Radio Constructor

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EDITORIAL

PROGRESS

GOOD news for readers of "Radio Constructor." For the first time since we started publication, the Board of Trade have granted a paper concession which affects post-war publications. This is not, however, the end of our troubles but at least we now have a little breathing space to develop the magazine. It is a start.

How will the increase affect readers? We could have devoted all our extra paper to more copies. Though still a young periodical, the demand for "Radio Constructor" is ever-increasing. All of our trade distributors were "pegged"—we had to ration copies. And we had to close our waiting list for annual subscribers! Moreover our mailbag often contains letters from would-be readers who simply cannot obtain a copy anywhere. Yes, there is a brisk demand.

On the other hand, we owe it to our faithful readers to provide more pages—to print more articles and to devote more space to sections of the fraternity who feel somewhat neglected.

Faced with a considerable case for either of these alternatives, we finally decided to play safe and compromise! *From the July issue onwards, the magazine will contain four extra pages each month and there will be many more copies for general distribution.* Under this arrangement, regular readers will be getting more value for their money and many of those who hitherto have been unable to get regular delivery will be assured of copies.

This has allowed us to re-open our subscription list and we enjoin anybody interested to apply for their annual subscription without delay. We still have only a limited number of copies at our disposal and we will probably have to shut down on subscribers again soon! So, if you want a sub—do it now!

Naturally, we hope that this concession is only the preliminary move forward to the magazine we dearly wish "Radio Constructor" to develop into. One thing is certain—we *are* making progress and will continue to do so. W.N.S.

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman will redraw in most cases, but relevant information should be included. All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6579.

AUTHENTIC AND UP-TO-THE-MINUTE INFORMATION ON VHF, BROADCAST BAND AND AMATEUR ACTIVITIES IS GIVEN IN OUR MONTHLY PUBLICATION "SHORT WAVE NEWS."

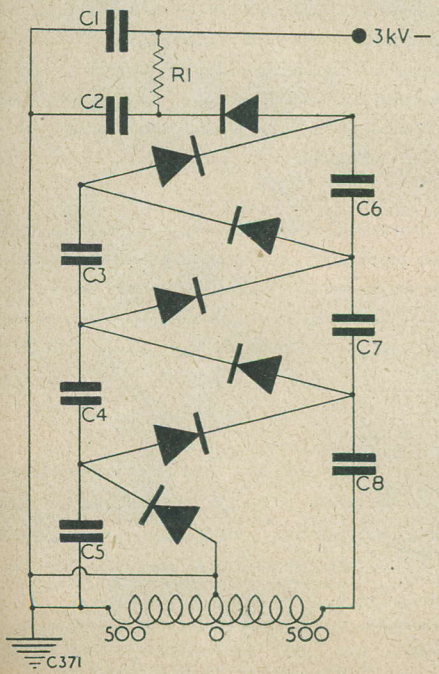
TELEVISION FANS — READ "TELEVISION NEWS" MONTHLY

for the television fan

EHT—for £2 or less

by R. J. Denley

HAVING under construction a televisor from war surplus equipment, the question of EHT arose, and bearing in mind that lack of cash was the reason for the use of ex-Government material, the same factor had to be taken into consideration in the question of an EHT unit. That ruled out a transformer, as transformers, to be reliable, have to be well constructed, and that meant hard cash, plus the question of rectifier replacements. The war surplus market was investigated, and some Westinghouse J50 rectifiers were discovered at prices ranging from 3/6 to 5/- each. Seven of these at 3/6 each were purchased, and with these a start was made. The output in mind was about 2.5 kV, but the highest voltage I had available was 500-0-500 on the mains transformer HT secondary, so it was decided to work from this point, and circuit A was evolved. I had on hand some 0.01μF mica capacitors, and these were just hooked up, the mains switched on, and an electrostatic voltmeter connected gave a reading of 2.9 kV. This was full of promise, but alas, on connecting a load of four megohms, down went the voltage to under 500, so it was obvious more capacity was needed. Six 0.1μF capacitors were tried, and on load this gave a reading of 2.3 kV. Further values were tried, and the most satisfactory arrangement found was two 0.2μF at the input end. (I used two 0.1μF in parallel, as these were easier to obtain) with the other four being 0.1μF. This gave an output of 3 kV on load.



Circuit. A. (*See circuit B for values*).

After consideration, it was decided it might be worth while making the output variable (as later events proved), so various methods were tried, including a tapped resistance network, which terminated in circuit B. It will be noted that the input to the rectifiers is from the sliders of the 25 kΩ potentiometers. These were of a pre-set type, obtained from a 62A Indicator, and were ideal, as once set, they would not vary in setting, which gave the following results (the external load was four megohms): 1.7 kv at 0.4 mA to 3 kV at 0.7 mA, which was quite sufficient for a VCR97 tube with which it was used.

The smoothing capacitor used was a 0.1μF, 3 kV working. This was found to be sufficient, but as I had another on hand this was used with a 100 kΩ 1 watt resistor between, as shown.

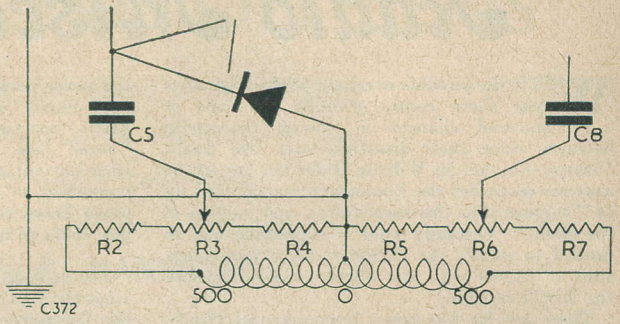
Before leaving the theoretical side, the following points should be borne in mind. The 0.2μF capacitors are 1,000 V DC working, and the four 0.1μF capacitors 500 V DC working. 3 kV positive EHT can be obtained merely by reversal of the whole seven rectifiers. If a higher voltage is required, it can be obtained by adding more rectifiers, although some experimenting may be necessary with the values of feed capacitors, and it is important to note that to obviate AC ripple the half-wave rectifier at each end must not be omitted.

Regarding construction, the whole unit, with the exception of the smoothing capacitors, was built on a paxolin panel 11″ x 6″; the rectifiers were mounted on pax strips 5½″ x ¾″, and the fixing holes ¾″ between centres. This was fixed edge-on to the main panel by tapped holes, and screws being inserted through main panel. 4BA screws with soldering tags under the nuts were

Circuit B. Values are :

C1, C2—0.1μF, 3kV
C3, C4, C6, C7—0.1μF, 500V
C5, C8—0.2μF 1kV
R1—100,000 Ω
} *common to both circuits*

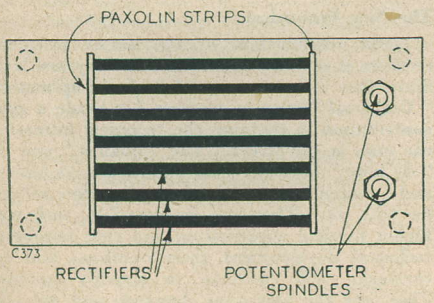
R2, R7—10,000 Ω, 2W
R3, R6—25,000 Ω, 5W
R4, R5—4,700 Ω, 1W
} *for circuit B only.*



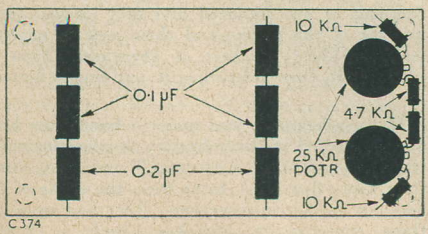
used as anchor points for the feed capacitors, which were at the back of the panel. The same method of fixing was adopted for the resistances for the voltage divider network. The whole unit must be kept well clear of any metal chassis, and in my case, I mounted them on four stand-off insulators, but anything, such as Tufnol rod, will suffice, as long as the spacing is approximately 2".

A list of components with approximate cost is given below.

7 Westinghouse J50 rectifiers	£1	4	6
4 0.1μF 500 V capacitors		2	0
2 0.2μF 1,000V capacitors		2	0
2 25 K Ω pre-set potentiometers ..		3	0
2 0.1μF 3 kV working capacitors ..		7	0
4 resistances		1	0
1 Paxolin panel			6
Total ..	£2	0	0



Front



Rear

Layout sketches

"RADIO CONSTRUCTOR" QUIZ

Conducted by W. Groome

With the emphasis on components we bring you this month's selection of queries. How many can you get right ?

(1) Two resistor of equal value, connected in parallel, have a total resistance of half of their separate values. Right or wrong ?

(2) Apart from capacitance, what important factor must be considered when choosing capacitors ?

(3) What is meant by "Core Saturation" in transformers ?

(4) Why is the grid of an RF pentode brought out via a cap at the top of the valve, instead of through the valve to the base ?

(5) Short, straight conductors have inductance. Right or wrong ?

(6) The RF stages of television receivers are tuned by adjusting cores in the coils and make no use of capacitance. Correct? Or not?

(7) How can RF and IF stages receive and amplify the single make or break of a switch in the domestic light circuit ?

(8) What is modulation hum ?

(Answers on page 629)

HIGH VOLTAGE TRANSFORMERS

Messrs. Millet & Holden Ltd. have produced an attractive leaflet dealing with their high voltage transformers. The new factory is just coming into operation and the leaflet mentioned is the first to be released. Copies may be obtained from the firm at Bircham Works, Bircham Road, Southend-on-Sea, Essex.

Radio Miscellany

WITH the possible overhaul of the BBC next year there comes grounds for hope of material changes if enough thoughtful listeners voice their dissatisfaction. No doubt Director-General Sir William Haley has got all the answers ready for the Committee recently set up to " inquire into the constitution and control of the BBC." Certainly a lot of explaining will be needed to justify the existence for a permanent staff of 12,000 who just about swallow up half the BBC's revenue.

There are far too many Departmental Heads, Assistant Chiefs, Planners, and Controllers of this, that and the other, passing chits, referring back and generally obstructing those who love and know the job still left in that ponderous organisation. Many keen and progressive men are baffled and frustrated, good ideas and innovations are shelved, while the " Higher-ups " either through smug self-satisfaction or weak irresolution, continue to get away with the dull monotony of routine programmes.

the most persistent, and not the most talented, who finally secure the low fee engagements? There just isn't enough left over when the "Stars" (big, only on BBC publicity) have had their cut out of the revenue we poor listeners are compelled to provide. Remember, even if you never listen to a BBC programme, you have to pay them to be allowed to use your radio.

Let us hope if we have to continue to take only what the BBC bosses choose to dole out to us, that the Committee do realise the urgent need for a general shake-up and a weeding out of the surplus staff. Particularly those with the Civil Service Complex who think broadcasting is a matter of filling in a given number of hours (too many, in any case) and compiling statistics of listeners who are forced to take it—or cease to be listeners. Happily the BBC have some good men and first-rate artistes. They must be used to the best advantage and given more scope—and stimulated by a spot of competition !

