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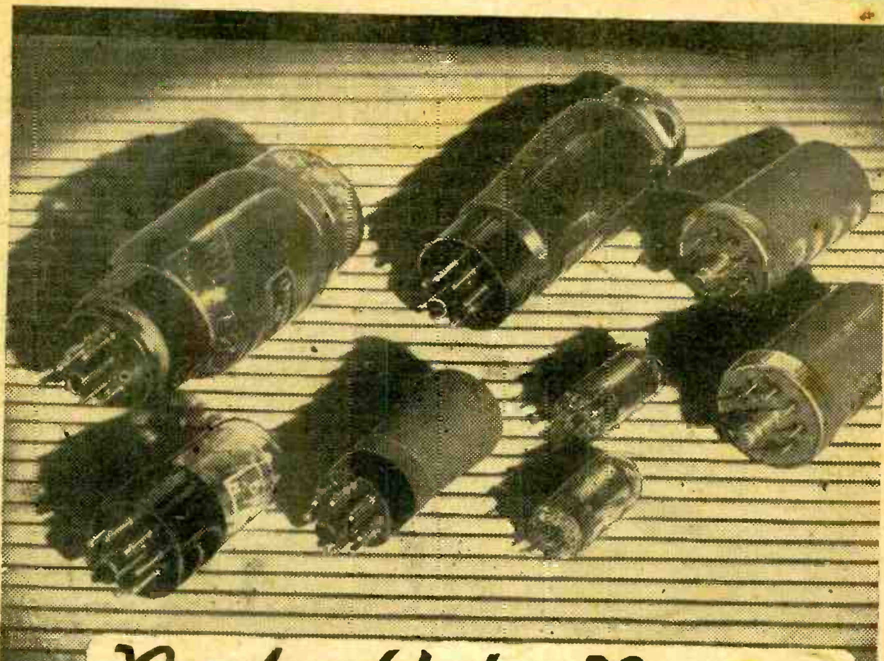
PRACTICAL WIRELESS

EDITOR:
F.J.CAMM



Radio Valve Review

CHIEF CONTENTS

Practical Wireless
18th YEAR OF ISSUE
EVERY MONTH.
VOL. XXVI. No. 528 JULY, 1950
Editor F. J. CAMM

COMMENTS OF THE MONTH

BY THE EDITOR

Outside Broadcasts

OUR sister service, television, is experiencing some of the difficulties which beset sound broadcasting in its early days. There has recently been formed an association for the protection of copyright in sport, and although discussions have taken place between the Postmaster-General and leading personalities in the sports world on the problem of the inclusion of sporting events in the B.B.C. television programmes, no one has pointed out that there is no copyright in such events, and it is a misuse of the term, which can only apply to manuscripts, printed matter, paintings and other permanently recorded matter. Although the question has been raised in connection with television, it is similar to that applying to outside broadcasts in the sound service, and if the B.B.C. give way on television it will have to do so on those.

The B.B.C. is in a difficult position. It is obviously more profitable to a promoter to draw fees from three hundred and fifty thousand viewers, than from fifty thousand people at, say, the ringside, and the B.B.C. therefore would merely be acting to enhance the profits of those promoting these outside events. On the other hand, the very topicality of some events renders necessary their inclusion in the programmes. The promoters argue quite wrongly that their gate is destroyed by these outside broadcasts, but statistics are not produced in support of this claim. A very high proportion of those who look in to a boxing match or to a race meeting would not go to such meetings anyway, either because of distance or of expense.

The Postmaster-General described the problem as one of far-reaching importance which extended to every field of social activity, and, after reviewing the bearing of the problem on the many interests involved, expressed the wish to see an increase in the volume of sports television to the general public in their homes through the B.B.C.'s television service. The representatives of sporting associations stated that their legitimate civil interests must be protected by a copyright or other legal safeguard, and the Radio Industry Council stressed the urgency of finding a solution to help British trade. The Postmaster-General gave an assurance that no licences would be granted permitting the televising of sporting events in places of entertainment without prior consultation with the promoters. It is important for the public to know that there is not a ban on the showing of sporting events in the television programmes. There is bound to be an interval before the Beveridge Broadcasting Committee Report, and the time might be used for the televising of additional experimental sports items in order to gather experience of the real effect on all interests of allowing sporting events to be televised.

Clearly the promoters of sports meetings should only be interested in the loss they may possibly suffer as a result of their events being televised, since they have based their profits on an expected gate. They should not seek to make a profit out of the work of the B.B.C. in bringing such events to the notice of a wider public. Indeed, as in the case of gramophone records, the televising of such events will result in an increase in the number of people who will visit them, and we think that the fears of the sports promoters are groundless. It is right that they should receive some payment, but it should not be based upon the number of people who look in, and in any case the fee should be limited to the estimated loss involved.

We agree, therefore, with the Postmaster-General that the period which must elapse before publication of the Beveridge Report on broadcasting should be used by both sides as an experimental period so that knowledge can be gained as to whether the attendances at sports meetings are affected by their being televised. It would be dangerous to make any agreement with sports promoters until experience is gained. Otherwise it would pay a sports promoter to concentrate on the fees he would receive from the B.B.C. and not to worry about selling tickets for the event, using this as an argument indicative of the loss of gate he has sustained as a result of the event being televised. The Postmaster-General will be well advised to make quite certain that such television programmes do not develop into a sports promoters' racket as it might easily do.

F. J. C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended March 31st, 1950.

Region	Number
London Postal	2,326,000
Home Counties	1,637,000
Midland	1,719,000
North Eastern	1,877,000
North Western	1,589,000
South Western	1,015,000
Welsh and Border Counties	723,000
Total England and Wales	10,922,000
Scotland	1,119,000
Northern Ireland	202,000
Grand Total	12,243,000

The above total includes 345,100 television licences.

