amplifier that is affected by the choice of these two systems is the output impedance.

If voltage feedback is used, the output impedance is reduced by the factor $(1 + \beta A)$. Current feedback, however, increases the output impedance by $(1 + \beta A)$.

In the case of our amplifier, with $\beta = 1/50$, and $A = 100$, and output impedance, without feedback, of say $10k\Omega$, the output impedance with voltage feedback becomes

$$10{,}000 \times \frac{1}{1 + 1/50 \times 100} = 3k\Omega \text{ approx.}$$

and with current feedback

$$10{,}000 \times (1 + 1/50 \times 100) = 30k\Omega \text{ approx.}$$

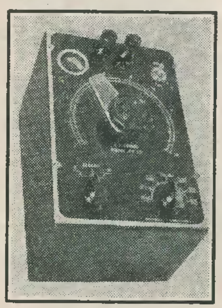
This change in output impedance should be borne in mind when matching the amplifier to the loudspeaker. Excellent as the results of negative feedback can be, the system cannot be used indiscriminately. More and more feedback does not necessarily mean better and better quality.

To avoid damage to or possible destruction of equipment, certain precautions in the use of negative feedback must be taken, and these, together with some practical applications, will be discussed next month.

TRADE REVIEWS

We have recently had the opportunity of thoroughly testing out the CR50 Capacitance-Resistance Bridge manufactured by Messrs. Grayshaw Instruments, 54 Overstone Road, Harpenden, Herts.

This is certainly a handsome instrument, with its crinkle finish cabinet and engraved metal panel—but it is not just a case of beauty being skin deep! Obviously a great deal of thought has gone into the design, resulting in a clean layout allied with rugged construction.



For the most part the circuit follows conventional lines, but depart. from the usual insofar as the scale is concerneds This is calibrated in a clockwise direction only, from 1 to 10, each unit being subdivided into tenths. Thus no awkward mathematical dividing has to be made. After setting to the null point, the scale reading is simply multiplied by the range value; the latter, too, are mathematically convenient. Thus, for example, a reading of 6.8 on the $1k\Omega$ range indicates a value of $6.8k\Omega$.

The power unit consists of a double-wound mains transformer, metal rectifier and resistance-capacitance smoothing filter. A 6U5G magic eye is employed as the null point indicator, and sensitivity is increased by the use of a 6SH7 as an amplifier. The magic eye is also used as a leakage indicator, in place of the more usual neon tube.

We were not disappointed when it came to checking the instrument for accuracy. Obviously, one cannot expect the precision associated with equipment designed for laboratory use—but for the home constructor and the service engineer the accuracy is more than adequate; this despite the fact that the retail price is only £6 19s. 6d. (postage and packing 4s. 6d.), which in our opinion is an extremely low one.

To sum up, here is an instrument which will prove very useful on any workbench, will not cost very much to instal, and is an item of test gear which we can, and do, recommend.

★ ★ ★

THE SORAD 541 TRANSMITTER

At the recent R.S.G.B. Convention Exhibition at Bristol, our attention was caught by a very fine commercially built amateur bands transmitter on the stand of Southern Radio and Electrical Supplies, of Salisbury, Wiltshire.

Mr. C. A. Harley, G2ACC, demonstrated this latest of his firm's products to us and we have pleasure in publishing provisional details of it herewith, together with an illustration showing what a neat, good-looking transmitter this is. He is certainly to be congratulated on having got a rating of 150 watts CW and 120 watts phone into such a handy size, particularly as every amateur band from 3.5 to 30 Mc/s is covered.

The specification of the 541 as planned is detailed below, but the makers say 'they reserve the right to vary this specification in the interest of progress' should the need arise. This looks like being a really exciting 'release' to judge from the prototype, and we are sure when the production models come along, they will find many enthusiastic owners.

Provisional Details

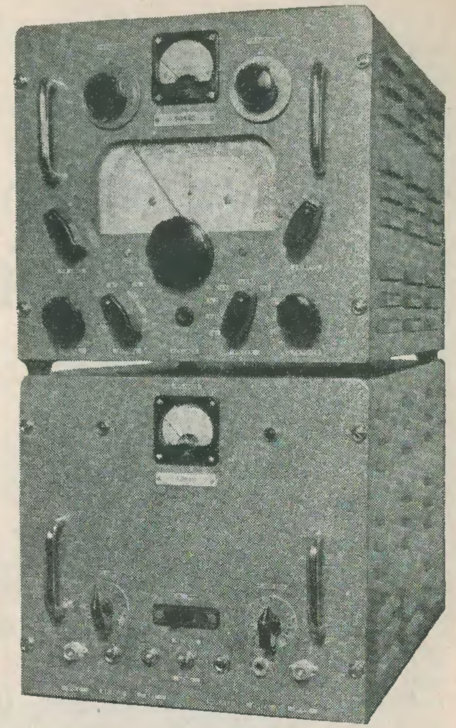
The Sorad 541 Transmitter is a space saving double-deck construction designed for ease of service. The actual table top area required is only 12" wide × 18" front to back, this being considerably less than previous models. Completely screened and band-switched, it incorporates the latest TVI suppression circuits and uses modern miniature valves, and is housed in an attractive new style cabinet in bronze scintilla finish. The overall size is 12" wide × 18" deep × 22" high.

RF Unit

The RF Cabinet, size 12" × 18" × 11" high, comprises a main chassis and front panel assembly which carries the tuning controls, band switches, meter and 9-way meter switch which selects anode currents of all stages, final grid current and EHT voltage; drive control, PA output control, key jack and two-position switch giving break-in or normal keying. The plug-in 3-stage VFO operated by a precision 2-speed dial giving 8–1 rapid net and 120 fine tuning by a push-pull movement of the control knob, employs a 12AT7 double triode operating as a grounded-anode Colpitts oscillator, with the second half of the valve as a cathode-coupled buffer amplifier followed by an N78 buffer amplifier. The output in the 3.5 Mc/s band is fed to a four stage plug-in wide-band buffer/multiplier using four 6BW6 miniature beam tetrodes, and the adjustable output is fed to a switched PA circuit using a pair of 5B/254M (Miniature 807) valves and a standard Pi-filter tank circuit for 80 ohm output in the 3.5 to 30 Mc/s amateur bands. A clamp valve, adjustable output and harmonic check point is provided. VFO netting is provided for by a biased push-switch in the lower deck. Provisional rating is 150 watts CW and 120 watts phone. The unit is connected to the Power supply and modulator cabinet by screened multi-way cable.