CENTRE TAP

DISCUSSES

The B.B.C. — Universal Sets — Dual Speakers — Jamming

Personally, I consider the BBC Listener Research Dept. a sheer waste: at least, on their present activities. Their information when it is all totted up merely shows, with estimated accuracy, the ratio of people believed to listen—not those who would be listening if they had something better to turn to.

The listening public, fettered to insipid programmes which have long since lost all trace of freshness and novelty, may feel uneasy about not getting much of a deal but a worse danger is that they may grow so accustomed to the same old formula that they finally resign themselves to it. This applies particularly to Variety and light entertainment. The threadbare weekly features churned out by the same gang of comics and crooners until even the dullest and most faithful of listeners are yawning their heads off. I sometimes suspect that when at last the Listener Research people discover that an idea has gone stale, it takes six months of chit passing to get the information to the programme Directors !

At one time the BBC were charged with being niggardly with the artistes' fees. Nowadays it seems the Big Names are grossly overpaid and the few newcomers with originality and ideas, if they survive the pruning and rebuffs of the Civil Service mind, are the underpaid. Is it that only

The New Enthusiasts

Home construction of the family broadcast receiver in pre-war years fell to a very low level. Since then it has been on the up-and-up and the " Universal " type of receiver has made a great contribution in reviving the technical interest of the man in the street. The " quality " and the " de luxe " fans have, of course, always thrived and I cannot imagine the time when they will not be with us. They are irrepressible, and with higher musical appreciation and ever improving technical development their numbers, and enthusiasm, will continue to steadily increase. They are the sort that demand, and get, the performance of a receiver that commercially costs upwards of one hundred and fifty guineas for a quarter of the price—and then seek to improve on it ! Their pleasure is threefold. First in planning it, then in building it, and finally in using it.

Many a beginner and many a handyman have been attracted to the hobby by the cheapness and simplicity of the " Universal," and they, more than any other class, have been the cause of the boom in home construction. Just how many of these constructors who have built a set for domestic listening will go further into the hobby is debatable. Probably just about half, but it is

easy to distinguish which of them will. It is not the man who builds a receiver from a kit of parts and wiring plan without getting interested in how, or why, it works.

The constructor who, as soon as his set is working seeks to improve it and to find out what the Americans call the "know how" finds the bug has bitten him before he realises it. After adding one or two minor improvements he goes forward whole-heartedly planning a more advanced edition while the first is reserved for listening, and when that is built he starts thinking about the next !

Heater Voltages

Usually one of the first questions that puzzle the beginner is the fact that the better class universal type of receivers incorporate a barretter and he is a little uncertain just what is gained by its inclusion. It is only when he gets down to more serious experimenting and acquires a good AC meter he becomes interested in the mains supply voltage. It is then he discovers it is not only the other chap's voltage that violently fluctuates from hour to hour. This is even more noticeable in industrial areas. My own supply, in a purely residential district, often drops 30 or 40 volts from its nominal value, especially in the winter months. Therein lies the chief advantage of the barretter, quite apart from its value when the set has occasional use on other supply voltages.

The barretter is simply a lamp with a special form of filament. As the current through the filament rises its resistance rises proportionately to oppose the increase. By this means a reasonably constant voltage is maintained on the heater chain, despite wide variation in the applied voltages.

The correct heater voltage is essential both to the performance of the valve and its useful life—and beginners find it difficult to believe that under-running the heater is a quick way to ruin a valve's emission !

Matching Dual Speakers

Probably one of the earliest additions the home constructor makes to his first set is a second speaker, usually one with a ten or twelve inch cone and a large baffle. When this is run by itself it sounds fine—equal to an expensive radiogram. So he decides to leave the original speaker in circuit in order to get the best of both: plenty of bass and plenty of top. To his astonishment it doesn't sound as good. The answer, though simple, is often overlooked.

In using two loudspeakers placed close together it is important to see that they are correctly phased. By this it is meant that both the cones should move in the same direction at the same time. If they are out of phase, the sound waves set up by each tend to cancel out, resulting particularly in a falling off in the reproduction of the lower frequencies. It is not important to match the phasing of speakers placed well away from each other as in the case of an extension running to another room.

To test for phasing, connect a 1.5 volt battery across the speech coil. The cone will move either forwards or backwards according to whichever way round the leads are joined. Mark the connecting tags with positive or negative signs according to the battery connections. For instance, if by connecting one way the cone moves backwards (towards the magnet) mark the tag to which the positive of the battery is connected with a plus (+) sign. Do this on both speakers.

If the speakers are to be connected in parallel the two "positives" are joined together, and if they are required to be used in series the "positive" of one is joined to the "negative" of the other.

Counterblast

The short-wave propaganda war is intensified and British and American increased activity is met by further Russian jamming. I cannot help thinking that we could bring off a great goodwill coup by moving all broadcast stations out of the amateur 40-metre band. Few people other than amateurs listen on these frequencies and they heartily curse the propagandists instead of heeding them. It would mean a change of a couple of hundred kilocycles either way at the most and in doing so, the warm approbation of the world-wide short-wave transmitting and listening fraternity would be gained.

The continuation of the Russians to encroach in a band which by International agreement should be reserved for amateur use would be even more intensely resented by short-wave enthusiasts all over the world. Their number is legion. Far greater than the number of the present (largely mythical) audiences.

By such a gesture the Democracies would confirm their genuine intention of giving a square deal to minorities, win the world-wide appreciation of the amateur movement, and also leave the Russians to alone bear the opprobrium of a mean form of 'piracy.'

THE EDITORS INVITE . .

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

SOME USEFUL COIL DATA

DENCO MAXI-Q COILS

CODING. Aerial Coil—Blue R.F. or Det.—Yellow Oscillator—Red

Range	Frequency coverage with 115 μμF Swing mcs.	Pin Connections			Tracking Capacitor
		Prim.	Sec.	Tracking Capacitor Pin†	
1 ..	— —	1 & 8	3 & 6	4	250 μμF
2 ..	.85 2.6	1 & 8	3 & 6	5	300 ,,
3 ..	2.5 7.3	1 & 8	3 & 6	7	1,800 ,,
4 ..	7.0 20.0	1 & 8	3 & 6	2	
5 ..	15.00 40.0	1 & 8	3 & 6	6*	
	Tuned by 50 μμF				
6 ..	30.0 60.0	1 & 8	3 & 6	—	
7 ..	50.0 90.0	1 & 8	3 & 6	—	
8 ..	72.0 130.0	1 & 8	3 & 6	—	

† *On oscillator coils, instead of using pin 6, these pin numbers are taken to the appropriate padding capacitors.*

* *Earthed on 465 kcs oscillator coils*

PREMIER MIDGET UNSCREENED COILS

Type	Wave Range with 450 μμF Swing	Trimmer μμF
Aerial	Metres	
,, 1 ..	700—2,000	60
,, 2 ..	220—557	60
,, 3 ..	16—47	30
,, 4 ..	12—35	60
,, 5 ..	34—100	60
,, 6 ..	91—261	60
,, 7 ..	250—750	60

R.F. Coils to match have the same type number preceded by letters "H.F." (*e.g.* H.F.4 etc.) Oscillators coils are preceded by "O" and details are as follows:—

Intermediate frequency, 465 kcs.

Type	Trimmer	Padder
O4 ..	60 μμF	.005 μF
5 ..	60 ,,	.003 ,,
6 ..	60 ,,	1,500 μμF
7 ..	60 ,,	600 ,,
1 ..	200 ,,	300 ,,
2 ..	60 ,,	600 ,,
3 ..	30 ,,	.005 μF

WEARITE "P" TYPE COILS

The long tags are the secondary windings and the high potential (grid) ends are marked with red. Aerial coils are preceded by letters "PA," H.F. Transformers by "PHF" and Oscillator Coils by "PO."

Type	Range in Metres with 450 μμF Swing	Trimmer
4 ..	12—35	60 μμF
5 ..	34—100	60 ,,
6 ..	91—261	60 ,,
7 ..	250—750	60 ,,
1 ..	700—2,000	72 ,,
2 ..	200—557	65 ,,
3 ..	16—47	55 ,,

Oscillator Coils

Type	Trimmer	Padder
4 ..	60 μμF	5,000 μμF
5 ..	60 ,,	2,400 ,,
6 ..	65 ,,	900 ,,
7 ..	73 ,,	350 ,,
1 ..	95 ,,	150 ,,
2 ..	76 ,,	450 ,,
3 ..	50 ,,	5,000 ,,

Trade Notes

HINTS ON TELEVISION AERIAL ERECTION

Philips Electrical Ltd. have produced a booklet on the subject of aerials for television reception. It contains advice on the various types to suit all conditions and gives the best methods of installation.

It is not always realised, the booklet explains, that distance from the transmitter is not the only factor to be taken into consideration when selecting the type of aerial to be used. The strength of local interference will often influence such a choice and due account must be taken of areas of poor signal strength and high interference.

The booklet also gives much good advice on feeder cables and their use and suitability and emphasizes that television is a much more exacting science than sound radio ever was. The days when " a piece of wire around the picture rail " would bring in a strong signal have never arrived with television, and never will, but care in the provision of a proper aerial will pay handsome dividends.

" Television Aerials " may be had by any Philips Appointed Dealer on application to Philips Electrical Ltd. (Radio Department), Century House, Shaftesbury Avenue, London, W.C.2.

FULL VISION DRIVE UNIT

Messrs. A.M.C. are marketing a full vision drive unit which will be of particular interest to readers contemplating the construction of a three wave-band receiver. The calibrated perspex coloured scale reads 16-50m, 200-580m and 800-2000m and it gives the positions of some of the more important station names. The scale also has kilocycle markings—a very useful feature.

The drive itself is an insulated universal flexible drive for direct mounting to the tuning capacitor shaft ($\frac{1}{4}$" dia.). Provision is made for internal illumination.

The maximum scale opening is 10" x $4\frac{1}{2}$". Total depth is $1\frac{3}{4}$" and the pointer travels 7". Further details of this unit may be obtained from Albert Manufacturing Company, 5 Shakespeare Road, Finchley, London, N.3.

CATALOGUES RECEIVED

Webbs Radio's catalogue now contains a list of price alterations and additions. Amongst the new items, we note such interesting gear as a 2-metre tuning assembly with loop type inductance (adjustable) with tapping clip and a second hairpin coupling loop supported on ceramic strip for aerial coupling. Also there is a 2-metre converter chassis, a 2-metre transmitter chassis, miniature tuning coils, a 145 Mcs beam aerial and numerous other features. The supplement also gives full details of the Eddystone price reductions. A comprehensive list for those aspiring to quality components and gear. Obtainable from Webbs Radio, 14 Soho Street, London, W.1., price 6d.

Garland Radio have six foolscap sheets in their 1949 Summer Component List. It contains a wealth of information on all types of components and surplus gear. Radio societies and clubs may avail themselves of a discount of 5% (under £5) or 10% (over £5) on non-proprietary goods. Copies of the list may be obtained from Garland Radio, 4 Deptford Bridge, London, S.E.8.