Radio Industries Club

AT the 19th Annual General Meeting of the Radio Industries Club, held at the Connaught Rooms, London, on Tuesday, April 25th, Mr. Norman Collins was unanimously elected President of the Club for 1950-51. Mr. Collins, Controller of Television of the British Broadcasting Corporation, took over the Presidency from Lord Burghley, K.C.M.G., at a luncheon which followed the annual meeting.

During the course of the luncheon a President's Microphone, to be used at all future meetings of the club, was inaugurated. The microphone is mounted on a specially designed table stand representing a lattice aerial mast, and at the base of the stand the names of the the presidents and chairmen of the club to date are engraved. The microphone and stand are entirely gilt.

A ballot to fill five vacancies on the committee of the club resulted in the following members being elected: Messrs. A. J. Dew, H. de A. Donisthorpe, W. E. Miller, W. G. J. Nixon and Owen Pawsey.

At the first meeting of the new committee held after the luncheon the following officers were elected for 1950-51: Chairman, Guy R. Fountain; Vice-chairman, J. G. G. Noble, M.C.; Honorary Secretary, W. E. Miller; Honorary Social Secretary, F. H. Robinson; Honorary Treasurer, Owen Pawsey.

H.M.V. Staff Appointment

MR. GEORGE CLIFFORD has been appointed to the post of Sales Representative of "His Master's Voice" Radio and Television Sales Division.

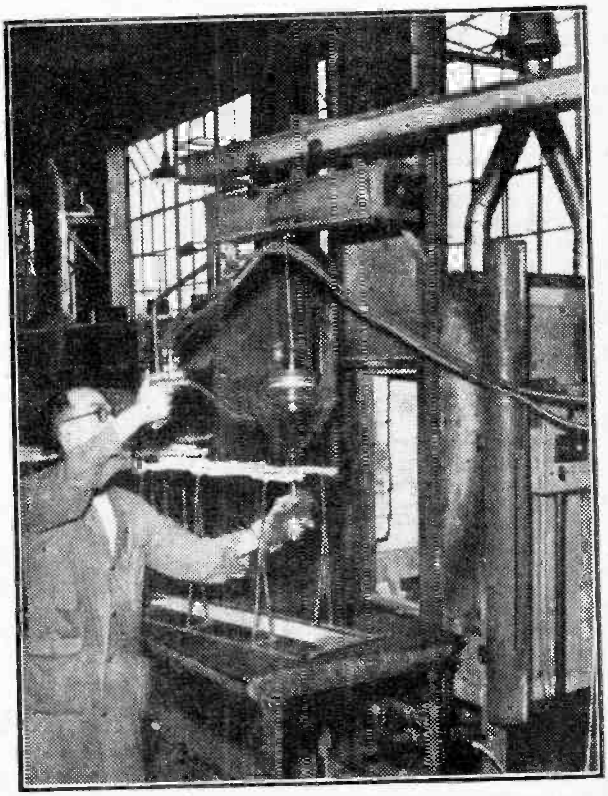
Previous to this appointment he has been assistant to Mr. Lawson, "H.M.V." Television Manager.

George Clifford has had a long association with the company dating from 1931 and broken only by the recent war. He served with the Royal Navy from 1940-1946 and left with the rank of Lieutenant.

Broadcasting Committee

THE Broadcasting Committee, under the Chairmanship of the Rt. Hon the Lord Beveridge, K.C.B., F.B.A., heard oral evidence on May 4th, 1950, from representatives of the British Council of Churches.

The Committee heard evidence on May 5th, from representatives of Undeb Cymru Fydd, from representatives of the National Institute of Adult Education (England and Wales), from representatives of the Ministry of Education and the Scottish Education Department and from representatives of the B.B.C.



Part of the new equipment recently installed by Mullards for speeding up picture tube manufacture.

Engineer-in-charge, Norwich

MR. E. N. B. HAMMOND has been appointed Engineer-in-Charge of the B.B.C.'s Norwich transmitting station, which was opened last year.

During the sixteen years that he has been with the B.B.C., Mr. Hammond has had a wide experience of transmitting stations. From 1943 to 1947 he was Engineer-in-Charge of the Clevedon station, near Bristol, after which he was transferred to Daventry, where he was in charge of the short-wave aerial system.

Argentine

THE Marconi Company have again received an important contract from abroad, this time for two 100 kW. medium-wave transmitters for the Argentine Government. They are to be installed near Buenos Aires.

Pigeon Guard

THE American authorities have stopped the roosting of pigeons in the columns of the State Education Building in Albany, New York, by electronic means. A series of porcelain terminals have been strung on wires and placed on ledges and cornices, and an R.F. pulse is sent through them. As a result a pigeon entering the field gets a shock which although not harmless prevents him from remaining. As a result the entrance to the building is now kept clean.

B.B.C. Enquiry

AS a result of a complaint that the B.B.C. gives preference to certain artists to the exclusion of others, documents sent to the Governor-General by an M.P. have been passed on to the Director of Public Prosecutions to consider what action, if any, should be taken in the matter.

Phototelegraph Service

CABLE and Wireless have recently opened a direct phototelegraph service between Athens and New York. This is, we believe, one of the longest routes in action for this type of service.

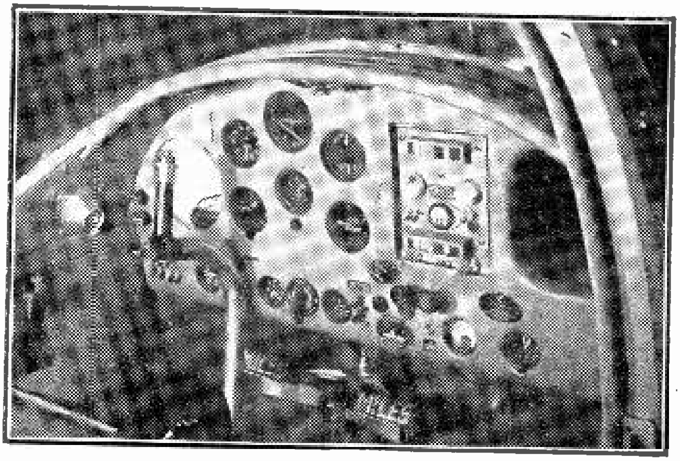
Brussels International Aeronautical Exhibition—1950

A V.H.F. transmitter, H.F. and V.H.F. fixed frequency receivers and a V.H.F. transmitter-receiver represent the Plessey range of communications equipment on the stand of Plessey International, Limited, at the above Exhibition.