Power Unit/Modulator

This is a similar cabinet to the RF Unit and comprises a dual power supply of 350 and 750 volts using Woden transformers and chokes, a pair of RG1-240A Mercury-vapour rectifiers and a 5U4G full-wave rectifier. The switching permits "Net," CW/Phone, Receive/Transmit, and sockets for relay working are provided at the rear. The modulator comprises a 6BS7 low microphony valve followed by two 12AU7 double triodes with push-pull output into a pair of 5B/254M (miniature 807) valves operating in class AB push-pull. A Woden multi-ratio modulation transformer matches the audio to RF load. Dual audio input at low and high gain permits alternative microphone, tape recorder/player etc., inputs. An audio check point at the input to the final audio stage is provided for headphones. Modulator output is 75 watts. A meter in the anode circuit of the output stage permits correct bias to be set and a constant check on audio output giving visual indication of modulation.



The Sorad 541 Transmitter

BOOK REVIEWS

Five Radio Manuals have been received from the Technical Book Department, Kendall & Mousley, 18 Melville Road, Edgbaston, Birmingham.

Manual No. 100. A Comprehensive Radio Valve Guide, Book 1, *by W. J. May*. Price 5s. This book lists over 2,000 thermionic valves of various types, covering frequency changers, tuning indicators, screened tetrodes and pentodes, voltage and current regulators, rectifiers, triodes, diodes, cathode ray tubes for TV sets, American and English sub-miniature valves, and output valves. Data is also given for push-pull operation ,and a further section deals with twin output valves. The main electrical characteristics are given for each valve, and a feature of the book is the panel of base diagrams which appears at each opening for all the valves listed on the opened pages, thereby avoiding further reference to other pages. An Index enables quick reference to be made to any particular valve.

Manual No. 121. A Comprehensive Valve Guide, Book 2, *by B. B. Babani*. Price 5s. This is a supplementary manual to Book 1, and lists over 1,000 additional types. The same method of presentation is adopted.

Manual No. 124. "At A Glance" Radio Valve and TV Tube Equivalents, *by B. B. Babani*. Price 5s. This very useful book lists over 2,000 receiving valves, all equivalents by each manufacturer being shown on every page. Further lists show CV types with commercial equivalents, commercial types with CV equivalents, and British Army, Navy and Air Force valves with commercial equivalents. Also included are war-time civilian valves and U.S.A. service types with commercial equivalents. An unusual feature is the list of TV picture tubes with suggested replacements. The tables show the valve types in numerical and alphabetical order for quick reference. The Introduction and List of Contents is printed in English and five foreign languages.

Manual No. 126. The Boy's Book of Crystal Sets, *by W. J. May*. Price 2s. 6d. An excellent primer at a very reasonable price which sets about educating the young experimenter in the right way. The Introduction describes briefly but clearly the broad principles of transmission and reception, and gives sound advice on efficient aerial and earth installation. The pages on Construction provide full details for making 12 different crystal receivers to cover Long, Medium and Short wavelengths. The progression from very simple to more complex designs is well arranged. The question of cost has been kept in mind so that pockets are not unduly strained.

Manual No. 127. Amplifier Manual No. 3, *by J. S. Kendall*. Price 3s. 6d. The author is well known as a technical writer, and this book is typical of his lucid and informative style. Brief but comprehensive chapters deal with power supplies, output stages, voltage amplifiers, feedback, phase-splitters, mixer circuits and tone control. The final chapter contains full details of five practical circuits and constructional data for the home constructor.

Show Report

Walton Amateur Radio Exhibition

Over 350 visitors attended the Exhibition organised by the QRP Society at Walton-on-Thames on October 30th, and interest, even among the uninitiated, was maintained throughout the afternoon and evening.

The exhibition, which was opened by Mr. A. O. Milne, G2MI, the President of the Radio Society of Great Britain, was unusual in that "live" displays of various kinds were in operation all the time.

The QRP station, G3JNB/A, in the hands of Mr. Vic Brand, was on the air almost from start to finish and achieved some very satisfactory reports and contacts, despite heavy QRM set up by other exhibits in the hall. With only 3 watts input 'JNB' was, on several occasions, able to direct would-be visitors to the hall; while to others, unable to come along at all, he passed running commentaries on the performance of the Radio Controlled model Churchill tank.

The tank undoubtedly provided the star performance of the day, and "George," its mythical driver, received rounds of applause for the accuracy of his control. Another popular series of demonstrations were those of the Mullard 5–10 amplifier which took place every hour throughout the afternoon and evening in the annex demonstration room, the usual collection of selected records being supplemented with interludes of B.B.C. FM from Wrotham.

The R.A.E.N., who provided yet another "live" display, encountered a number of difficulties in putting over their programme; there was no truth, however, in the rumour that the several walkie-talkie operators who were supposed to be in the thick of a simulated disaster in the neighbourhood of Walton Bridge were actually ensconced in a local hostelry. When these stalwarts did eventually make contact with the station in the hall, it proved something of a revelation to the many members of the public who were not acquainted with the potentialities of these little sets.

Among the static exhibits, Data Publications Ltd. did good business with their books and back numbers of *The Radio Constructor* were quickly sold out. Proops Bros. Ltd. of Tottenham Court Road also drew a great deal of attention, surprise being expressed at the very reasonable price asked for their gear. On the QRP Society stand the visitors' book collected many names and calls well known to the radio fraternity, and it was of interest to note how far some of the visitors had come for the exhibition. Mr. Tony Cockle, G31EE, who manned the stand for much of the time, found himself inundated with enquiries about his Transistor Transmitter which was on show. The Society's new Reference Booklet on Amateur Codes and Abbreviations also proved a popular item.

For the more radio-minded visitor the stand arranged and supervised by Mr. Hicks-Arnold, G6MB, provided several fascinating attractions, among them a most versatile oscilloscope "hook-up" and samples of the future of radio in the form of printed circuits. Of interest (and some merriment) was a tuning unit of immense proportions, made by '6MB in 1913, beside which was exhibited the current equivalent measuring about ⅜-in. diameter.

A very impressive show was put on by the British Amateur Television Club, and many visitors took a delight in walking across the line of the cameras and seeing the results on the screens of the two receivers which had been kindly loaned by Messrs. Peto Scott.