H.P. Radio Services (55 County Road, Walton, Liverpool, 4) are issuing illustrated sheets on items of special interest. These include Modulator Units, Power Packs, Communications Receivers, IFF Receivers and so forth. The details of each item are accompanied by a photograph, which is a good guide as to the general make-up of the gear. Copies are obtainable on request.

POPULAR CIRCUIT REPRINT

Iliffe & Sons Ltd. have just published *High Quality Audio Amplifiers*, which consists of reprinted circuits and descriptions from " Wireless World." This 24-page booklet, on crown quarto sheets, comprises the following items :—Circuit Details for 4, 8 and 12 watt designs; AC/DC Quality Amplifier with negative feedback (Two-watt output); High Gain Push-pull phase-splitter; Advantages of tetrodes in the Output stage and an Economical 50-watt amplifier using KT66's.

Those interested in amplifier design will find these tried and tested " Wireless World " circuits of much value and will obtain good value for their 2/6. The booklet is obtainable from your local bookseller.

COIL WINDERS

Those interested in coil winding gear will find the folder of Messrs. Kolectric (Grovehill, Beverley, East Yorks) worth while. The attractive coloured sheets give details of automatic and hand winding machines, an armature winding head and a dual reel holder and tensioner. On the reverse sides, scale drawing are given of the various units, with specifications and so forth. A full price list is included. Readers genuinely interested in these machines may obtain copies of the folder on application.

Query Corner

A " Radio Constructor " service for readers

IF Transformers

"I have a pair of IF transformers which were taken from an old superhet and I would like to use them in a receiver which I am about to construct. Unfortunately I am not sure of their resonant frequency. How can I determine this?"

R. Lessie, Richmond.

There are various methods of measuring the resonant frequency of a tuned circuit, but the majority of these require the use of apparatus which many constructors will not possess. The easiest and possibly the most accurate method of making the measurement is to connect the resonant circuit across the RF output terminals of a signal generator, and with the aid of a valve voltmeter measure the voltage across the circuit. At non-resonant frequencies a parallel tuned circuit will have zero impedance and hence the voltage across it will be zero. At the resonant frequency the impedance of the circuit will be high and the voltage across it will be at a maximum. Thus by operating the tuning control of the signal generator until a reading is obtained on the valve voltmeter it is possible to accurately determine the resonant frequency of the tuned circuit under test. If no valve voltmeter is available a " magic eye " tuning indicator of the high sensitivity type may be employed with equally satisfactory results. The grid circuit of the tuning indicator should be arranged as a leaky grid detector whilst the anode circuit should consist of the normal one megohm load. Upon applying the signal to the grid circuit of the indicator the " petals " will close in the normal manner.

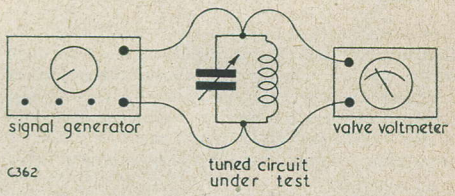


Fig. 1. To determine the resonate frequency of a tuned circuit.

It is, of course, possible that neither signal generator nor valve voltmeter is available, in which case an attempt must be made to compare the frequencies of the transformers in question with that of the IF of any superhet which is available. The procedure for this operation is as follows:—

Tune the receiver to the local station and connect one section of the transformer under test between the top cap of the IF valve and chassis. A 0.001μF capacitor is connected in series with the transformer to prevent the grid bias of the IF valve from being shorted out. If the addition of the transformer to the receiver does not seriously reduce the volume the frequency of the transformer is similar to that of the IF of the receiver in use. This will not be the case if the addition of the transformer reduces the volume to zero.

When making either of the above mentioned tests the trimmers of the transformers under test should be set to their mid position.

Double Humped Tuning

"I have just completed a simple superhet receiver which gives satisfactory results but for one defect, the tuning on strong signals is double humped. By this I mean that the volume is greatest when the receiver is tuned to a point on either side of the station, When the tuning is accurately set to the station the volume is poor and the reproduction badly distorted. I have tried retuning the IF

" Query Corner " Rules

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

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

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

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

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

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

transformers but without success. Can you suggest the cause and cure?"

R. Roblin, S. Kensington.

The cause of this type of defect can generally be traced to overloading in one or more stages of the RF and IF sections of the receiver. The effects in the case in question are particularly marked and hence it is safe to assume that the IF amplifier valve is overloading on strong signals. Overloading of one of the valves in the HF side of the receiver is most likely to occur in the IF amplifier as this valve handles the largest signal voltage. When an IF amplifier is overloaded the peak signal voltage on its grid exceeds the negative grid bias, and thus the grid becomes positive during a part of each cycle. This results in a flow of grid current which considerably reduces the input impedance of the valve thereby damping the IF transformer. This effect may be stated in a slightly different manner, as follows.

If the peak signal input voltage to the stage exceeds the negative grid bias the stage gain will be considerably less than it would be if the signal voltage was less than the bias. A little consideration of the foregoing will indicate how overloading results in the double humped tuning effect described in the query.

So much for the cause of the trouble; now to consider the cure. If some means is provided to increase the bias on the valve when it is handling a large signal voltage, overloading will be avoided. This increase in bias is normally obtained by means of an AVC system or by a manually operated control. Thus, if the receiver incorporates an AVC system it should be carefully overhauled. As there are relatively few components associated with the AVC circuit this should prove to be a simple job. If no AVC system is employed in the receiver an IF gain control should be fitted. Such a control must be arranged so that the grid bias of the IF valve may be increased and consequently the stage gain reduced when a strong signal is received. A typical method of obtaining this bias is shown in Figure 2 where an additional potentiometer is included in the earthy end of the screen grid potentiometer.

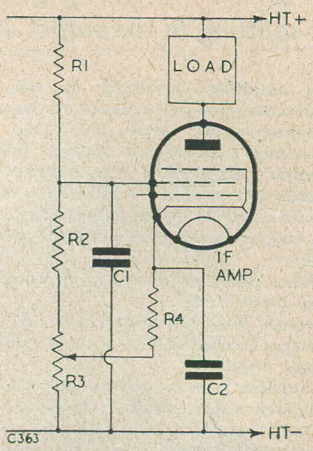


Fig. 2. An IF gain control. Typical circuit values for a 6K7 or equivalent valve are:—R1—25,000; R2—30,000; R3—15,000; R4—250. C1 and C2 can both be of 0.01μF.

Mains Transformer Tapping

"I have a mains transformer, the primary of which is marked as follows: 10-0-200-220-240. *What is the purpose of the tap marked* 10?"

L. Riches, Glasgow.

In order that the correct voltage should be obtained from the secondary windings of a transformer, the voltage which is applied to the primary winding must be that for which the winding was designed. For example, if a 210 V supply is connected to a 200V primary winding on a transformer all the secondary voltage will be 5 per cent higher than their marked values. In order that a transformer might provide its marked voltages within small limits it is necessary that its primary should have a large number of tapping points to accommodate the various supply voltages which are found in different parts of the country. For a range of supply voltages between 200 and 260 volts, six 10 volt taps would be required. The provision of a large number of tapping points is both costly and cumbersome, and a great improvement may be obtained by tapping the winding every 20 volts and winding an additional 10 volt section on one end. The 10 volt section is then used to fill in the gaps between the 20 volt taps. For example, taking the transformer mentioned in the query the following method of connection is used:—

Mains voltage	*Connection*
200	0—200
210	10—200
220	0—220
230	10—220

etc.

BE CAREFUL!

We regret to record the death of two well-known amateurs through electrocution.

F. A. Beck, who operated under the calls HB9CE, in Switzerland, and HE1CE in Lichtenstein, met his death because he had failed to earth his transmitter and receiver. F.A.B. was the Editor of the Swiss radio journal "Old Man."

The second victim was M. Gammon, VE3ZM of Guelph, Ontario, who was electrocuted whilst working VE3IY. In this case it appears that the tragedy was due to insulation breakdown in a component.

It cannot be over-emphasised that the greatest care should be taken when dealing with electricity. In certain circumstances even comparatively low voltages can prove fatal. BE CAREFUL!

TWO-VALVE PUSH-PULL AMPLIFIER

Phase-splitting in the output stage.

By W. Groome

THE amplifier described in this article represents push-pull reduced to the absolute minimum—two valves only (the output pair), output transformers and a few small components. Although it is not claimed to be a high-fidelity job, it will be found to be superior to the average single-ended amplifier, and to possess, the following advantages in common with other push-pull:—

1. Mains hum neglible unless introduced with the input to V1.
2. Second harmonic distortion nil.
3. Output double that of a single valve of the same type.

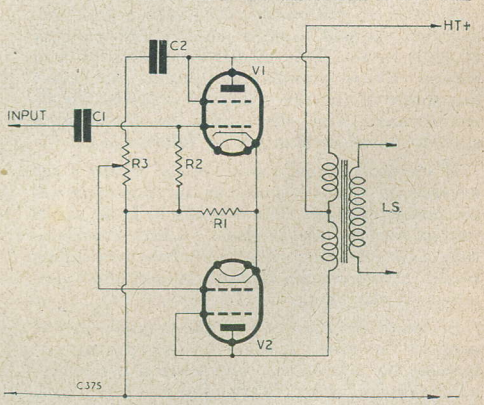
This amplifier has one advantage which is not shared by some other circuits, in that the required input is only the voltage that would be needed for a single valve. It would have to be double for an amplifier using a cathode-follower phase-splitter. The amplifier requires very little pre-amplification, and in many cases can be operated from the output of a double-diode-triode detector. It could form part of a 4 or 5 plus rectifier local-station receiver comprising 1 or 2 RF, double-diode-triode, and push-pull output.

As many readers know, the two valves in a push-pull stage have to receive an input which is of opposite phase on each grid, and the phase-splitting is usually effected in a preceding stage. The "concertina" or cathode-follower for example, makes use of the fact that phase-reversal takes place between grid and anode while the cathode remains in phase (*i.e.*, follows). One output valve grid can therefore be fed from the cathode, and the other can receive the signal of opposite phase on the anode. It is an excellent arrangement, and its only disadvantage is the absence of gain. In the arrangement shown, no extra valve is used. Instead, advantage is taken of the phase reversal which takes place in the output valve V1, which is the only one to receive true input. The output at its anode is of the right phase to drive the other output valve V2, so it is taken via C2 and R3 to V2 grid. Due to the amplification of V1, however, the peak to peak voltage is too great, so that R3 must be a potentiometer in order to adjust it to the same level as the input to V1. R3 also serves as the grid leak for V2. C2 blocks the direct HT supply.

The presence of C2 and R3 across the anode load of V1 causes a slight loss of balance at high audio frequencies. Many readers will consider this negligible, but balance can be obtained if required by connecting a capacitor and resistor (fixed) of the same values as C2 and R3 between V2 anode and earth.