Designed originally to meet airport local control requirements, and with a carrier power output of approximately 12 watts, the V.H.F. fixed frequency transmitter, Type P.T.10, provides R.T. communication in the 118-132 Mc/s. band. Within these limits, the crystal controlled operational frequency may be varied by the insertion of the appropriate crystal, it being then necessary only to tune for a minimum or maximum meter reading, according to the stage concerned. The complete equipment, consisting of a modulator and an R.F. unit is conveniently mounted for desk operation, but may be rack mounted, with a suitable receiver and loudspeaker unit, to form a complete transmitter-receiver installation. Operation is extremely simple, and frequency stability complies with international requirements.

B.B.C. Producer Resigns

HENRY CALDWELL, B.B.C. producer, best known probably for his television "Cafe Continental" series, is leaving the B.B.C. at the end of June. No reasons have been given at the time of going to press and his future activities have not yet been disclosed.



A Plessey V.H.F. transmitter-receiver, type P.TR. 61, installed in a privately-owned Miles Gemini aircraft.

British Standard

A REVISED Standard has just been issued for two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors. The number is B.C. 546 : 1950 and costs 3s. post free.

Mullard Lectures

A SERIES of four lectures on industrial electronics is being given by the staff of Mullards at the Engineering Centre, 351, Sauchiehall Street, Glasgow, C.2. The first was on May 11th on "Ultrasonics"; the second, on June 8th, is on "Some Industrial Measuring Instruments"; the third, on September 14th, will be on "Photo-electric Devices" and the last, on October 12th, will deal with "Vibration Test Methods and Measurements."

Tape Recording Equipment

Main Details of This New Method of Making Sound Records

By K. KEMSEY-BOURNE

TAPE recording has a number of advantages over other methods, especially for amateur use. One valuable point is that an unsatisfactory recording can be erased from the tape so that the tape may be re-recorded, and this record/erase cycle can be repeated any number of times without any harm to the medium. Tape is capable of excellent quality with low background noise, and will run for long periods or even continuously.

The drawbacks of the tape system really affect commercial users more than amateurs. For example, mass production of tape recordings is not yet an economic proposition. Again, it is not easy to pick out short sections of a long recording, which must be possible for certain broadcasts. In a recent enquiry among American radio and recording engineers, 300 replied "No" and 80 said "Yes" to the question "Do you believe that tape recording will eventually supplant disc recording?" (for broadcast and transcription use, that is).

The design of tape recording equipment presents an array of interesting problems, and to some extent these interlock. Summarised briefly, a complete system is made up of the following components:—

1. The tape.
2. Magnetic heads for recording, reproducing, erasing.
3. Suitable tape driving mechanism—motors, capstans, etc.
4. Amplifying equipment, equalisers, microphones, loudspeakers, oscillators, power supplies, volume indicators and other accessory equipment.

These various sections all influence one another, and their design considerations are not altogether separable.

The Tape

This, the actual recorded medium, obviously plays a major part in determining the effectiveness of the system. Tape should have a high remanence, to ensure satisfactory signal/noise ratio; in practice the figure ranges between 300 and 700 gauss. Then a high coercivity is required—the higher the better for good high-frequency response—but this has to be compromised, since high coercivity makes subsequent erasure more difficult, and something between 250 and 500 Oersteds is usual.

As far as handling is concerned, the tape should be smooth, strong and uniformly dimensioned, stable and incorrodible under normal conditions. It should be easy to cut and splice, not too springy to spool easily, and compact for storage. Its magnetic properties must be homogeneous, and there must be a minimum possible tendency to transfer recorded signals on to adjacent layers of tape.

On top of this, it should be cheaply made in bulk! Coated plastic tape has replaced the old metal Blattner tape.

Powder Coatings

The magnetic material is prepared in the form of small particles, about a micron in diameter (40 millionths of an inch), mixed with a binding lacquer and applied to the base. It is possible to produce synthetically magnetic materials, such as the red and black iron oxides (gamma— Fe_2O_3, and Fe_3O_4), in the form of small particles. Reduced iron, made by way of the carbonyl process, is another suitable material.

Good dispersion of the magnetic particles through the binding lacquer is essential. Magnetic material represents some 25-30 per cent. of the total coating. Cellulose esters, such as the nitrate and acetate, and polyvinyl compounds, are used to make the lacquers.

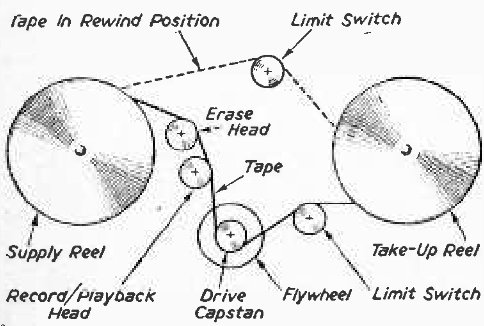


Fig. 1.—Typical layout details of a tape-recorder deck.

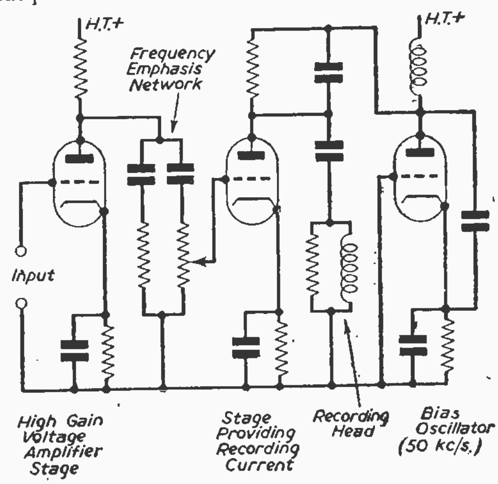


Fig. 2.—Simplified circuit diagram of recording amplifier, giving the required pre-emphasis.