No report of the exhibition could be complete without a record of thanks to those behind the scenes whose hard work (and, at times, frantic efforts) made the show possible —especially are thanks due to those who so willingly provided transport at their own expense, and to those who battled with the aerial wire which rose magnificently to the top of the nearby church tower.

Instrument cases in steel, complete with light alloy front panel. Colours Black (Red and Green 10 per cent extra). Back punched for ventilation.

Type "9," 8"×9"×8" is 18/6 with panel in light alloy.

Type "12," 10½"×12"×10½" is now 25/– with panel in light alloy.

Type "9–12," 9"×12"×9" is now 21/– with panel in light alloy.

Chassis at the following prices. These are in aluminium of 18G.

6×4×2½	5/6	6×5×2½	7/6
8×6×2½	8/–	10×6×2½	8/6
10×7×2½	9/–	10×8×2½	9/6
12×8×2½	10/6	10×9×2½	11/–
14×8×2½	13/9	14×9×2½	14/–
16×8×2½	14/9	16×9×2½	15/6

Suppliers of technical publications. A full range of components, by well-known manufacturers, are stocked, Mullard, Brimar, Cossor, T.C.C., Dubilier, Erie, R.E.P., Wearite, Elstone, Morganite, etc. High stability 1, 2 and 5 per cent resistors available from stock or to order.

Radio Control for Model Ships, Boats and Aircraft.	8/6
The Osram 912 Amplifier.	3/6
The Mullard 5-10 Amplifier.	2/6
Amplifier Manual No. 3. *by J. S. Kendall.*	3/6
Bernards Valve Manual No. 1.	5/–
Bernards Valve Manual No. 2.	5/–
Bernards Valve Substitution Manual.	5/–
The Emperor Radiogram Construction Book, *by Walter J. May.*	3/6
The Boy's Book of Crystal Sets	2/6
Practical Transistors and Transistor Circuits, *by J. S. Kendall.*	3/6

Packing and post 3d. per book extra

KENDALL AND MOUSLEY

Electronic Engineers and Laboratory Equipment Manufacturers

18 MELVILLE ROAD . BIRMINGHAM 16

G2ACC offers you . . .

- **Aerial Wire.** 14swg hard drawn copper enamelled, cut to any length, 4d. per yard.
- **Feeder Cable.** Belling Lee: L336 Twin 80 ohm, 6d. yd.; L600 coaxial 70 ohm, 1/3 yd.; L1221 twin screened 70 ohm, 1/6 yd. Telcon: K25B twin ribbon 300 ohm, 9d. yd.; K35B twin circular low-loss 300 ohm, 1/6 yd. Samples free on request.
- **Coax Connectors.** Belling Lee L734 plug, 1/3; L604 socket, 1/2; L616 Line Coupler, 1/6.
- **"Disc" Ceramic Capacitors.** 500v d.c. (300v a.c.) wkg. Non-inductive for TV.I. suppression, etc., 470pf, .001 mfd., .002 mfd., .003 mfd., .005 mfd., 9d. each; .01 mfd. 350v wkg., 1/3; .01 mfd. 2000v. wkg., 2/3.
- **Constructional Manuals.** Envelopes with manual and large scale plans: Viewmaster 7/6; Tele-King 6/–; Sound Master 6/6; Viewmaster Big Picture Conversion 3/6. Osram 912 Amplifier Manual, 3/6.

Catalogue No. 9. 56 page, illustrated catalogue 3d. post free.

Minimum postage and packing on orders under £2 is 6d

Southern Radio and Electrical Supplies

SORAD WORKS
REDLYNCH · SALISBURY

Telephone DOWNTON 207

RADIOVISION

4 PRAED STREET
LONDON W2
Telephone **AMB 4670**

We have a very large selection of Valves and Spares at the Lowest Possible Prices

We have a Large Selection of used but perfect C.R. Tubes. Every Tube carries a 6 week guarantee. Callers can see picture on premises.

9"	£4 0 0
12"	£6 0 0
15"	£8 10 0

Post, Packing and Insurance, 10/–

URGENTLY WANTED

COMMUNICATION RECEIVERS TEST EQUIPMENT. RADIOS—and TELEVISION SETS, TAPE RECORDERS.
Best Prices Given

Phone or Call

G2AK THIS MONTH'S BARGAINS G2AK

DROP THE HINT

An Ideal and Inexpensive Christmas Present from the YL or XYL

CRYSTAL HAND MICROPHONES
High quality, complete with lead and plug. Very sensitive. Chrome finish. List 2 gns. **Our price 25/–.** Few only.

STREAMLINED BUG KEYS
By famous maker. Brand new in cartons. Listed over £4. **Our price 45/–** only.

FISK SOLARISCOPES
Complete with Charts, give World Time, light and dark paths. Invaluable to the DX man. List 21/–. **Our price 7/6** post free.

SPECIAL VALVE OFFER: TZ40, 35/–; 6L6G, 10/6; 5R4GY, 12/6; 829/3E29, 60/–; 100TH, 90/–; 866A, 17/6, or 30/– per pair; 807, 10/– each or 17/6 per pair; 931A, 45/–; 813, 80/–.

SHADED POLE MOTORS. For Tape Recorders or Gram units. With voltage tapping plate 200/250 volts. 3 hole fixing. Our price 12/6 each, or 21/– pair, postage and packing on either 1/6.

METERS: 2½in. Flush Mounting 0-10mA, 12/6; 0-100mA, 12/6; 2in. Flush 0-4A Thermo, 5/–; 0-.5A Thermo 2in. Round Flush, 7/6; 0-5m A square 2in. 10/–, 0-20V, 7/6; 0-350mA, Thermo, 7/6; 0-15A Thermo Proj., 2½in., 7/6; 0-50mA, 2½in., 7/6.

TWIN FEEDER: 300 ohm twin ribbon feeder, similar, K25, 6d. per yard. K35B Telcon (round), 1/6 per yard. Post on above feeder and cable 1/6 any length.

AIR-SPACED CO-AXIAL Cable. 150 ohms (normal price 3/11 per ft.), 20-yd. coils only £1 per coil, post free.

PHILIPS CONCENTRIC AIR TRIMMERS: 8pf max., 9d. each, or 6/– doz.; 30pf max., 1/– each, or 10/– doz.

AR88 SPARES: Cabinets, £4 15s., packing and carriage, 7/6; complete set of 14 valves, £5 10s.; Perspex escutcheons, 22/6; "D" type, i.f.s., 12/6. **Output Transformers** to Government specification, 37/6 each.