No particular valves are specified as the amplifier should work well with any matched pair, and the constructor will have his own opinion as to output required. The choice of tetrodes (or pentodes) strapped as triodes, as shown in the diagram, has much to commend it. There is the advantage of indirectly heated cathodes, and further, the constructor may use the same pair in future experiments, either as triodes or in their normal role when greater output is required.

The present circuit will work very efficiently if the valves are connected as triodes by wiring the screen-grids to HT+ instead of to anodes, but it should be remembered that if pentodes are used as such their third harmonic distortion is not cancelled out in push-pull as second harmonic is. For minimum distortion, triode connection is the better method in any circuit not employing negative feed-back.

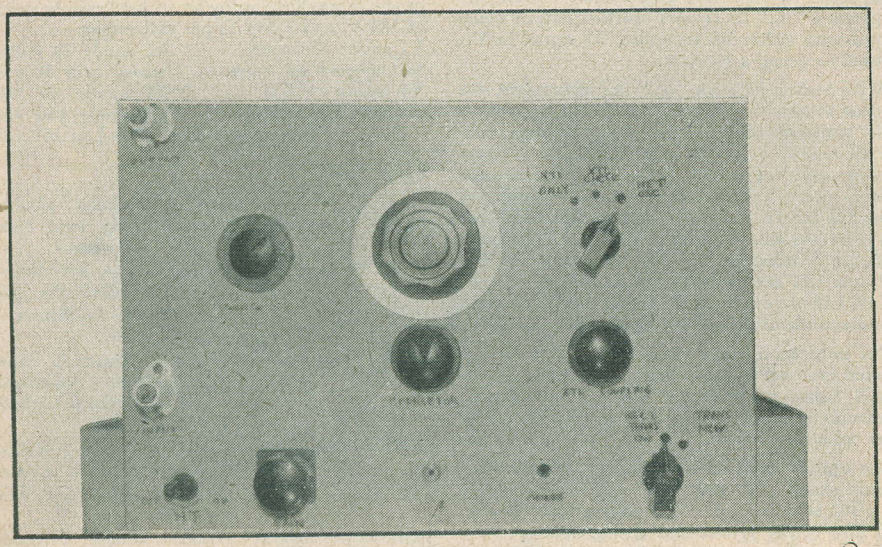


The Circuit. The reverse-phase input for V2 is obtained from the anode of V1, via C2 and R3.

Component values will, of course, depend on the valves used, but C1 and C2 may be safely settled at 0.1μF and 220,000 ohms will probably be found suitable for R2 and R3. The bias resistor, R1, must be half the resistance required for a single valve.

This article is intended to assist the constructor who prefers to make a modest start with push-pull, but if it is intended to progress to more ambitious arrangements, it will be a wise plan to obtain a high quality output transformer and loudspeaker which can make the best of a high-fidelity amplifier. The transformer should have several ratios, so that triode or pentode valves may be used as required, and should have but little phase shift, as future equipment may involve the use of voice-coil feed-back. A 12" high-fidelity loudspeaker of 15 ohm impedance will be a wise and lasting investment. By obtaining worth-while components at the beginning the reader will avoid further outlay when later experiments with high-fidelity amplifiers demand the use of good quality components.

CRYSTAL TEST OSCILLATOR



Describing an accurate crystal checked instrument for setting up and frequency checking of transmitters and receivers

BY F. W. HATTEMORE

THE apparatus about to be described is the outcome of many months of research and testing to find a suitable circuit for a multi-purpose instrument, and incorporates the best features of each arrangement tried. The frequency range is wide and can be set to any band between 100 kcs. and 30 Mcs by suitable choice of L3, which can conveniently be a plug-in type of inductor.

The power requirements are 6.3 volts for the valve heaters, and 120/240 volts for the HT supply; a 120 volt battery might be used, for example, where no supply mains are available. No power supply unit is shown, as individual constructors may have their own particular preferences in this direction.

The circuit consists of an EF50 as a transitron oscillator for frequency stability, and simplicity of coil construction, this being coupled to a 6SA7 as mixer, the method of coupling being such that the oscillator is only very lightly loaded. The signal grid of the 6SA7 can be fed with crystal controlled energy from the 6SJ7 crystal oscillator, as a frequency check, or energy from a transmitter or oscillator whose frequency it is desired to measure, via the aerial input socket Sk1. The amount of crystal coupling can be varied by the potentiometer R8.

The output of the mixer is fed to (a) aerial output socket Sk2 via an attenuator R2 for receiver checking, and (b) to the leaky grid detector V4, a 7A4 (or any medium impedance triode, 6J5, L63, 6C5). The AF component developed across R15 is fed via C17 to the transformer T. The primary of this transformer is connected to the CW/MCW switch Sw2, which in position " D " couples the transformers to the detector, and in turn to V5, an ML6 used as AF amplifier to feed telephones or loudspeaker. With Sw2 in position " E," the primary of the audio transformer is disconnected from C17, and coupled to V5 anode via C20, and the telephones disconnected and earthed. V5 then becomes a tone oscillator and modulates the output of V1, V2, or V3, depending on the position of Sw1, the selector switch. With this latter in position " A," it will be seen that HT supply is connected only to V1, V3, and V5, and crystal only is in use, the signal being either pure CW or modulated by V5, depending on the setting of Sw2. With Sw1 in position " B," HT reaches both oscillators, and mixing of their outputs takes place in V1 electron

stream, the output being detected by V4, and passed via V5 to the telephones for frequency companion by zero beat adjustment. With Sw1 in position " C," its crystal checked output being mixed with either an incoming *Tx* signal in V1, or used to set up a receiver.

With Sw2 in position " D," the instrument can be used to receive or transmit *CW*, but in position " E " transmits an MCW note only. Components are all readily available, but should be of finest quality only. For V1, V2, and V3, ceramic holders were used, and a ceramic insulated capacitor for C6 the main tuning capacitor, and the corrector C7. Wiring must be mechanically rigid, and values of by-pass capacitors C9, C5, C12, and C19 are critical, and must be as stated. If C19, C12 are deviated from, the correct amount of audio modulation will not be obtained on MCW.

The inductor L3 is a plug-in type, and can be selected to cover the band required, about 200μH being required for the 1.7 Mcs band, harmonics of which can be used if desired on the other amateur bands.

The unit is built on a solid heavy gauge aluminium chassis, 18" x 10" x 2", and a front panel 16" x 10" is employed. The photographs give a good idea of the layout and arrangement.

A rod aerial 1' long is used with the equipment being connected to Sk1 on receive, and Sk2 on transmit. The crystal is a 1,000 kcs bar, and its associated oscillator circuit is a highly efficient frequency standard, and very stable since no power is taken from V3, and it operates on low voltages. The crystal is protected from heat radiated by the valve V3 by surrounding it with an aluminium screen. The first step in setting up

(*continued on page* 628)

Test Voltages

The following test voltages are obtained on the model in use here, using an on-load supply voltage of 180 V, and a 200 Ω per volt meter:—

V1 anode 170 volts.	V2 anode 70 volts.
Screen grid 60 volts.	Screen grid 50 volts.
V3 anode —	V4 anode 30 volts.
Screen grid 65 volts.	V5 anode 160 volts.

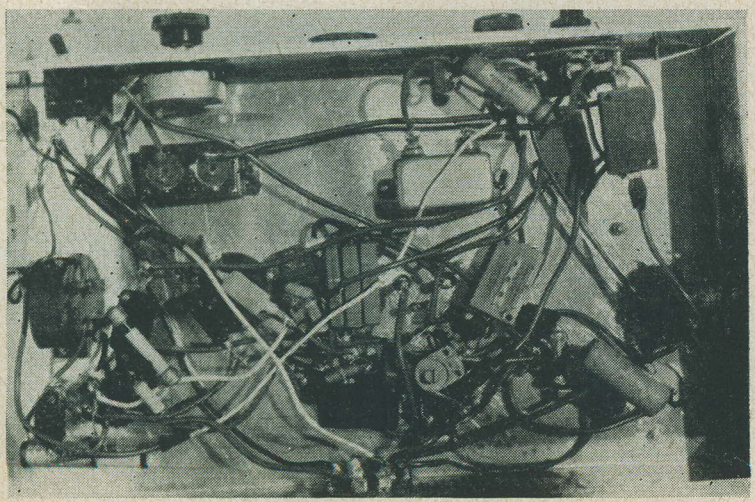
Total HT current 27 mA at 180 volts.

Valve Bases

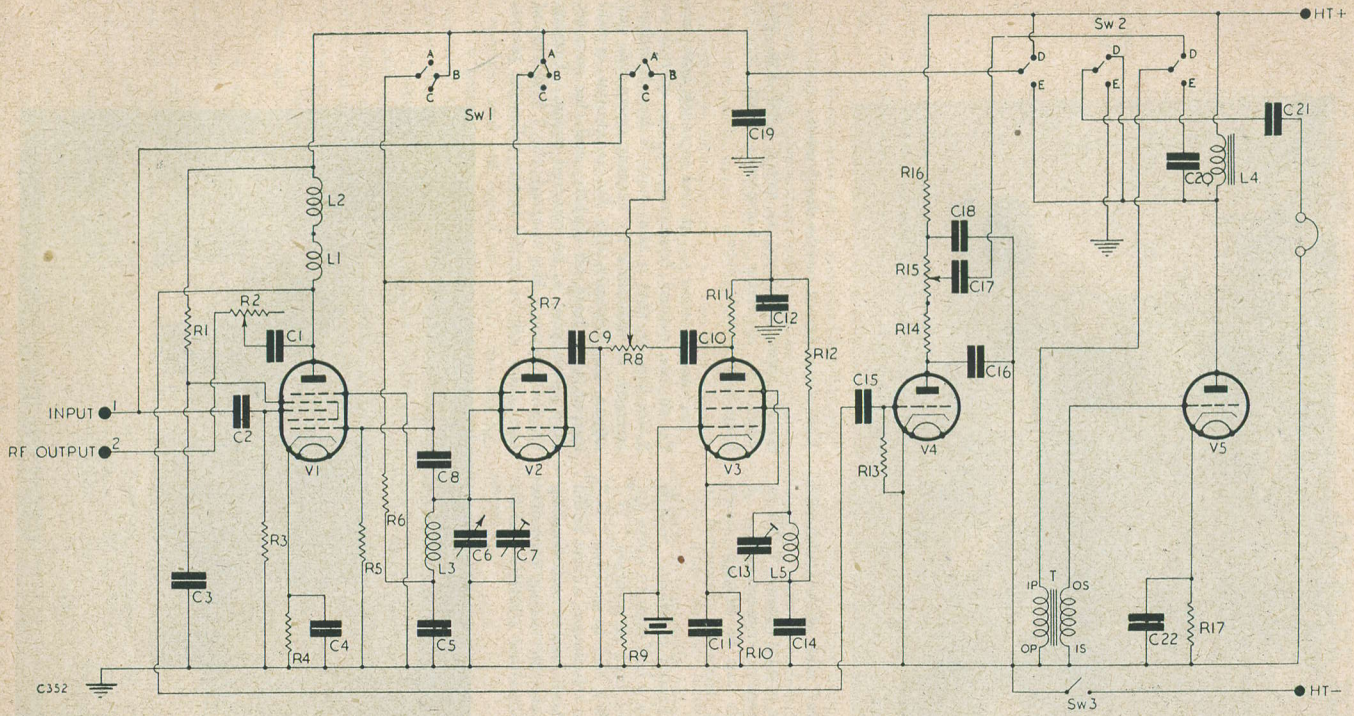
Valve	*Type of Base*	*Pin connections, clockwise from locating key, viewed sub-chassis*
6SA7	I. Octal	1 Suppressor; 2 Heater; 3 Anode; 4 S.G.; 5 Osc. grid; 6 Cathode; 7 Heater; 8 Control Grid.
EF50	9-pin Loctal	1 and 9 Heater; 2 Screen grid; 3 Anode; 4 Suppressor; 5 and 8 Earth; 6 Cathode; 7 Control grid.
6SJ7	I. Octal	1 Earth; 2 and 7 Heater; 3 Suppressor; 4 Control grid; 5 Cathode; 6 S.G.; 8 Anode.
7A4	8-pin Loctal	1 and 8 Heater; 2 Anode; 6 Grid; 7 Cathode.
ML6	5-pin British	Same as Battery valve, centre pin-cathode.