Tape Base Materials

In selecting the base, conflicting requirements have to be considered. If the tensile strength is low then the cross-section of the base must be increased, making volume per unit of playing-time high. The base must be smooth, flexible, not self-adhesive, and stable under temperature and humidity changes, all of which means that plasticisers must be very carefully chosen. Plastics (and sometimes paper) make good bases.

The base is usually made in wide rolls and cut into narrow ribbons of the required width. Tape is usually ¼in. wide. 0.002in. thick, and spooled in lengths of 600, 1,200 and 3,200ft. With a well-made tape a signal/noise ratio of 60 decibels is obtainable. Homogeneous, impregnated tapes can be used for recording, but these are more liable to produce off-set noises on adjacent layers than are coated tapes.

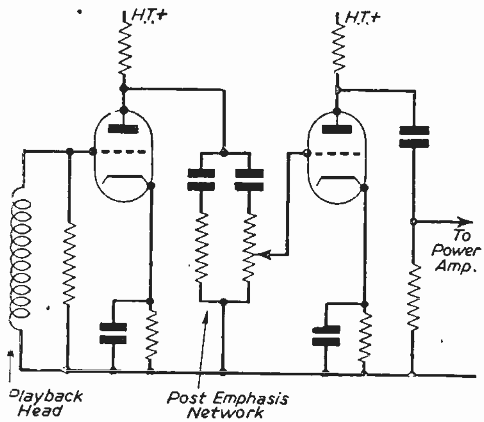


Fig. 3.—Simplified circuit diagram of play-back amplifier, with post-emphasis. Note the similarity to Fig. 2, which means that the same general circuit can be used, with equalising circuits operated by change-over switches.

The Design and Uses of Heads

Although it is possible to design a single head to perform all three functions of recording, reproducing and erasing, it is preferable to have separate heads for each operation, and, in fact, it is essential if high-quality work is to be done. The reason for this will soon appear.

Direct-current Erasing

All that is needed to erase a tape recording is a magnetic force of strength sufficient to saturate the recorded medium in the right direction. A suitably placed bar-magnet will, in fact, serve, and magnets are fitted on a number of commercial tape recorders. Alternatively, a solenoid, fed by D.C. current, can be used. The solenoid can be switched on or off as required; the bar-magnet needs to be moved into action mechanically.

The erasing field must in any case be of opposite polarity to the recording bias field used: for example, if the bias current made the contacting pole of the bias-head a north pole, then the erasing head must act as a south pole.

Alternating-current Erasing

A standard method of demagnetising any ferro-magnetic material is to put it in an alternating magnetic field and then gradually reduce that field to zero value. That is the basis of A.C. erasing, although with tape there is the complication that the material to be de-magnetised is moving fairly fast. This means that dimensions have to be worked out carefully, so that the design of an A.C. erase-head is more complex than for a D.C. head.

As before, the tape is subjected to an A.C. field that must initially be powerful enough to saturate the medium. This field now has to decay to zero during subsequent reversals of the field, so that the frequency of the erasing field controls the necessary effective length along the tape of the field. Too low an erasing frequency would not subject the tape to enough decreasing reversals of the A.C. field to ensure complete erasure of the signals on the tape.

Head Requirements

An erasing head may, with advantage, set up a diffused field, but the opposite holds for recording and reproducing heads. It is good practice to have a separate erase head even if the same head is used both to record and reproduce; this is done extensively on economic grounds.

Again for economic reasons, it is convenient to use the same frequency for A.C. bias (at the time of recording) as for A.C. erasing, since this means building only one oscillator. The erasing frequency cannot be allowed to become too high, as hysteresis and eddy-current losses become serious and it is difficult to maintain a strong enough erasing field under the diffused conditions.

An erasing head operated on 50 cycles (mains frequency) can be used, provided the dimensions of the applied field are made sufficiently large. This is not normally done, because it becomes difficult to erase and record simultaneously: the 50 cycle field leaks badly unless very good magnetic shielding is available.

If the tape is allowed to pass a series of bar magnets of decreasing pole-strength and alternate polarity, N-S-N-S, etc., this gives the effect of A.C. erasure without the use of an oscillator or energised head. As with D.C. magnet erasing, a suitable mechanical gadget must be provided to swing the magnet system into position when wanted, and—equally important—to keep it well out of the way during play-back.

Recording Heads

For these the field must be sharply defined, and losses must be small. The field/current relationship must be linear. As in the case of disc-recording heads and pick-ups, the resonant frequency must be high, preferably above the frequency of any A.C. bias used.

Obviously the head must make uniformly close contact with the passing tape. Pole-piece and eddy-current losses are kept down by constructing the poles of insulated laminations and by using low hysteresis alloys, such as Mumetal and Permalloy.

Play-back Heads

The important thing here is shielding. Erasing and recording heads themselves generate a field far greater than any external field, but the varying field generated by the tape on the play-back head is very small indeed and can easily be interfered with if good shielding is not fitted. Mains hum induced from drive-motors, power transformers, etc., can be very troublesome, just as it is with

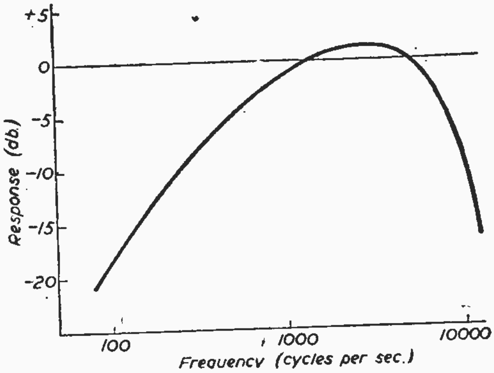


Fig. 4.—Typical tape characteristic for constant current recording.

high-gain amplifiers in other applications. External effects can be minimised by careful placing and orientation of the play-back head. Although it is possible to use hum-bucking coils built in to the play-back head, this is not recommended, and there is no real substitute for efficient magnetic shielding.