COPPER WIRE: 14G, H/D 140ft., 15/–; 70ft., 7/6. Post and packing 2/–. Other lengths pro rata.

RACK MOUNTING PANELS: 19in x 5¼in., 7in., 8¾in., or 10½in., black crackle finish, 5/9, 6/6, 7/6, 9/– respectively, postage and packing, 1/6.

D.A. CRYSTAL MIKES, 12/6 each, post and packing 9d.

PANL HOME CRACKLE. Black Brown or Green, 3/– tin, postage and package 8d.

NOISE LIMITERS. Plug in type, 3 positions. No wiring required. Ready to use. 15/– p. & p. 1/–.

THIS MONTH'S SPECIAL

T.V. POWER TRANSFORMERS BY PARMEKO

PRI 200-250V. E.H.T. 6KV RMS, 350/350V 250mA 6.3V 6A, 4V .3A. 4V for E.H.T. Rect. already wired to holder. Beautiful job **£4 10 0.** Carr. paid.

Carriage paid on all orders over £1 except where stated. Please include small amount for orders under £1.

CHAS. H. YOUNG, G2AK

ALL CALLERS TO **110 DALE END, BIRMINGHAM**
PLEASE PRINT YOUR NAME AND ADDRESS

MAIL ORDERS TO **Dept. 'R', 102 HOLLOWAY HEAD, BIRMINGHAM** Midlands 3254 Central 1635

NEW! EXPERIMENTAL KITS in Radio, T.V. etc.

LEARN THE PRACTICAL WAY

Specially prepared sets of radio parts (which you receive upon enrolment) with which we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio sets. Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business — these Practical Courses are intended for YOU — and may be yours at Very Moderate Cost.

EASY TERMS FROM 15/- A MONTH

FREE! PROSPECTUS

POST THIS COUPON TODAY

To E.M.I. INSTITUTES, Dept. 179X, Grove Park Road, London, W.4.

SUBJECTS(S) ....

NAME ....

ADDRESS ....

.... DEC

COURSES WITH PRACTICAL EQUIPMENT INCLUDE:–
Radio (Elementary and Advanced), Television, Mechanics, Electricity, Chemistry, Photography, Carpentry. Also Draughtsmanship, Commercial Art, Amateur S.W. Radio, Languages, Etc.

E.M.I. INSTITUTES

The only Postal College which is part of a world-wide Industrial Organisation

IC56

HOME RADIO OF MITCHAM

for

FREQUENCY MODULATION

We stock all the components for the "Jason" Frequency Modulation Tuner (fully described in July and Sept. issues of *Radio Constructor*). Demonstrations given during normal transmission periods.

JACKSON 25 + 25pf type U101	10/9
JACKSON full vision dial with Caliband scale	14/6
Chassis fully drilled	8/–
Set of coils and transformers with s. mica condrs. and cans	£1/0/6
Complete set of fixed resistors	5/–
Silver mica and ceramic condensers	ea. 9d.
8 mfd 150v condenser	1/8
New Z77 or equiv. valves. Guaranteed	ea. 10/6
Diodes GEX34	6/6

All parts in stock for the ELECTRONIC TIMER and ENLARGER. Send s.a.e. for full list.

We stock the full range of EDDYSTONE and DENCO parts.

Bona fide engineers and dealers send for our special Trade List of resistors and condensers, etc.

HOME RADIO OF MITCHAM

187 LONDON ROAD, MITCHAM, SURREY

MITcham 3282

Frequency Modulation Tuner

described in the July and Sept. 1954 issues.

JACKSON BROS. dial and condenser	£1 5 3
Completely drilled chassis	8 0
All coils with S.M. Condensers and Cans	£1 0 6
Complete Set of Parts, including valves, pair of matched Germanium crystals and small items such as nuts and screws	£7 2 6
Complete Tuner, assembled and aligned	£10 0 0

G. BLUNDELL

7 SUNNYSIDE HOUSE

CHILDS' HILL LONDON NW2

£5. TV Tubes, guaranteed for 3 months. 12 inch.

CRM121—A or B, other makes occasionally. Insured carriage 15/6. Picture shown to callers.

SPECIAL OFFER of tubes with burns or cathode to heater shorts **30/–** plus carriage.

V.H.F.1124 RECEIVER **17/6.** Complete with valves. 30.5-40 Mc/s IF 7 Mc/s 6 channel switching. Covers T/V sound, fire, amateurs, etc. Convertible to mains. (A.C. or A.C./D.C.). Drawings free. Post 2/–.

H.T. BATTERIES **1/9.** Alldry min.; 40V+L.T. 1½V. **3/9.** 60V+1½V **3/9.** 67½ V personal portable type **3/9.** 60V **5/9.**
Post on H.T. Batteries 1/9 each.

L.T. BATTERIES. 4½V. New Ever Ready, ideal bell batteries, only **1/0.** Post 6d. (List price 3/6).

METERS **12/6.** 200 micro amp. New and boxed. (Ex Oil temp.) 2" scale in 2½" square mounting. Post 1/6.

METERS **8/9.** 700 micro amp movement. (ex-radiator) 2" scale in 2½" square mounting. Post 1/6.

CAR RADIO TRANSFORMERS, **5/9** 6 volt, new. Post 1/9.

SPOT LIGHTS, **8/6** Butler's new, but ex-W.D. 7¼" x 6½" deep. Prefocus fitting. Post 1/–. BULBS for above, 6 volt 30, 36 or 48 watt. 12 volt 36 or 48 watt. **4/6** each.

CRYSTALS. Germanium **1/9.** Brand new by B.T.H. Long wire ends. Post 3d.

DUKE & CO

621 Romford Road, Manor Park, E.12

GRA 6677 *(Half-Day Thurs)*

T.N.B. Radio offers

Weymouth S/H Coils 3 wave, matched pairs with circuit, **7/6.**

Weymouth IFFs 465, matched pair with circuit, **6/–.**

All popular Coils stocked.

Aluminium Chassis, all sizes stocked. Specials made to order.

Mullard and G.E.C. amp chassis in stock.

Brand New Valves. Tested and Guaranteed.

SERVICE TYPES.