Permissible alternative valves:—

V1 None.
V2 SP61 (VR65) (change base).
V3 None.
V4 L63, 6J5 or 6C5 (change base).
V5 6J5 or L63 (change base).



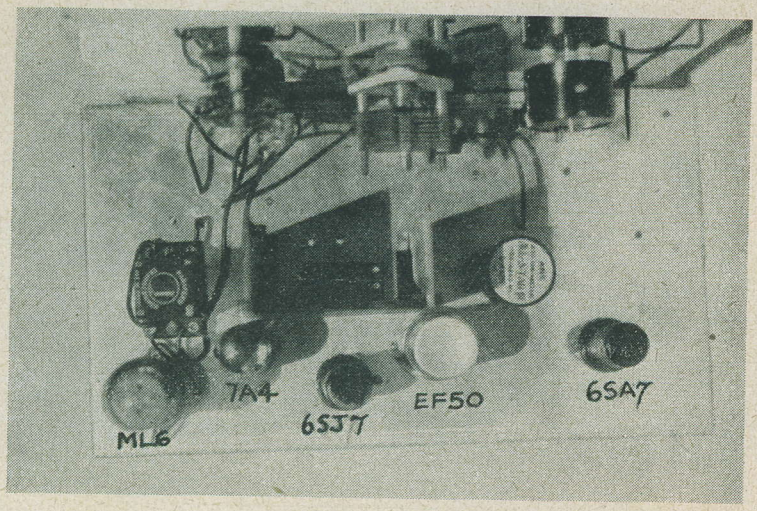
General view of the under-chassis showing the positions of the various components.



Component List

C1, 2, 8, 15, 200$\mu\mu$F Mica.
C3, 19, 0.1μF.
C4, 5, 11, 12, 14, 22, 0.01μF Mica.
C6, 50$\mu\mu$F variable.
C7, 3$\mu\mu$F variable.
C9, 0.03μF Mica.
C10, 0.001μF Mica.
C13, see text, 40$\mu\mu$F.
C16, 500$\mu\mu$F Mica.
C17, 21, 0.5μF.
C18, 2μF.
C20, 0.002μF Mica.

R1, 30K Ω
R2, 250K Ω Potentiometer.
R3, 14, 20K Ω
R4, 200 Ω
R5, 100K Ω
R6, 7, 27K Ω
R8, 15, 50K Ω Potentiometer.
R9, 13, 2M Ω
R10, 350 Ω
R11, 0.25M Ω
R12, 16, 50K Ω
R17, 1K Ω
T, Intervalve trans., 1 ; 3.
L1, 1.5mH.
L2, 20mH.
L3, See text.
L4, LF choke, small output type.
L5, 0.5mH.



A " birds-eye " view of the instrument. Component layout can be clearly seen.

the meter is to check the crystal against WWV or GMT standard frequency transmissions. A crystal on the high side can be brought down somewhat by a small trimmer connected in parallel.

The instrument is calibrated as follows. Switch on the filaments and allow a half hour to warm up. Switch on Sw3 (HT) put Sw2 to position " D " (transmit and receive CW), Sw1 to position " B " (check oscillator), plug in telephones, adjust audio gain R15 to about two-thirds, and crystal coupling R8 to maximum. Rotate the tuning capacitor C6, when numerous heterodyne whistles will be heard, these occurring at every 1,000 kcs, and wherever oscillator harmonics and crystal harmonics beat together.

Set the corrector C7 at mid-capacity and tune C6 to the second harmonic of the crystal on 2,000 kcs, so that a beat note is heard, reduce strength to minimum by turning down R8, and adjust the trimmer C13 for maximum crystal output, then back off slightly, and this once set may never need to be touched again. Turning C6 down from 2 Mcs through the 1.8 Mcs band harmonics will be heard at the following places,

Looking from behind the unit.

as beat notes of varying amplitudes:—

	Transitron Oscillator Freq.	*Crystal Harmonic*	*Osc. Harmonic*
1.8 Mcs Band	2000	2	1
	1916.6	23	12
	1908.33	21	11
	1900	19	10
	1888.8	17	9
	1875	15	8
	1857.1	13	7
	1833.3	11	6
	1817.1	20	11
	1800	9	5
	1777.7	7	4
	1769.23	23	13
	1750	14	8
	1727.2	19	11
	1714.2	12	7
	1700	17	10

Example: When the transitron oscillator is set to 1800 kcs, the 5th harmonic will produce a beat note with the crystal oscillators 9th harmonic, on 9 Mcs.

Correct harmonics can be identified by listening to stations whose frequencies are known to be accurate, and intermediate points can be obtained by interpolation and a calibration curve drawn up for each range. Once calibrated any necessary correction can be made by the corrector capacitor C7, which is brought out to the front panel directly underneath the tuning dial. Needless to say, a good tuning dial should be used, capable of being accurately read and reset, and should have a high reduction drive.

To use the frequency meter to set up a transmitter on a predetermined frequency, allow an initial warming-up period of half an hour, switch on HT, and put Sw1 to " crystal check " and Sw2 to Transmit and Receive CW. Plug in telephones and rod aerial into Sk1. Set tuning dial to nearest crystal check point to required frequency, and if not exactly at zero beat at the correct dial setting, adjust the corrector for zero beat. Switch Sw1 to " Heterodyne Oscillator " only, turn up audio gain, and tune C6 to correct frequency setting required, ascertained from calibration chart. Now tune transmitter VFO to zero beat in the telephones.

To set up a receiver to a definite frequency repeat the crystal check provess as before, and using rod aerial in Sk2 position, listening on the receiver, set frequency meter dial to required frequency, and Sw2 to " Transmit MCW " position. It should then be an easy matter to find the signal on the receiver. Similarly, to measure the frequency of an unknown transmitter, using the " Transmit CW " position of Sw2, rotate C6 for heterodyne, tune to zero beat, and the frequency can be ascertained from the calibration.

The procedure here when listening is to keep the frequency meter filaments on, so that it is always warmed up ready for immediate use by switching on the HT switch.

ANSWERS TO THE QUIZ

(1) Right.

(2) The working voltage. For safety, select capacitors with a higher rating than the voltages they will actually have to handle.

(3) Magnetisation of the core by the steady anode current which lowers its ability to respond to the signal. Remedies are (*a*) Correct choice of core size and material (the manufacturers usually state the maximum current rating of output transformers) and (*b*) In inter-valve circuits, feed the primary through a capacitor, thus blocking the anode current.

(4) To keep it well away from the anode lead. Coupling through proximity would cause instability.

(5) Right. At very high radio frequencies, even the inductances of the internal connections of valves have considerable influence.

(6) Not correct. Capacitance exists between turns of coils, in wiring and between the electrodes of the valves. The designer's problem is often that of keeping these small capacitances small enough. Coils are designed to resonate with them, so that although not shown on the diagram, nor visible in the set, the capacitances do exist and are used.

(7) The switch produces a spark which radiates a very wide range of radio frequencies. If the switch operated without this fault its only output of interference would be about one cycle of some audio frequency, which would not influence the set.

(8) Hum which has modulated the carrier wave during its passage through the pre-detector stages. It exists only in the presence of a carrier wave.

LABGEAR

We have received the latest list of Labgear short wave products, in folder form. The majority of these products, of an acknowledged high standard, are designed to cater for the amateur transmitter. Nevertheless, many of the lines will be of interest to the non-transmitting constructor. For instance, there is a wide range of IF transformers, both miniature and standard, which, though of a particularly high standard, are of competitive prices. Again, the range of receiver tuning coils and RF chokes will be of much interest.

Since many beginners in radio construction wil eventually progress to the stage when they take out their transmitting licence and build their transmitters, it is as well to keep informed on the latest trends in transmitting components and equipment. The Labgear folder may be obtained on application to Labgear Limited, Willow Place, Fair Street, Cambridge.

LOGICAL FAULT FINDING

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

By J. R. DAVIES

5: NO SIGNALS

THE tests required for finding the fault in a receiver with which no signal at all is received show to the full the need for a logical approach to servicing.

Fig. 16 shows the block schematic layout of two receivers. Fig. 16(a) represents that of a conventional straight receiver, Fig. 16(b) that of a conventional superhet. The oscillator is shown as an off-shoot of the frequency-changer, although, in actual practise, the two valves are usually combined in the one envelope.

The procedure used in finding the cause of the cessation of signals is to look at the receiver as a series of blocks (just as in Fig. 16), locate the *block* in which the trouble is occurring, then find the actual faulty *component* within that block. Now, first of all, the troublesome block—or " stage," if you like—must be located. The *order* in which the " blocks " are tested is always the same. First, the power supplies are checked, then the output stage, then the next stage before that, and so on, working back from the speaker to the aerial. Let us take an example of the procedure. Assume in Fig. 16(a) that the power supply is found to be serviceable, and that the output stage is also working satisfactorily. If we can get no signals through the AF stage then it is obvious that the trouble lies in that stage.

However, let us proceed from generalities and get down to our muttons.

Checking the Power Supplies

This is quite a simple job. If the set is a battery set it means that the batteries should be checked for correct voltage, and that these voltages are getting to the set. We should ensure that all plugs are home, that the valves light up and that HT is present in the set. A quick check with the meter between the speaker transformer primary and chassis is quite sufficient for the latter test and only takes a second or so. With a mains set it is sufficient to see that the valves light up and that HT is present, again testing between speaker transformer, or any other convenient HT positive point, and chassis. Incidentally, it may save time to check these points before the chassis is taken out of the cabinet, as, quite often, a fault may be due to, say, a flex lead being pulled out of a power plug terminal, or something equally pettifogging.