Small D.C. fields at the play-back head lead to a rise in noise level, which means that precautions must be taken to prevent the pole-pieces from becoming permanently magnetised.

The same remarks, on small gap, low losses, resonant frequency and contact with the tape, as for record heads apply.

Drive Mechanisms

The tape must be wound past the heads at absolutely constant linear speed, and this speed governs the frequency response possible. In most cases the tape passes round a capstan driven by a constant-speed motor through a flywheel.

Fast re-wind is desirable, unless two tracks are put on the same tape in opposed directions.

Other Equipment

A magnetic recording does not have a linear frequency response characteristic, and correction circuits must be included in both recording and play-back amplifier circuits to provide equalisation. The amplifying gear must also provide bias and erase currents; as mentioned above, these can be obtained from the same oscillator, which can be of the Colpitt's type, and 50 k/cs. is a typical figure.

The design of the amplifiers depends almost entirely on the medium and magnetic heads to be used, so that full information must be either obtained from the manufacturers or worked out empirically.

Appendix of Addresses

For the benefit of experimenters who are having difficulty in obtaining parts or tape, here is a list of some of those firms who can supply equipment and information on it.

Audigraph, Ltd., 7, St. Peter's Place, Broad Street, Birmingham 1.

Burland Radio Accessories, 4, Carlton Terrace, Portslade, Sussex.

Bristol Cine Service, 33, Alma Vale Road, Bristol, 8.

Judge Industries, 676-678, Romford Road, Manor Park, E.12.

Morecambe Sound Service, 4, Green Street, Morecambe.

R.H. Electronic Service, 93-95, Button Lane, Sheffield.

Several of these firms market complete tape-decks, with all heads, motors, pulleys, etc. Messrs. Wright & Weaire, Ltd., 138, Sloane Street, London, S.W.1, market their own twin-track "Tape-Deck" recorder, less amplifier, and Messrs. Boosey & Hawkes market a complete self-contained wire recorder.

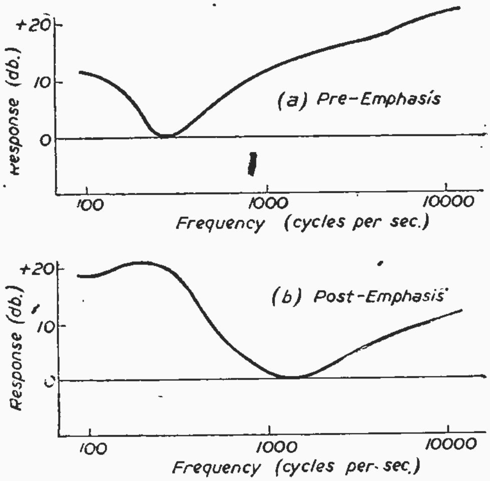


Fig. 5.—Typical amplifier response characteristics required for (a) recording, (b) play-back to give maximum signal/noise ratio. Exact curves depend on tape used, tape speed, and design of heads.

Radio Valve Review—4

The Subject This Month is the Diode and Double Diode

THE term "diode" applies to any two-electrode valve, but in everyday practical language those diodes which are designed for use as power rectifiers are usually termed "rectifiers" and the word "diode" is artificially restricted to two-electrode valves intended for use as detectors or for such purposes as A.G.C. rectifiers where the amount of power handled by the valve is very small. It is in this restricted sense that the word "diode" is used in this article.

Applications of the diode will be restricted to those already mentioned—detection and A.G.C. It is true that a diode can be used as a mixer valve, and valves in which a diode element is combined with a triode oscillator, forming a complete frequency changer unit, are available. But this application, although used in certain V.H.F. service equipment, is not normal radio or television practice.

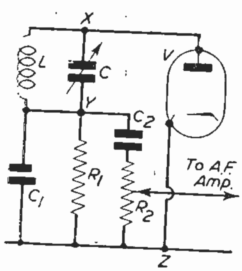


Fig. 1.—Basic circuit of the diode when used as a speech detector.

Fig. 1 is a basic circuit for a diode used as a speech detector. L.C. is a tuned circuit—usually the secondary of the last I.F. transformer (or the output circuit of the final R.F. stage in a T.R.F. receiver). Across the points XY, therefore, is developed an H.F. voltage bearing the programme modulation. This voltage is applied to the detector stage which consists of the diode V in series with the complex network between the points YZ. This network comprises the diode load resistor R1, shunted by C1 and also by the potentiometer R2 and capacitor C2 in series.

As a result of the rectifying property of the diode, the diode current consists of unidirectional pulses corresponding to the positive half-cycles of the modulated H.F. signal, and can be considered to be equivalent to a direct current modulated by the A.F. programme and by a H.F. ripple. The values of R1, C1, R2 and C2 are so chosen that the H.F. ripple is by-passed through C1 and the A.F. modulation through C2 R2, while the direct current component flows in R1. The A.F. signal, therefore, appears across R2, which is a variable potentiometer whereby a signal of suitable strength can be tapped off and transferred to the A.F. amplifier stage. R2, of course, acts as a volume control.

Weak Signals

The diode detector, now almost universal practice in radio reception, is a considerable improvement upon the triode or pentode detector so far as distortion is concerned. It is, however, not a perfectly distortionless detector. In common with all other thermionic valves, the internal resistance of the diode is not of constant value for all values of applied voltage, and the relation between internal resistance and anode voltage is not a simple one. As a result, a diode shows considerable distortion on weak signals, and noticeable distortion with strong signals if deeply modulated.

If, however, the H.F. amplification is sufficient to supply a signal greater than 1.0 volt, distortion at normal modulation depths will not be noticeable.