954 ...	2/6	6V6G ...	8/6
EF36 ...	5/–	6J5 ...	5/6
EF39 ...	7/6	6SH7 ...	6/6
EBC33 ...	8/–	6SG7 ...	8/6
EK32 ...	8/–	6SK7 ...	8/6
EF50 ...	5/–	6SN7 ...	10/6
Red Silo		6SL7 ...	9/6
EF50 ...	10/–	12J5 ...	5/–
KTW63 ...	5/6	12AH7 ...	5/–
KTZ63 ...	5/6	SP41 ...	2/6
RK34 ...	2/3	SP61 ...	2/6
CV6 ...	2/3	VR116 ...	2/6
5Z4G ...	9/–	EB34 ...	2/–

SET OF BATTERY VALVES ANY FOUR
1R5, 1T4, 1S5, 3V4, 3S4, **30/–**

Please add a little for post under 10/–. Stamp for list.

T.N.B. RADIO

166A ROOKERY ROAD, HANDSWORTH BIRMINGHAM 21

---

20 WATT AMPLIFIER FOR 50/-

20 WATT AMPLIFIER FOR 50/– less valves. Front panel 19in. wide for rack mounting 18in. deep. This unit is divided into 2 sections, the top section containing the amplifier and consisting of output transformers, valveholders, etc., tone control, volume control. Valve line-up 2 PX 25's, MHL4 and a U14. Contains also a 3in. 0.200 milliamp meter, complete with input and loudspeaker sockets. The bottom portion contains the power supply unit for 200–250 v. mains and consists of mains transformer 500-0-500, 120 milliamp 3–4 volt heater windings, smoothing choke, condensers, variable resistances, etc., also power output for providing H.T. and heater voltages for a pre-amplifier. Indicator light and on and off switch. Sold less valves, believed to be in working condition at our NEW PRICE of **£2/10/–**, carriage 15/6. The weight of this amplifier is approximately 50 lb.

AERIAL COUPLING UNIT. Type G. Ref. ZA.0843. Containing large inductances, variable transmitter type condensers, 0–1 ma., M.C. meter 2in. dia., indicator light, etc., with controls brought out to front panel 15 × 11in. Contained in metal box 15 × 11 × 15in. deep with 2½in. hinged lid, complete with circuit. In new condition, apart from external scratches to case. Price 27/6, carriage 6/6.

WIRE WOUND POTS. 10,000 ohms, 4in. dia., 2½in. deep with wiper arm and 8in. spindle, new condition, dismantled from units, price 8/6, postage 2/6.

ARTHUR T. SALLIS (RC)

93 NORTH ROAD, BRIGHTON SUSSEX

Telephone Brighton 25806

IF YOU REQUIRE

High Class Print

consult

A. QUICK & CO. LTD.

Oxford House · Clacton-on-Sea

WE SHALL BE PLEASED TO QUOTE

BUILD

with Confidence

Send 2/6 today for our "HOME CONSTRUCTOR" HANDBOOK AND SUPPLEMENTS—**20 CIRCUITS** 68 PAGES, including illustrated catalogue of components.

And don't forget that where coils are wanted you **NEED** our **STANDARD SUPACOILS**—single hole fixing, iron cored, all wave ranges Ae, HF, or Osr, 3/– each

SUPACOILS (Dept. RC)

21 MARKHOUSE ROAD LONDON E.17

VALVES

NEW TESTED AND GUARANTEED

1A4	8/6	6BR7	8/–	6X5GT	8/–	EAF42	9/6
1A7G	12/6	6BS7	8/–	7H7	8/6	EB91	6/6
1B4	8/–	6SA7	8/–	12AH7	7/6	EBC33	8/6
1C5GT	11/6	6F6G	8/6	12AT6	8/6	ECL80	10/6
1E7	9/6	6F8G	8/6	12AT7	8/6	EF22	7/6
1H5GT	10/6	6G6G	4/9	12AX7	6/9	EF37A	15/–
1R5	7/6	6J5GT	5/6	12K8GT	8/6	EF36	7/6
1S5	7/6	6K7G	5/6	12K7GT	8/6	EF39	7/6
1T4	7/6	6K8G	8/–	25A6G	8/–	EF91	7/6
3V4	7/6	6L6G	9/6	57	7/6	EF92	8/6
5U4G	8/6	6N7	6/9	58	7/6	EL32	7/6
5Y3GT	9/6	6Q7G	8/–	5763	7/6	EL91	10/6
5Z4G	8/6	6Q7GT	8/6	807	8/6	EZ35	8/–
6AG5	6/9	6SJ7	8/–	954	2/6	EZ40	8/6
6AM6	7/6	6SK7	8/–	1625	10/6	KT33C	8/6
6AT6	8/–	6SL7GT	8/–	9006	5/6	KT66	12/6
6BE6	8/–	6SN7GT	8/–	AZ31	10/6	PL81	10/6
6BW6	8/–	6SS7	6/9	DAF91	7/6	PL82	10/6
6B7G	8/6	6U7G	8/6	DF91	7/6	PY82	10/6
6B8	7/6	6V6G	7/6	DL94	7/6	X65	10/6
6B8G	7/6	6U5G	7/6	EA50	2/–	Y63	7/6
6BA6	8/6	6X4	8/–	EAC91	6/–		

Matched Pairs KT66, **25/–**; 6V6G X GT, **17/–** per pair
6K8G, 6Q7G, 6V6G, 5Z4G, 6K7G, **34/6** per set.
1R5, 1T4, 1S5, 3V4, **27/6** per set.

ELECTROLYTIC CONDENSERS

Tubular Type	*Can Type*
2/350v T.C.C., **1/3**	8/500v Dubilier, **1/9**
8/350v T.C.C., **1/6**	8+8/450 B.E.C., **4/–**
8/450v Micromite, **2/6**	8+16/450 B.E.C., **5/–**
8/450v B.E.C., **2/–**	16+16/450 B.E.C., **5/6**
8+8 500v Dubilier, **4/6**	4+4+4/450v., **3/6**
16/275v T.C.C., **2/–**	8+4+4/450v., **4/3**
16/450v Micromite, **3/3**	16/275v T.C.C., **2/–**
16/450v B.E.C., **3/–**	32/350v B.E.C., **3/9**
32/450v Hunts, **4/6**	32+32/350v B.E.C., **4/6**
32/500v Dubilier, **4/9**	32+32/450v B.E.C., **5/9**