To continue, let us assume that we have a mains receiver and that no HT is present, although the valves light up. The components which are most likely to be causing the trouble are the electrolytic smoothing capacitors. So let us make a further assumption, that being that we now find a short-circuit between HT positive and chassis. There is little point in ripping all the electrolytics out of the chassis to check them as it is quite easy to find the guilty members whilst *in situ*. Fig. 17 shows a typical smoothing circuit with " C1 " and " C2 " as the electrolytic capacitors and points " A," " B " and " C " as test points. Using one prod of the testmeter (at the " ohms " position—and with the mains to the set switched off!) connected to " C," we check the readings at " A " and " B." We find that at " A " we have a reading of 300 ohms to " C " and at " B " a reading of 100 ohms to " C." As the resistance of the choke can be somewhere in the neighbourhood of 200 ohms, it is obvious that at point " B " there is a 100 ohm leak to chassis. Then, of course, C2 is the most likely component. Even then it is worth-while isolating only one of its

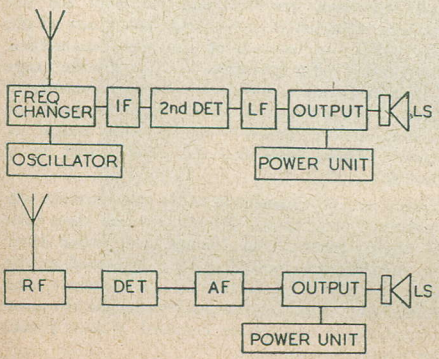


Fig. 16(a). Block schematic diagram of a typical superhet receiver.

Fig. 16 (b). Block schematic diagram of a typical " straight " receiver.

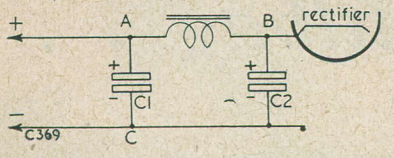


Fig. 17. A diagram illustrating selective fault location (see text).

connections and making *certain* that it is the faulty component, before going to all the fuss and bother of removing it and fitting another. It may happen that, say, one of the windings of the choke has shorted to a lamination or to the case !

This last paragraph is only intended as an illustration to show that a few moment's work with a testmeter can often save a lot of unnecessary toil. The illustration was simple but the principle can be applied to nearly all servicing work. It should be possible for one to say to oneself, " Ah—Ha ! I *know* that that component is faulty ! "—before screwdrivers, spanners, sweat and toil are used to lug it out.

However, if we were to particularise on every little thing that could happen when once the faulty stage has been found, this article would fill a book. So let us proceed to the testing of the next stage in the receiver.

Checking the AF and Output Stages

We now come to the AF and output " blocks." (See Fig. 18, which shows the circuit of a typical AF amplifier.) These two stages may be considered together, as their treatment, apart from the fact that the output stage is checked before the previous one, is similar. We check each stage by the simple process of touching the grid of the valve with the finger. The grid of the output valve, when touched, should give a faint hum, screech or " plop " when the finger touches it. Whatever happens there should be some audible effect. When the grid of the previous valve is touched there should be a good loud hum, screech or similar disturbance. Make sure, by the way, that the volume control is turned to full during this process. If the grid of the valve required is below the chassis and rather awkward to get at, a small screwdriver should be held so that the finger touches the metal of the tool, its blade then being used to touch the appropriate valve-holder tag. For greatest success and also to minimise the chance of shock, the other hand should be clear of the chassis and not touching any metal object.

Having gone so far, let us assume that one of the stages is unserviceable. This will almost certainly infer that the valve in that stage is faulty or that it has not got the correct voltages applied to it. Most probably there is a complete cessation of voltage altogether to one of the electrodes. It doesn't take a second, if a mains receiver is being used, to check that the valve is passing approximately its correct current. Using a testmeter with its negative prod connected to chassis, we can touch the positive prod to the cathode of the appropriate valve, " A1 " or " A2 " (reference to Fig. 18). The reading obtained should then correspond to the correct bias required by the valve. V1 should require 1-3 volts bias, V2,10-20 volts. If the check shows that no voltage is built up across the bias resistor then it is obvious that the valve is passing no current and the voltages applied to its screen-grid and anode should then be measured. If a battery set is used we do not have the advantage of the cathode bias check, but we still have the ability to check other voltages. The whole thing consists of quickly " prodding " the various terminals of the valve-holder and taking intelligent assumptions from the readings. The process is so quick that it is not worth-while changing the valve until these tests have been carried out. A word of warning, however, is necessary when reading the anode voltage of V1.

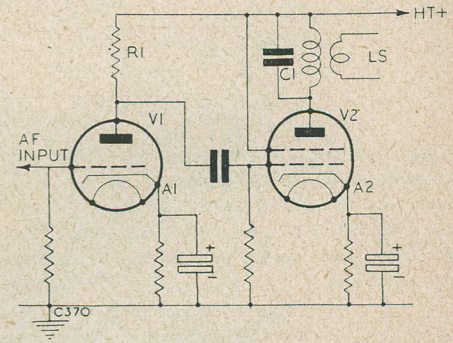


Fig. 18. A typical example of the AF and output stages in an average receiver.

A very low reading may be given. This is because the anode load of V1 is usually of a high value, and the current taken by the meter will cause a heavy voltage drop across it, apart from the standing current there already.

Having checked the voltages on the various electrodes and found everything satisfactory, the valve itself should then be suspected. If there is still no signal after the valve has been replaced we must look for less obvious things in the circuit. For instance, the breaking-down of C1 (Fig. 18), the tone correction capacitor may stop signals from being heard. Or, again, the speaker may be faulty. This latter can easily be checked by applying the prods of the testmeter (set to " ohms ") to the transformer primary, with the receiver switched off. Apart from the testmeter reading, a " click " should be heard in the speaker as well, due to the internal battery in the meter.

——To be continued——

from the mailbag . . .

AND STILL THEY COME . . .

A further selection of letters on the subject of " point-to-point " wiring diagrams and the technical standard of " Radio Constructor."

WILLING TO LEARN

I don't think the articles are too highbrow. Although the TV articles are a little above my head I will return to them as my knowledge ncreases. I should like to see a series dealing with test equipment.

I never did like point-to-point diagrams—they never got anyone anywhere.

Yours sincerely,
B. S. Notley
(Redditch, Worcs.)

The May issue disproves the idea that the magazine has become too highbrow. It contained articles for the less advanced and others. I am one of the lesser advanced but I have built two sets from your journal and they have proved very successful.

Yours faithfully,
Frank F. Woods
(North Wembley, Mddx.)

CONVERSION

As one who has only a fair insight of the subject, I would say you are not too highbrow. When I first started the hobby I would have said yes! Unable to read a circuit diagram, a friend asked me to check a lead; I took so long in finding it on the point-to-point sketch that my friend said " you must learn to read a circuit diagram." I looked at the circuit and found what I wanted immediately—thus it was I realised I had been going about things the wrong way. The symbols gave me some trouble, but looking back I am amazed at the rapidity with which I learnt. From that day the construction of sets has been so very much easier!

I was able to appreciate the descriptions of various virtues to this or that circuit and to compare circuits with one another. Though I am at times puzzled regarding descriptive matters I always pore over the point in question. For we must progress in knowledge to gain a greater delight in our hobby. We tend to lose interest if things are " ABC-ish." Perhaps this is borne out by the fact that of five radio periodicals I know, only one to-day remains that taking it cover to cover is always a little more " technical " than its contempories.

I think that the article by Hector Cole (page 131, Vol. 1), is ideally expressed and if all articles had similar diagrams that would suit me fine.

Sincerely yours,
E. Collins
(Portsmouth)

PRACTICE AND THEORY

I personally think that the *average* constructor is quite capable of building a set around a theoretical circuit, but he must be sure that when finished it will perform satisfactorily. Quite a few, like myself, have only the basic theory behind how a set works—and this is sometimes not a complete picture!

Every keen constructor has probably acquired " surplus " components for future building programmes and articles describing circuits of receivers as they stand—modifications and rebuilds around components are of great use to us.

And when we are tired of looking at our VCR97 televisors perhaps we can have a few articles on a more elaborate set-up. Maybe a TV set using a white magnetic tube would be of interest to us who have been " drawn " into television by means of these surplus CRT's and units. It must, however, be magazine tried and tested as nothing is more disappointing to find a set constructed to a flowery description does not turn out to be as stable or efficient as stated!

Yours truly,
D. Berister (Luton, Beds.)

WILL HE BOTHER?

As far as I can see you are catering for beginner and the advanced. If a reader understands what purpose each component serves and why it is of a certain value he can design his own circuits anyway. In other words, he will not bother to read the description. It would be best, then, to keep the articles as they are:—the advanced constructor can see other people's ideas and the beginner with limited knowledge can read the simpler circuits and long for the day when he can build that multi-valve super.

The inclusion of simple superhets in the magazine is a step in the modern direction, but I would like to see a description of a superhet "personal" portable. Also a 28 Mcs convertor using a single 6K8.

Yours truly,
R. C. Maltby
(Cambridge)

THREE SUGGESTIONS

I am an interested reader and will be for as long as the magazine is published. In its covers I find everything I require. My knowledge is self-taught and my activity goes back to the days when valves had four pins and a spike!

Like many others I have accumulated a collection of spare parts—chokes, transformers, valves, etc.—that I cannot identify or calibrate. Therefore I suggest:

(1) A list of those ex-WD parts most commonly encountered; with their civilian classification, i.e. Army valves carry a VR number but not always a civilian one.

(2) A lot of components are not readily identified by appearances and some clue to their ZA number might be of use.

(3) Whole units can be purchases and without some idea as to their original use the purchaser may buy unnecessary junk to get hold of one or two components apparant on inspection. A list of these units with a brief description would help the buyer.

Sincerely yours,
B. Rowell
(Harrow Weald, Mddx.)

IT'S DIFFICULT TO PLEASE YOU ALL BUT —these readers are happy

I consider your magazine the best "buy" in radio literature. Keep up the good work.

Yours faithfully,
J. Rundle
(Lewisham, S.E.13)

May I say that after being a regular reader for a year I regard the "Radio Constructor" as being the most useful of the whole bunch—all of which I take.

Too many magazines fail to offer much on the purely receiver side—a defect from which the "RC" does not suffer.

Yours faithfully,
D. Early
(Wakefield, Yorks)

The Editor,
"Radio Constructor."

MARKING VALVE BASES

I have just read Mr. D. J. Cross's comment (p. 595, June issue) on my article about marking valve bases, which appeared in your April issue.

The alternative scheme he puts forward as a "much better" idea was originated by myself, *fourteen years ago*! I suggested it in an article entitled "Keep a Radio Data Book" which was published by Amalgamated Press in their journal "Popular Wireless" (issue No. 667, Vol. XXVII, dated March 16th, 1935) over my initials.

The suggestion was quite practicable in those days, when valve types were relatively few. But now that the experimenter has so many different types of valves at his disposal, I honestly think it is quicker, easier and more reliable to mark the actual valve bases once and for all, instead of going to the trouble of writing out and referring to a lot of loose-leaf sheets every time a particular valve is used in a fresh circuit.