The second application of small diodes is for automatic gain control. A complete description of A.G.C. in all its various forms is outside the scope of this article, and it must suffice to illustrate a basic circuit for delayed A.G.C., that is to say, an A.G.C. system in which, although the grid bias to the controlled valves is increased (and their gain therefore reduced) as the signal input increases, the control does not take effect until the signal input exceeds a pre-determined value. By this means weak signals, up to a certain strength, are amplified to the full capability of the receiver.

Such a circuit is illustrated in Fig. 2. Here, V1 is the final I.F. amplifier and V2 a double-diode, comprising two diode sections with a common cathode. Diode d' is the detector, and the network C1, R1, C2, R2 will be recognised as identical with that in the basic detector circuit of Fig. 1. Diode d'' is the A.G.C. rectifier and its anode is fed with a modulated I.F. signal taken from the primary of the final I.F. transformer via capacitor C3 which isolates the A.G.C. circuit from the D.C. high-tension supply. This modulated I.F.

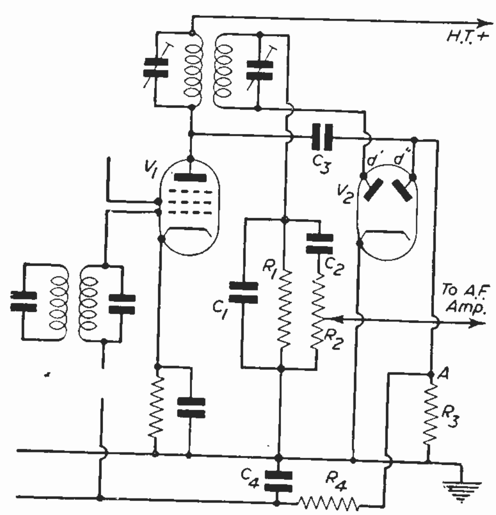


Fig. 2.—A double diode in a circuit providing demodulation and A.V.C.

signal is rectified by diode d", and a unidirectional voltage therefore appears across the load resistor R3. The negative potential at point A varies with the signal strength and is available as additional grid bias for the variable-mu valves in the diode should not be less than 1.0 v. r.m.s. if reasonable quality is required.

Obviously the normal radio receiver will give at least this signal voltage at the detector for all worth-while stations and very considerably more

DIODES AND DOUBLE DIODES

FOR MULTIPLE VALVES, DATA IS FOR DIODE SECTIONS ONLY

In each case of multiple valves the diode to be used as detector is at the negative end of the filament.

Type	Description	Construction and Base	Vf (V)	If (A)	Va mx. (V)	Ia mx. (mA)
	Mullard (1) **BATTERY Equipment Types**					
DAC32	Diode triode	Octal	1.4	0.05	110	—
DA90	Single diode	All glass B7G	1.4	0.15	330 (P.I.V.)	0.5
DAF91	Single diode A.F. pentode	All glass B7G	1.4	0.05	—	—
KBC32	Double diode triode	Octal	2.0	0.05	—	—
	Maintenance Types					
TDD2	Double diode triode	5-pin	2.0	0.1	—	—
TDD2A	Double diode triode	5-pin	2.0	0.12	—	—
2D2	Double diode	5-pin	2.0	0.09	125	0.5
	(2) **A.C. Equipment Types**		Vh (V)	Ih (A)		
EBL21	Double diode output p'nt'de	All glass B8G	6.3	0.8	200	0.8
EB34	Double diode	Octal	6.3	0.2	200	0.8
EBC33	Double diode triode	Octal	6.3	0.2	200	0.8
EBL31	Double diode output p'nt'de	Octal	6.3	1.2	200	0.8
EAF42	Diode-H.F. pentode	All glass B8A	6.3	0.2	200	0.8
EB41	Double diode	All glass B8A	6.3	0.3	150	9.0
EBC41	Double diode triode	All glass B8A	6.3	0.225	200	0.8
EAC91	Diode triode	All glass B7G	6.3	0.3	50	5.0
EB91	Double diode	All glass B7G	6.3	0.3	200	9.0
	Maintenance Types					
EB4	Double diode	Side contact	6.3	0.2	200	0.8
EBC3	Double diode triode	Side contact	6.3	0.2	200	0.8
EBL1	Double diode output p'nt'de	Side contact	6.3	1.2	200	0.8
2D4A	Double diode	5-pin	4.0	0.65	200	0.8
Pen4DD	Double diode output p'nt'de	7-pin	4.0	2.25	200	0.8
TDD4	Double diode triode	7-pin	4.0	0.65	200	0.8
	(3) **D.C./A.C. Equipment Types**					
CBL31	Double diode output p'nt'de	Octal	44.0	0.2	200	0.8
UBL21	Double diode output p'nt'de	All glass B8G	55.0	0.1	200	0.8
UAF42	Double diode H.F. p'nt'de	All glass B8G	12.6	0.1	200	0.8
UB41	Double diode	All glass B8A	19.0	0.1	150	9.0
UBC41	Double diode triode	All glass B8A	14.0	0.1	200	0.8
	Maintenance Types					
CBL1	Double diode output p'nt'de	Side contact	44.0	0.2	200	0.8
2D13A	Double diode	5-pin Side contact	13.0	0.2	200	0.8
2D13C	Double diode	5-pin	13.0	0.2	200	0.8
PEN4-ODD	Double diode output p'nt'de	7-pin	44.0	0.2	200	0.8
TDD13c	Double diode triode	7-pin	13.0	0.2	200	0.8

H.F. amplifying stages to which it is applied via a suitable filter network R4, C4.

Delay Voltage

The "delay" feature whereby the A.G.C. bias is not effective until the signal strength exceeds a certain value arises from the fact that, owing to the rectifying action of the detector d[1], the cathode of V2 is maintained at a steady positive potential. Diode d", therefore, does not become conductive and no A.G.C. voltage is produced until the signal applied to d" exceeds the positive bias on the cathode.