Bias Condensers 12/50v T.C.C., **9d.** 25/25v, **1/3.** 25/50v, **1/6.** 50/25v, **1/6.** 50/50v, **2/–.**
P.F.S. 2–2000, **6d.** .003–.1, **8d.** .25–1 mfd., **1/–.**
Resistors. Most values. ¼w, **4d.** ½w, **6d.** 1w, **8d.** 2w, **10d.** Wire wound 10w, **1/3.**
Potentiometers. All values. Long spindled, s.p.s.w., **4/–.** d.p. s.w., **4/9.** Less s.w., **3/–.**
Wavechange Switches. Midget 1p 12w, 2p 6w, 3p 4w, 4p 2w, 4p 3w, **4/–.**
Toggle Switches. Q.M.B.: sp, **2/–**; spdt, **3/6**; dpst, **3/9**; dpdt, **4/6.**
O/P. Transformers. Pentode: 60ma, **4/6.** 45ma, **3/6.**
Co-Axial Cable. Stranded. 75ohm ¼in., **6d.** yd.
B7G V. Holders. Ceramic with Scng. can, **1/–.**

R. COOPER

32 SOUTH END CROYDON SURREY

Telephone CROydon 9186

Solder with LITESOLD

REGD. TRADE MARK

THE LIGHTWEIGHT CHAMPION

Rapid Heating—Extreme Lightness—Eight different models—Bit sizes, ⅛", 3/16", ¼", ⅜"—Prices from 19/6. *Details of full range in folder No S8 sent on request.*

NO TRANSFORMER NECESSARY. FOR MAINS OR LOW VOLTAGES

Sole Manufacturers and Distributors

LIGHT SOLDERING DEVELOPMENTS LTD

106 GEORGE ST. CROYDON SURREY

Telephone CROydon 8589

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 3d. per word, minimum charge 2/–. Trade advertisements will be accepted at 8d. 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

RECEIVER. Eddystone S640 with speaker, mint condition. Also R1224A receiver. £20 the pair. Hill, 169 Trinity Lane, Waltham Cross, Herts.

FOR SALE. Mullard 17" Tube type 43/64, used few weeks only. Guaranteed perfect, £15. Delivered 30-mile radius. Smith, 16 Newey Road, Wyken, Coventry.

FOR SALE. Inexpensive Television constructed in three sections and bolted together. R1355 for sound and vision, separate power pack for each section. Complete less speaker. Offers. Beal, "Charnes," Huggetts Lane, Willingdon, Eastbourne.

FOR SALE. TV containing Pye Strip complete with new VCR97 and enlarger but less HT pack. No cabinet. Buyer collects. £6 10s. Box No. D143.

FOR SALE. Pullin series 100 Testmeter, £5. GEC Miniscope in carrying case, £6. Willson, 49 Benacre Road, Ipswich.

FOR SALE. Eddystone S640 receiver complete with S-meter and Speaker, £21. Transmitter, 75 watt, 1.7 to 28 Mc/s, complete with power pack and anode modulator. Leak TL12 Amplifier with pre-amp., as new, £28. Lowther-Voigt corner horn speaker, £35. Column speaker cabinet with Axiom 101, £9. Box No. D142.

COMPONENTS. EC52 4/–, 6C6, 6D6 7/6 each. Condensers, resistors, potentiometers, IF transformers and wire. Muskett, 212 Stanhope Drive, Horsforth, Leeds.

AMATEUR selling up. New valves, tubes, components going cheap. SAE for details. Pritchard, 12 Rock Lane, Hastings.

FOR SALE. Micro-ammeters, 0-200 FSD, scaled 0-100, 3½" flange. New, few only. 25/– each. Tidman, 5 Burnside Crescent, Chelmsford, Essex.

FOR SALE. O- -0 and O-V-1 battery SW receivers, bandset and bandspread, cover all bands, ideal portable or standby. £2 and £3. SAE details. Box No. D138.

COMPONENTS. Unused valves at 5/– include EL33, 807, U52, 6J7, 6AC7, 6SN7, 6SL7 and 6L6. Mains and output transformers, chokes, coils, meters, resistors, condensers, pots, pick-up, all cheap and guaranteed. Box No. D141.

FOR SALE. Taylor RC Bridge, £4. 12" Celestion speaker, 30/–. Selection unused mains and battery miniature valves, 6/– each. SAE for list. W. Blackwell, 25 Barons Way, Egham, Surrey.

[continued on page 319

SMALL ADVERTISEMENTS

continued from page 317]

OFFERS FOR Gauge 0 track, about 50 curves and straights, loco shed, signal box, etc. Ridge tent, 8 ft long, 5 ft high, 6 ft wide approx. Light weight canvas and poles. Gramo playing desk with crystal pick-up. Heavy camera tripod, grey painted wooden legs, chrome fittings, a really rigid job. 8" speaker in cabinet. Elca II 35 mm Camera, Prontor S, Elocar f 3.5. Case and Filter, new. 14" globe of the world. Rotary converter, 12V in, 275V at 110 mA plus 500V at 50 mA out. Another 24V in, 230V AC at 120 watts out. Wanted—Gen. on German RV12P, 2000 valves. "East Keal," Romany Road, Oulton Broad, Lowestoft, Suffolk.

TRADE

RADIO COMPONENTS. Send stamped addressed envelope for bargain list of speakers, resistors, condensers, etc. G. M. Peck, 53 High Street, Thames Ditton, Surrey.

MEDICAL BOOKS. In addition to radio publications, you can obtain from us the following popular works on health subjects. *Smoking and Cancer*, 2/-. A comprehensive discussion on this important subject. *So You're Grown up Now*, 1/-. Personal information for the Teen-ager. *So You're Expecting a Baby*, 9d. A most helpful book for the young Mother-to-be. Please add 2d. for postage. Data Publications, Ltd., 57 Maida Vale, London, W.9.

A PRIVATE RECORDING for Christmas. Tape to disc, from 12/6. Queensway Recording Studios, 123 Queensway, W.2. Telephone BAY 4992.

BLUEPRINTS. High Gain 10 Metre Converter, with a de-luxe circuit comprising EF91 RF stage, ECC91 double triode mixer and oscillator, EF92 IF amplifier, with stabilised voltage supply via a 7475, 1/8 post free with full instructions. Data Publications, 57 Maida Vale, London, W.9.

KENDALL AND MOUSLEY. Manufacturers of Laboratory Equipment, chassis and instrument cases, also suppliers of B.V.A. valves, Radio and TV components. 18 Melville Road, Birmingham 16.

COILS, COILS, COILS. We can supply coils for all frequencies, RF Chokes, Filters, etc. Coils wound to specification—send details for estimate. Send SAE for circuits and data. The Teletron Co., 266 Nightingale Road, London, N.9.