Yours sincerely,
W. Oliver, G3XT

Ex-W.D.

MOTOR GENERATORS

"Serviceman"

describes the selection and uses of these plentiful units

THERE is, at present, a large number of "surplus" motor-generators on the market which have been offered to the home-constructor at quite attractive prices. These motor-generators usually consist of machines which convert low DC input voltages to high DC outputs and were originally intended for use in aircraft or in mobile equipment where the source of supply was a storage battery. These generators are extremely useful to the constructor who wishes to obtain an HT supply for a car radio, or to those who live in the country and have no mains available. For example, the writer has constructed a receiver for use from a 24 volt supply for relatives in the second category. The motor-generator used is an American job rated at 28 volts input and 250 volts output and functions quite satisfactorily. The four valves in the receiver are Mullard 6.3 volt 0.2 ampere valves (the output valve is an EL32) and are wired in series for connection to the 24 volt supply.

Choosing the Particular Type Required

A certain amount of care is needed when choosing the particular type of generator required from the advertisers' lists. Many of the generators offered were originally designed to give a high voltage at a high current for transmitters, and it would be uneconomical to use a machine of this type for an ordinary receiver. Some of the models available are rated for, say, a 12 volt input but the advertisers state that they will function quite well from 6 volt supplies, giving something less than half the original output. Before purchasing a generator which is not to be used at its rated values, however, the constructor should ensure from the advertisers that the generator will supply sufficient current at this lower voltage.

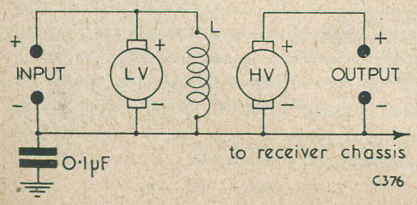


Fig. 1. A typical motor-generator circuit.

Suppression of Interference

By far the most difficulty experienced in using these motor-generators will be experienced in suppressing interference caused by sparking at the brushes. Unless the brushes are making almost perfect contact at the commutator a certain amount of interference is almost inevitable and will have to be suppressed. This interference will be picked up by the aerial and any unscreened RF wiring or components in the receiver itself. The best remedy is complete screening of the generator and leads, but unfortunately a lot of interference may still be injected into the supply leads to the generator. If the generator is being run from low-voltage house mains, then all the wiring in the house is capable of radiating the interference.

Let us analyse how this interference may be caused and cured. Fig. 1 shows a simple shunt-wound machine which will illustrate the various points quite well. The input is applied to the LV (Low Voltage) brushes, the output being obtained from the HV (High Voltage) commutator. It is usually convenient to join the HV negative and LV negative together, if this has not already been done in the machine itself. This negative line may then be connected to the receiver chassis and thence to earth (via a capacitor if the LV input is of a "floating" character). The interference will then be caused by sparking at the HV or LV brushes or both.

Should the HV brushes be causing the interference, this may be eased by connecting a capacitor across the brushes as shown in Fig. 2(a), or by using a choke and capacitors as in Fig. 2(b). The choke used will have to be chosen after experiment. One of the old-fashioned single-pile "reaction" chokes should suffice for most cases. A more elaborate all-wave choke may be used if interference is still troublesome. The choke should be capable of carrying the HT current taken by the receiver and the components forming the suppression circuit must be mounted as close to the offending brushes as possible.

On the LV side we have greater difficulty in suppressing interference. Usually there is more sparking at these brushes than appears on the HV side and if chokes are used they must be capable of carrying the relatively heavy current present in this circuit.

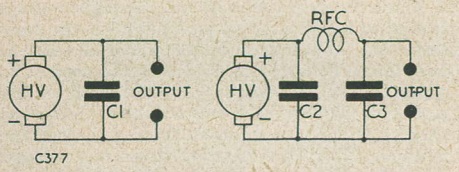
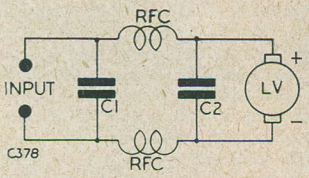


Fig. 2. (a) Simple interference suppression at the HV brushes (b) A more complicated HV suppression circuit.



(c) Suppression of interference at the LV side.

A simple 0.01μF capacitor across the input should be used in the first attempt, this being mounted right at the brush terminals. Fig. 2(c) shows the connection if more elaborate suppression is required. 20 or 30 turns of heavy copper DCC wire on a 1" former will usually make a fairly efficient choke for the LV side. Increasing the value of the capacitors will occasionally give good results, even making them as large as 2.0μF if necessary. If paper components of large capacity are used for this purpose they should be " shunted " by a mica 0.01μF capacitor to ensure suppression at the higher frequencies.

For complete suppression of interference the motor-generator and all its wiring should be entirely screened, the screening being connected to the chassis of the receiver. Most generators, however, are made in self-contained metal cases, and if these are connected to earth, it may not be necessary to shield the remainder of the components and wiring. It is sometimes beneficial to position the motor-generator some distance from the receiver and aerial lead-in, as this also will save the trouble and expense of complete screening.

Smoothing

Smoothing the HV supply from the generator should present little trouble. Fig. 3 shows the circuit best employed and it will be seen that it is quite normal and straightforward. As the ripple from the generator is not as strong as that given by the usual AC rectifier circuit the values of the chokes and capacitors need not be very large. The choke can, indeed, often be replaced by a resistance of 1,000 to 3,000 ohms if this is desired. Alternatively C_1 can be entirely omitted in some cases. C_2 should have a minimum capacity of some 8.0μF, however, as this capacitor also serves to decouple the HT line in some receivers.

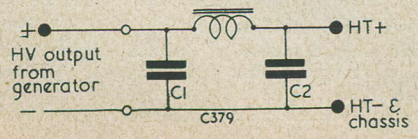


Fig. 3. Smoothing the HV output.

Great care should be taken to see that the output is always of the correct polarity, otherwise the smoothing capacitor will have an extremely short life (assuming that electrolytic capacitors are used). For this reason it is very advisable to make some sort of fool-proof connection for the input voltage, as a reversal of polarity here would have the same effect on the output.

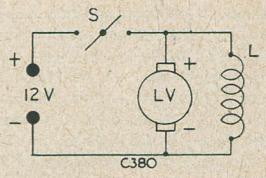


Fig. 4. Illustrating the theory of starting (see text).

Starting the Motor-Generator

It is very improbable that the motor-generator purchased will be supplied fitted with any form of starting circuit.

A starting circuit is necessary usually, in order to save overloading of the switch, brushes and commutator. For those readers who are not familiar with this type of circuit it might be helpful to briefly run through its theory and working.

Fig. 4 shows the circuit of the input side of an ordinary shunt-wound motor generator, switched on and off by the switch S. The field coil will have a fairly high resistance, the current taken by this being well within the range of the ordinary 2 amp switch. The resistance of the armature, however, is usually very low and the resistance presented to the two brushes may have a value as low as half an ohm or less. When the armature is rotating, by reason of what is known as the " back EMF " (a voltage caused by dynamo action in the armature), the effective resistance of the armature winding is considerably increased. Nevertheless, when the armature is stationary the resistance of its windings is only that apparent at the brushes. Now if the value of this resistance was, say, half an ohm, and the input supply was 12 volts, we can see that, on the moment of closing the switch, the current flowing in the

circuit would be of the order of 24 amps. This is obviously far too large a current to be accommodated by an ordinary light-action switch. When the armature starts turning the input current soon drops to a normal value. What is required, then, is some device which will limit the current to a safe value until the armature has developed sufficient speed.

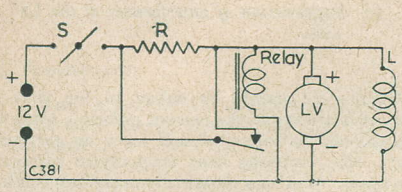


Fig. 5. A simple starting circuit.

This is where the starting circuit comes into use. Fig. 5 shows an extremely simple and effective circuit which has been successfully used by the author. For purposes of illustration, let us assume that the input pressure is 12 volts as before. The relay is then adjusted so that its contacts will close when a voltage of 7 to 9 volts is applied to its coil. The working of the circuit is as follows:—

When the switch S is closed, the input voltage is applied to the input commutator via the resistance R. This resistance, the value of which is best found by experiment, limits the current to some one or two amps. As the speed of the armature increases so does its effective resistance, thereby reducing the current flowing through the resistance R. This therefore drops less voltage, more appearing across the brush terminals. When the armature has developed sufficient speed the voltage across the brushes reaches 7 to 9 volts and the relay is sufficiently energised for its contacts to close. The resistance R is then short-circuited and the full input voltage is applied to the armature. The whole operation only takes a few seconds, but it enables the generator to be turned on by a switch as light as that used in the normal volume control.

Maintainance

The maintainance of these motor-generators should present little trouble. The armatures and brushes should be kept free from dust and grease, particularly the latter, and should occasionally be examined for wear. Cleaning should be carried out with carbon tetrachloride. The bearings should be lubricated occasionally, using light grease or oil as required.

Little other maintainance should be needed, as most motor-generators will give trouble-free service for considerable lengths of time.

"AUDIOM R22"

12"—20 watt fully dustproof permanent magnet loudspeaker. For use with this High Power 12" Reproducer, Messrs. Goodman's Industries Ltd. are now offering their 30 watt heavy duty high fidelity output transformer type H6.

This transformer has been designed to meet any individual requirements permitting AC powers up to 30 Watts to be handled with negligible harmonic distortion. In appearance, the H6 is identical with their Medium Duty High Fidelity Transformer H4.

In view of the forthcoming general release of the "Axiom 22," a new illustrated descriptive folder can be obtained upon request from Goodman's Industries Ltd., Lancelot Road, Wembley, Middx.

NEW POST-GRADUATE ENDOWMENT — IMPERIAL COLLEGE

Following discussion between Standard Telephones and Cables Limited and Professor Willis Jackson, concerning the need for a fuller development of facilities for post-graduate teaching and research in the field of Telecommunications, the Company has endowed a Readership to be known as the Henry Mark Pease Readership in Telecommunications in the City and Guilds College of the Imperial College of Science and Technology, South Kensington.

Henry Mark Pease, one of the pioneers of the telephone industry in this country, who died in March 1947, was Managing Director of Standard Telephones and Cables Limited, until 1928. He took an active part in forming the British Broadcasting Company, and was one of its original directors.

Mr. E. C. Cherry, M.Sc., A.M.I.E.E., has been appointed to the Readership. Mr. Cherry was attached to the Telecommunication Research Establishment of the Ministry of Aircraft Production during the war period and is known particularly for his contributions to the subject of electric circuit analysis.

OBITUARY

Philips Electrical Ltd., regret to announce the death of Mr. Robert Ernest Gale, Manager of the High Frequency and Instrument sections at the company's works in Aboyne Road, Tooting.

Mr. Gale, who was 47, was admitted to Caterham Cottage Hospital early this year. He was transferred to Guy's Hospital for an operation about two weeks before his death.