Small diodes, suitable for use as detectors and A.G.C. rectifiers, are available in several forms. They may, for example, consist of a single diode unit, or of two diodes in a single bulb. In the latter form, the two diode anodes may be mounted one above the other on a common cathode, or two separate cathodes may be used, in which case it is usual for the two sections to have internal electrostatic screening to avoid interaction.

Again, one or two diode sections may be included in the same envelope as an H.F. pentode, a voltage amplifying triode or even an output pentode, thus making possible a variety of different detector-cum-A.G.C.-cum-voltage amplifying arrangements.

There is not much by way of operating conditions which can be tabulated for these small diodes. As previously mentioned, the input to a detector for the local station. As detectors these diodes work satisfactorily with a load of about 0.5 MΩ. For A.G.C. rectification the diode load is usually two or three times this value. The values chosen, however, depend greatly upon the circuit selected and the general design of the receiver.

For the rest, the only information needed to guide selection of a suitable valve is the heater or filament rating and the maximum anode voltage and current ratings. This information is tabulated above. For convenience and for the sake of completeness similar data is also given for the diode sections of multiple valves such as diode pentodes and double-diode triodes.

On your Wavelength

by THERMION

Arpertoonity Narks

IT came as a surprise to me to learn that the Criminal Investigation Department of Scotland Yard have been asked to investigate the reasons why this programme came off the air. It was run by Hughie Green. As the matter is, therefore, *sub judice*, I shall not comment on it except to say that if, as a result of these investigations, it does reappear in the programmes, the B.B.C. will insist upon the use of pure English, and correct pronunciation of English, for which purpose it set up a committee some years ago, composed largely of Welshmen and Scotsmen, to decide on the correct pronunciation of our language! It jars on my nerves when I hear the programme announced as "arpertoonity narks."

Incidentally, aren't we having too many programmes on the lines of Itma, Have a Go, arper . . . pardon, Opportunity Knocks, etc.? These programmes vary only in detail, the *raison d'être* being the wise-crack of which the artists get the credit which really belongs to the people who spend their lives hatching up wise-cracks, and retailing them to programme builders. More than half the credit for the success of the Itma programme belongs to Ted Kavanagh. The public, however, seem under the stupid impression that these quick-fire wise-cracks occur spontaneously to the artist before the microphone.

Like actors who can declaim, after months of rehearsal, the words of Shakespeare, but who are singularly tongue tied when called upon to make an extempore speech of their own, many of these well-known broadcasters seem bereft of ideas when they have to make a speech. They are, of course, sugary sweet in their platitudinous tritisms and sickly sentimentalities. All are aptly summed up in the phrase:

> Empty shells from eight to ten.
> Filled with the wit of other men!

D. Sisson Relph

THE death of D. Sisson Relph takes my mind back to the days when, as a boy straight from school, he came into my office as an office boy to learn the art of journalism. He was 45 years of age when he died. Graduating from office boy to editorial assistant he served the now defunct *Amateur Wireless*, and later became editor of the *Wireless Magazine*, also defunct. He later joined the Trader Publishing Company, where he edited the *Wireless Trader*, until at the beginning of the war he joined the R.N.V.R., in which he became a lieutenant. When he returned after the war, he was transferred to the book department of Iliffe and Co., and was responsible for the production of Technical Books.

R.T.R.A. Evidence

THE Radio and Television Retailers Association, which has made representations to the Beveridge Committee on broadcasting, has taken the unusual course of publishing the evidence it gave. From this it appears that they think that arrangements should be made for some form of commercial broadcasting independent of the present programmes. They think that this will provide healthy competition, and, therefore, result in improved programmes. As supporting evidence they say that in a recent poll, dealers were in favour of commercial broadcasting by nine to one. For some reason industry in this country has set its face against it. I know that on Sundays at least, before the war, more people listened in to Radio Normandy and to Radio Luxembourg than they did to the English programmes. But that was in the days of Reith, and those miserable Sunday programmes which he thought essential to the well being of the British soul. I wonder whether with our much brighter Sunday programmes people would still listen in to Radio Normandy and Radio Luxembourg? I doubt it. It is no use using the argument of 1939 to the conditions applying in 1950. I fail to see that the R.T.R.A. is a competent body to express an opinion on the matter. If they hope that such programmes will sell more radio sets, I demur. Such a system, however, would undoubtedly benefit the artists, since to-day the B.B.C. engage them with minor exceptions on take-it-or-leave-it terms. From this point of view the B.B.C. would have to enter into competition with the proposed commercial broadcasting station, presuming that it had an independent Charter. If, on the other hand, the B.B.C. also controlled commercial broadcasting, the B.B.C. policy would be bound to permeate the commercial programmes, and this would be a disadvantage. Unless commercial broadcasting can be run on absolutely independent lines and entirely divorced from the B.B.C., it would fail. The B.B.C. method of producing popular programmes of the type which would appeal to firms wishing to spend money on radio programmes is entirely wrong. The system seems to be, that someone puts up an idea for a regular programme. If it is approved he gets a fee for producing it, and can make his own arrangements regarding the cast. This has given rise to severe criticism in some quarters, the suggestion being that such producers do not select their artists by merit, but according to the rules of the Old Pals Act. In the past bribery and corruption has been hinted at.

I agree with the R.T.R.A., however, when they say that television should be run under a separate organisation and have no connection whatever with the sound services. It is that very connection, at the moment, which has prevented the more rapid development of the new service.

Radio Valve Faults

Types of Fault and the Process of Fault Finding in the Modern Radio Valve

FAULT finding in any form of apparatus can usually be simplified into direct action along fairly well-defined channels provided the construction and operation of the apparatus is properly understood. The ability clearly to understand what one is looking for and thereafter to undertake an investigation in a systematic manner not only saves considerable time but also produces that optimistic feeling of being well on top of the job that is of no minor importance in this type of investigation.

There is, however, considerable danger of deduction if the fundamental knowledge is over-simplified and it is well, therefore, in considering faults and fault finding in radio valves to have a basic understanding of their construction and the manner in which they function.