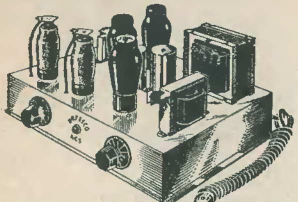
I.P.R.E. PUBLICATIONS. 5,500 Alignment Peaks for superhets, 5/9. Sample copy *The Practical Radio Engineer*, 2/-. Membership examination particulars, 1/-. Syllabus of TV and Radio Courses free and post free. Secretary, I.P.R.E., 20 Fairfield Road, London, N.8.

FREE! Brochure giving details of Home Study Training in Radio, Television, and all branches of Electronics. Courses for the hobby enthusiast or for those aiming at the A.M.Brit.I.R.E., City and Guilds, Telecommunications, R.T.E.B. and other professional examinations. Train with the College operated by Britain's largest Electronic Organisation, moderate fees. Write to E.M.I. INSTITUTES, Postal Division, Dept. RC28, E.M.I. Institutes, London, W.4.

OSMOR—for efficient coils, coilpacks, etc. Send 5d. stamp for FREE circuits and lists. Dept. RCC, Osmor Radio Products, Ltd., 418 Brighton Road, South Croydon, Surrey. Telephone Croydon 5148/9.

[continued on page 320

DEFESCO AUDIO AMPLIFIERS



Ready for use or **KITS** from **50/-**

Illustrated Data available. Valve/Component Lists. *Stamp please.*

RADIO UNLIMITED
ELM ROAD : LONDON E17

ALL ITEMS POST PAID UNLESS OTHERWISE STATED

VALVE BARGAINS. 1R5, 1S5, 3V4, **6/3.** 1T4, **5/3.** ECL80, **8/-.** 12AT7, 12AX7, **8/6.** 7S7, 7C6, **7/6.**

SPEAKERS. 6½", **11/6.**

ELECTROLYTICS. 8 mfd 450v. small ali can, **1/-,** six for **5/-.**

Germanium diodes, **1/-.**

A. BLACKBURN
CENTRAL HOUSE
BURY WHARF, BURY ST., RUISLIP, Mddx.

NEW GUARANTEED SURPLUS VALVES XH, XP, 2X2, VU120A, VU111, **3/6.** 1A3, 1L4, **4/6.** 3D6, 6AG5, 6C4, 6AL5, 6AM6, 6J6, 6J7G, 6K7G, 6F8, VS110A, 954, 955, 956, 15D2, AC6Pen, EF50, EF91, EB91, W77, EF92, Z77, **5/-.** 6AC7M, 6U5G, OZ4, **6/-.** 6F6G, 6K7M, 6K7GT, 6G6G, EL32, 6K6G, 6CH6, 1T4, **6/6.** 12BE6, 12A6M, 7C5, 6F7, 6J7M, 6V6GT, EF50 (Syl.), X66, 6AK5, VR105/30, VR150/30, 6AT6, 6BA6, 6BE6, 6BJ6, 6BW6, 6BS7, 6SG7M, 6SK7M, 6AB7M, 6L7M, 6X4, 6X5GT, 6SN7GT, 6SL7GT, 5Y3GT, EF37, EL91, 3A4, 3S4, 1R5, 1S5, **7/6.** EL35 (6L6G), 6Q7G/GT, U22, 6SA7M, 12AT7, 12AX7, 5U4G, 5Z4G, 6K8G, **8/6.** 807, 7S7, 1W4/350, 50L6GT, **9/-.** 5763, 6SQ7M, CBL1, ECH35, ECH42, **10/-.** 6AG7M, 866A, 2D21, **12/6.**

All despatched by return. Please add 6d. postage

JOHN ANGLIN
160 CLEETHORPE ROAD, GRIMSBY, LINCS
Telephone 56315

RECEIVERS. R109, **£4 10s.;** R1116, **£6 10s.;** TBY8, **£15;** HRO Junior, **£17 10s.;** HRO's New, **£29;** BC348 mod. A.C., **£18;** 1953 Hambander complete, **£25;** DST100, **£26 10s.;** HRO Senior Rack Model with Coil Cabinet, **£30;** RF Units 24, **12/6;** 25, **16/-;** Meissner Signal Calibrator 100 kc. 50 kc. 10 kc., **£5;** American Valve Tester Model No. 314 brand new in Case, **£12 10s.;** Co-axial Cable 75 ohm, **10d.** yd.; Variac 220v. 7.5a., **£5;** Mixed Resistors, **15/-** per 100; Valves from **2/-** to **9/-.** **Your requirements, please.** *(Please add postage.)*

N. T. LOWE
6A MIDDLE BROOK STREET
WINCHESTER *Telephone* 4989

SMALL ADVERTISEMENTS

continued from page 319]

JOIN THE ISWL. Free services to members including QSL Bureau, Translation, Technical and Identification depts. DX certificates, contests and activities for the SWL. Monthly magazine "MONITOR" duplicated, containing articles of general interest to the SWL and League members, 10/6 per annum, post free. ISWL HQ, 86 Barrenger Road, London, N.10.

PANL, the air-drying crackle finish. In black, green and brown at 3/6 per 1/8th pint can, post paid, from G. A. Miller, 8 Kenton Park Crescent, Kenton, Middx.

"GLOBE KING" (Regd.) Miniature Single Valve Receiver gets real DX. Amateur radio enthusiasts should send for free copy of interesting literature and catalogue (enclose stamp for postage). Write to makers: Johnsons (Radio), 46 Friar Street, Worcester.

APPOINTMENTS

ELECTRONIC WIREMEN required to assist in the production of Prototype High Grade Television Transmission and similar equipment. Applicants to possess fundamental knowledge of radio and television, to be capable of producing own component layouts and wiring to a high standard. Pension Scheme. Canteen. Write, stating age, experience and salary required to CINEMA-TELEVISION LIMITED, Worsley Bridge Road, Lower Sydenham, S.E.26.

TELETRON FERRITE ROD AERIALS

Wound on high permeability Ferroxcube rod & designed for use with 500 pf. (max) tuning condenser. Nominal Inductance for type. FRM. 165. u/h. Q at 1.Mc.185. Waveband 550.kc/2.Mc.—8/9d. FRD. 2.2.MH. Waveband 150 kc/2 Mc/s. LW and MW. 12/9d. 3d. postage.

THE TELETRON CO LTD
266 NIGHTINGALE ROAD . LONDON N9
Telephone HOW 2527

REPORT PADS

REPORT/REPLY RATIO LOW ?