He joined Philips twenty years ago, starting as an assistant in the radio department.

TIME SAVING TIPS

—*for Constructors*

Everyone who uses "surplus" gear soon accumulates a goodly collection of nuts, bolts and washers. Not only are these of all shapes and sizes, but also are likely to have two different types of screw-thread—British and American.

In the larger sizes of screw or bolt, it is easy to tell the difference between the two threads at a glance. In the smaller sizes, however, it is

W. OLIVER
G3XT

describes three useful pointers on NUTS and BOLTS

difficult. And in the case of nuts, especially small nuts, it is almost impossible. So you select a nut at random and try it on a bolt to see if it fits. A misfit may be obvious at once; but more often it will run on about three turns before the thread jams. You find you are trying to "marry" an American nut to a British bolt, or vice versa, and the two screw-threads are temperamentally incompatible.

The trouble usually arises from throwing all the nuts into one box and all the bolts into another. I made this mistake myself, and you would scarcely credit the amount of time that I have been forced to waste in finding the right nuts to fit the bolts. It would have been far quicker to have spent a few extra minutes, when originally dismantling the various items of ex-Service gear, in screwing each nut back on to its appropriate bolt. But you can profit by my experience and take this simple precaution in future, if you have not already thought of it or found it out by exasperating experience!

Another useful tip is to toss the nuts and bolts into a suitable solvent to get rid of the various sticky messes that the manufacturers of Service radio equipment were so fond of painting over nuts and bolts to prevent them coming unscrewed accidentally through vibration, etc. These prevent the nuts running on freely when re-using the parts, and waste time by forcing you to use a spanner instead of just running the nut on quickly with your fingers.

Although the time wasted over one individual bolt and nut is trifling, it adds up in the aggregate to, literally, *hours* if one is doing a lot of constructional work.

Finally, another tip from experience: when bolting components to a metal chassis, I find that it is quicker and neater to tap the holes for the fixing bolts than to use nuts. If you first drill all the holes, then place a suitable tap in the drill-chuck instead of the bit, you can (with care) tap all the holes very quickly. A locking-washer under the head of the bolt keeps it secure. One is spared the trouble of running on nuts in awkward places under the chassis; and if at any time you want to remove any of the components or change them experimentally, dismantling is quicker and easier with the threaded holes than when one has to undo nuts.

In constructional work, it is usually the little fiddling, trifling jobs that waste time; so take care of the minutes, and the hours will take care of themselves!

Hogwash-Major calling !

Your Editors always have a nice fat mailbag. We get all sorts of letters. But the other day we had something a little different. It was signed by J. Jorum, Hon. Sec. SDER (H-M) and we feel that readers will be highly interested in the activities of this hard-bitten secretary's radio club. We have no further comments! (*N.B.:—Space permitting, the saga of Hogwash-Major will be continued month by month*).

Myrtle Cottage,
Hogwash-Major.
July, 1949

Dear Sir,

As no doubt many readers of the technical press are already aware, we in Hogwash-Major have decided to inaugurate a select society, the purpose of whose existence is the enquiry into the various phenomena associated with the science of radio in addition to the correlation and subsequent publication of any outstanding discoveries encountered by us during our experiments.

With this end in view the official inauguration of the Society for the Development of Electronic Research (Hogwash-Major) was recently carried out here.

The Founder members present were Mr. Wellington Pitmarsh (F'l'd., A.M., Brit. I.R.E.), who was elected as President, Lieut. Jonathan Needy (ex R.N.), Treasurer, and the Secretary.

Despite the fact that membership of the Society was of a strictly limited nature, in actual fact it was found extremely difficult to obtain any members at all. Nevertheless, after a certain amount of quiet canvassing the Society now has a Junior Section, consisting of Master William Westinghouse who is apparently very much *au fait* with the latest developments of electronic technique and talks extremely learnedly of cavity magnetrons and the like (much to the discomfort of his senior members).

We also have, despite the strong objections of the Treasurer, a Female Member, Miss Lavinia Twittering, who, while frankly owning to a very sparse knowledge of radio, states that she is only too, too willing to learn.

After the official business of inauguration had been completed a survey was made of the equipment at present available. This had been contributed by members and consisted of a somewhat early crystal receiver, a five valve straight set with four neutralised-triode RF stages, a moving-iron loudspeaker movement, and an enormous 20 kilowatt spark transmitter. This latter had apparently been purchased by our ex-Naval member at Portsmouth Dockyard " for a song."

The literature available proved to consist of a 1923 edition of the Admiralty Handbook, several bound volumes of " Popular Wireless," a copy of the works of Percy Bysshe Shelley, erroneously contributed by our Female Member, and a sixpenny booklet describing the installation of electric light fixtures.

It was found, however, that the Junior Section of the Society was in possession of many excellent books and treatises, in addition to a very large stock of components, tools and equipment, all of which were in perfect order. It was then proposed by the President that all the available gear and literature should be immediately presented to the Society without reserve. This proposal was carried by four votes to one.

The future activities of the Society have not as yet been fully worked out, although the Junior Section has already decided upon setting up equipment to check the figures recently obtained in Australia concerning the time taken for centimetre pulses to travel to and from the moon.

A full report on the further activities of the Society will be submitted in a month's time.

Until then I remain,

Yours sincerely,

J. Jorum, Hon. Sec. S.D.E.R. (H-M).

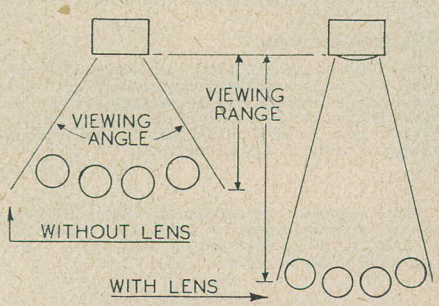
THE TELEVISION LENS

An article for those contemplating the addition of a magnifying lens to their televisors

By P. MANSFIELD

THE need for bigger and yet bigger screens on television receivers has always been felt, but the difficulty always has been the steep rise in costs associated with increased tube size, besides the difficulties incurred with the greater EHT and scanning amplitude requirements. Lenses of one sort or another came early to mind, but no material suitable for a lens was really a commercial proposition. Comparatively recently, however, the liquid-filled lens has come on to the market. Much experiment and planning was required to produce an article which would give the best service at the best price. Many different firms have had a dabble, some using mineral oils for their liquid, some using concoctions of their own making, many using liquid paraffin, and not a few using pure and unadulterated tap water. The snag of the early lenses was a strong tendency to discoloration and even to-day there are lenses on the market which will turn yellow after about two months if left exposed to sunlight. Whatever the means of construction, however, the end has always been the same—various efficiencies but almost uniformly high cost.

Are these magnifying lenses worth while? I am asked that question many times daily and my answer is always the same. Yes, definitely. Although I know that technically it is an impossibility, a lens definitely appears to give a slight "depth" to a picture. There is the feeling that the scene which you are viewing is almost three dimensional. Slight distortions which there may be on your screen are not accentuated by a lens, rather they seem to be ironed out, to blend better with the whole. The most frequent objection to a magnifier is "I've been told that it distorts if you sit at the side." Perhaps it does. But who will go to an ordinary cinema and occupy a seat at the side when it is possible to sit in the centre block? "But then not so many can view the screen." There is an answer to that too. With an enlarged picture, viewers may sit further from the set, so that, although the viewing angle may be lessened, the total space available is as big as ever. The diagram will clarify this.



A sketch showing the relative viewing angles and distances with or without a lens fitted. The angles are exaggerated and with a good lens an inclusive viewing angle of up to 70 degrees can be obtained.

Having stated that a lens is advantageous, we come to the only fly in the ointment, the inflated price.

A range of lenses now obtainable is of particularly good construction, and instead of the usual arrangement of a bulb and back-plate in separate mouldings cemented together, the bulb and flange are made in one pressing, then cemented to a sturdy back-plate, lessening considerably the chance of fracture. They are of exceptional clarity and a wide viewing angle has been maintained.

These lenses are now being distributed by Duke & Co. of 219, Ilford Lane, Ilford, Essex. By purchasing a factory's entire surplus stock they are able to be offered at less than half normal price. 9″ and 10″ sizes retail at 50/-, 12″ size at 59/-, and a special 6″ type for VCR97, etc. at 25/-. Post extra. These lenses are the product of a reputable manufacturer, but to avoid embarrassment to the dealers holding stocks at higher prices, the name will not be divulged.

For Your Reading

MAGAZINES.

"Radio Constructor."

Published monthly and designed to cater for the home constructor, giving details of receivers, transmitters, test gear and other radio equipment. Price 1/3 monthly.

"Television News."

Published monthly for the viewer. *Television News* gives details of forthcoming programmes, criticisms of past features, articles on stars and personalities of television and details of the latest developments both at home and overseas. Essential to the keen viewer. Price 1/- monthly.

"Short Wave News."

The third of our magazines, catering for the "DX" fan. Up-to-date news of VHF, broadcast band and amateur activity are published in each issue in addition to constructional articles, exclusive news of the International Short Wave League, "visits" to ham shacks and other features of interest to the short wave enthusiast.
Price 1/3 monthly

These magazines are distributed through local booksellers. A limited number of annual subscriptions can be accepted, but please write first for confirmation. Sample copies will be sent on request.

OTHER PUBLICATIONS.

The World Radio Handbook.

This beautifully produced handbook gives extensive information of interest to broadcasting station listeners. It includes details of all the chief broadcasting stations in the world, such as frequencies, call-signs, times of transmission, type of programme, the postal address, hints on identification and the stations attitude to listener reports. This veritable mine of information is a "must" for broadcast listeners. Price 6/9 post paid.

"These You Can Hear."

This booklet, well illustrated and printed on art paper throughout, was published to afford an opportunity to those who had just decided to take up the hobby of SW listening. Containing information of how to tune in stations, when to listen, and details of many internationally known stations this booklet is ideal for those just starting the hobby and of great interest to those who have already been bitten by the bug. Price 2/3 post paid

Data Booklet No. 1.

The first in this series, this booklet deals with the now famous "Basic Superhet." It describes the construction of the basic receiver and various "add-on" units which may be added when the basic receiver has been built. Full coil and valve details are given. Price 1/2 post paid

Data Booklet No. 2.

Now in its sixth printing *Inexpensive Television* needs little introduction to readers of this magazine. Have you had your copy yet? Price 1/8 post paid.

Now in its sixth printing *Inexpensive Television* needs little introduction to readers of this magazine. Have you had your copy yet? Price 1/8 post paid.

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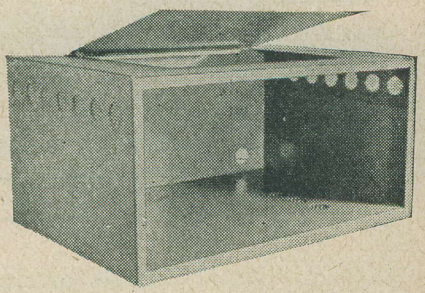

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