Then send a report which contains all the information a station requires. Each pad contains 50 printed forms detailing the headings under which reports should be made. Your QSL returns will be much higher if you use these properly prepared reports. Printed on a high quality paper suitable for airmail transit they cost only 3/9 post paid.

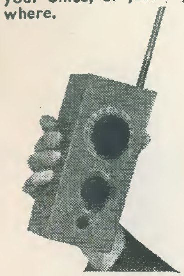
Orders with remittance to

DATA PUBLICATIONS LTD
57 MAIDA VALE LONDON W9

CONSTRUCTORS *build these at low cost !*

PERSONAL PORTABLE RADIO 30/- *Post Free*

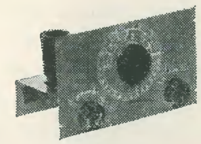
This little set was designed to give you a real personal portable radio that you can enjoy anywhere without disturbing others. Use it on camping trips, in bed, in your office, or just anywhere.



Send 2/- for layout, Wiring diagram and Components Price List.

ALL-WAVE RADIO 30/-

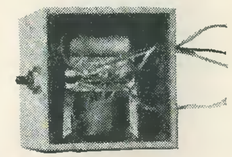
Ideal for the beginner or for those requiring a simple standby receiver.



This 1 valve S.W. receiver can be built for 30/-, from our list of components, which can be purchased separately. It includes valve and 1 coil covering 20-40 metres. Provision is made to increase to 2 or 3 valves if required, and all components are colour-coded so that the beginner can build this set quite easily. *Send 2/- for specification, wiring diagram, layout and price list.*

POWER UNIT TYPE PU1
120v @ 20ma, 6·3v @ 1·5A
32/6

Replace those expensive batteries with one of these power units. Supplied in component form together with easy to follow constructional details.



An ideal power supply for both these Receivers and for inclusion in Home-Built Test Equipment.

R.C.S. PRODUCTS (RADIO) LTD.
11 OLIVER ROAD *(Mail order only)* **LONDON E.17**

YOU CAN RELY ON US

Radio and TV Component Bargains

VALVES
6V6G **7/6,** 6X5G **7/6,** 6X5gt **7/6,** 6SN7 **9/6,** EM34 **7/6,** 6U5G **7/-,** ECC40 **9/-,** EL42 **8/-,** ECC81 **9/6,** 6K7G **7/6,** 6K7(metal) **8/-,** KT63 **7/6,** EF54 **6/-,** EF50 **7/-,** EL32 **7/6,** 12A6 **7/-,** 12SC7 **6/6,** 6J7G **7/6,** 76 **6/6,** 12J5 **4/6,** EB34 **3/6,** EF36 **6/6,** 6B4 **7/6,** 6B8 **7/-,** 6K8G **8/6,** 12K8gt **8/6,** 1T4 **7/6,** 1S5 **7/6,** 1R5 **8/6,** 3A4 **7/6,** R3 **9/-,** 35Z4 **7/6.**

TRANSFORMERS TV
WB107 Line **32/6,** WB106 Frame **25/6,** WB103 Heater **42/-,** WB103A Heater **52/6,** Denco WA/LOT1 Line **42/-,** WA/FMA1 Frame **21/-,** WA/FBT1 F/Blocking **16/-,** Allen LO308 Line **40/-,** FO305 **21/-,** BT314 **15/-,** and Haynes (when available) Osram 912 Amplifier Book **3/6,** all parts stocked.

VOLUME CONTROLS
5K, 10K, 25K, 50K, 100K, 250K, 500K, 1mg, with Switch **4/-,** Less S/W **2/6,** DP Switch **5/6,** Wirewound Preset from 100Ω to 30K **3/2** each. Standard 3w Colvern **6/4.**

TRANSFORMERS
Speaker Trans. Pentode O/P **4/6.** Midget Mains **3/9,** Battery Standard **4/-,** Super-Midget for P/Portables **5/-.** Charging Transformers 2v, 6v and 12v charging at 2a **19/6,** 1v, 2v, 4v, 6v, 10v 15v, 20v, 30v, up to 15v at 4a 30v at 2a **22/6.** Midget Mains Transformer 60m/a 250-0-250v 6.3v at 3a, 5v 2a **21/6.** Elstone SR/250 or SR350 **28/6.**

SOLDERING IRONS
Tyana Pencil Bit **14/11,** Adcola Pencil Bit **25/6,** Detachable Bit **33/6,** Henley Small Pencil Bit **19/8,** Solon Standard Pencil **25/4,** Oval Bit **23/8,**

LINEAR POTS
¼ mΩ, ½ mΩ, 1 mΩ, 2 mΩ, **6/6.** As above with Centre Tap **7/6.**

COILS
Osmor Full Range **4/-** each, Weymouth 'H' Type **3/9,** 'K' Type **5/-,** CS3W3 **12/3** per pair, CT2W2 **10/-** per pair. Denco Maxi-Q Midget Chassis or Plug-in Type **3/11** each. Full Range of Osmor and Weymouth Coilpacks.

IF TRANSFORMERS
Denco IFT11 **12/-** pair, P4(Weymouth), **15/-** pair, Wearite M800 **21/-** pair, 501/502 **20/-** pair.

Q MAX CHASSIS PUNCHES
⅝", ¾" **12/4,** ⅞" **13/4,** 1", 1⅛", 1¼" **16/-,** 1" Square **24/-.** (All inclusive of keys).

RESISTORS
¼w ½w 4d., 1w 8d.. Midget Type 'T' ½w max **6d.,** Type 'R' 1watt max **8d.** Full Range. 2% High Stab. **1/6** each (Range 100 ohms to 2mg). Wirewound max 7 watts **2/3**, 10 watts **2/9** (33 ohms to 10K only).

A BARGAIN
New Tubular 8mfd 500v Wire-End Electrolytics **1/11** each. 2 for **3/6.**

Orders Despatched Promptly, C.O.D. by Return (over £1). Please add P/Pkg. fee up to £1-1/- £2-1/6. Over £2 Free. Catalogue of Surplus Ready soon 6d. each. Catalogue of New Proprietary Components (250 Illustrations, 70 Pages) 3/- Returnable on Order over 30/-

Next Door South Ealing Tube Station. 6 o'clock, 1 p.m. Wed

82 SOUTH EALING ROAD
LONDON W5 *Telephone* **EAL 5737**

RADIO SERVICING CO