Fundamentally, the radio valve consists of some form of cathode which will emit electrons when heated, an anode which held at a positive potential to the cathode will cause a flow of electrons to it from the cathode, and one or more grids held at various and perhaps varying potentials to control the electron flow will then act as electrostatic screens.

To these we should perhaps add a heater which by the passage through it of a current of electricity will heat the emissive material composing the cathode and finally, in most types of valves, a vacuum to allow of the free passage of electrons without their being impeded by gas molecules with the resultant destruction of the desired characteristics of the valve.

The operating characteristics of the valve are determined by a combination of its electrical and geometrical design. As examples under the heading of "electrical" we might place the emissive material and the self-capacitance and inductance of the electrode system.

Under the heading of "geometrical" we could include such items as the physical design of the electrode system which would, of course, include the dimensions of the electrodes and spacing, the mesh of the grid and other such items. Mechanical features, such as the electrode supports, the base, etc., really come under both headings, but are not immediately relevant in this simplified analysis.

It is reasonable to state that if the geometrical characteristics of the valve remain unchanged and the emission, insulation, and vacuum are up to standard, the valve may be considered as in sound condition.

This, then simplifies our considerations of the form of tests necessary to check that a valve is in sound condition, and it is left to consider the faults under these headings that are more likely to occur.

Types of Test

It may be well at this stage also to differentiate between the types of test necessary for varying purposes.

A valve designer may be called upon to produce a valve to carry out a given function, and in such a case he will find it necessary to undertake measurements of a considerable degree of accuracy to ensure that the valve complies with the required characteristics.

The user of a valve, the correct characteristics of which are already published, will not usually find it necessary to make measurements to a similar degree of accuracy. His requirements are to make such checks as to ensure that the electrical and geometrical and mechanical properties remain sound and from this he is able to deduce that the valve is capable of fulfilling its operating requirements. Fortunately, in order to make such checks the test can be simplified and made comparatively speedy, an important matter for engineers engaged on maintenance routine.

The satisfactory operation of a valve in any particular piece of valve-operated apparatus depends not only upon the condition of the valve itself, but also upon the circuit in which it is used, the condition of the components in that circuit and even upon the physical conditions under which it is used in the apparatus.

Examples

A valve might, for instance, produce symptoms of microphony in a set in which its physical position was such that sound vibrations from the loudspeaker were directly impressed upon it. In some other form of apparatus the same valve might function perfectly satisfactorily. Again, a valve of the frequency changer type might still satisfactorily perform its function in one particular receiver whilst failing so to do in another, the difference being due to the particular characteristics of the circuit used in the oscillator section. A still further example might be that of a valve used as a voltage amplifier in some apparatus having total low gain. Slight noisiness in such case might be insufficient to be noticeable, whereas in a multi-stage high-gain amplifier a similar amount of noise in the valve might cause the valve to be unsuitable, especially if it were in an early stage.

This would appear to suggest that the best test for any valve might be that of testing it in the set or apparatus in which it has to function, but apart from the obvious inconvenience of the method, such tests cannot be considered as wholly satisfactory for many reasons. Intermittent faults and potential future troubles can usually be detected far more readily by the use of suitable methods of checking the valve away from its associated circuits. Valve faults of this nature if allowed to continue on the ground that the set is still functioning may finally result in damage to other components. Stage gain may be found and this might be due either to the valve or to components in its associated circuits. If the valve itself has been checked and found to be satisfactory, the tracing of the trouble obviously becomes more simple.

It would not be within the scope of these articles to go into details of the construction of apparatus and instruments for checking such possible faults, but an indication will be given of the suitability or unsuitability of various methods.

(To be continued)

L.F. Coupling in Short-wave Receivers

Hints for the Keen Long-distance Experimenter

By A. W. MANN

SHORT-WAVE experimenters, as a rule, study commercial designs and appreciate many of the salient features incorporated. In many instances, however, cost being the ruling factor, they confine their activities to the home construction of simpler types. While what may be termed home-constructed receivers of the semi-communication-type superhet are built and used by a minority, the majority favour the simple regenerative non H.F. and T.R.F. types.

Such receivers do not compare favourably with the superheterodyne so far as selectivity and sensitivity are concerned, but nevertheless are capable of reasonably good performance in the hands of the average operator.

Home Construction

Amongst home constructors are some who follow the recommended procedure of drawing down their contemplated experimental receiver in theoretical form, and including in the circuit diagram all the modifications and additions they feel desirable in the finished receiver.

This is followed by above, and below, chassis layout diagrams, after which the receiver construction and wiring is taken in hand. In order to attempt such work, however, a reasonable amount of previous constructional work, and knowledge of radio fundamentals is most desirable.

It is better otherwise to stick to published designs. It should be noted, however, that receivers of experimental design which, when completed, require no further alteration or modification, are the exception rather than the rule.

Battery-type Receivers

The purpose of this article is to discuss, for the benefit of experimenters who use battery-operated receivers, a few low-frequency amplifier coupling methods which are worth trying.

At Fig. 1 is shown, in theoretical form, the straight transformer coupling method. Using a good make of L.F. transformer, with a ratio of 3:1 or 4:1 and a power valve in conjunction with it, sufficient volume will be available for headphone reception when preceded by a regenerative detector.

While this form of L.F. coupling is satisfactory when built into a receiver by an experienced constructor, there are several other methods which, in the interests of stability, are far better suited to the requirements of short-wave receiver construction.

A Better Method

The method shown at Fig. 2 is a much better one, and is known as resistance feed. The connections, as shown, provide a step-up ratio of 4:1. Fig. 3 shows a slight modification in the connections, which increases the step-up to a ratio of 5:1.

Decoupling

While the resistance feed method has much to recommend it, the writer's preference is for that shown at Fig. 4. This is a very stable form, and is a modification of the straight method. In addition to the L.F. transformer a resistor of between 10,000 ohms and 50,000 ohms and a fixed condenser of 1μF to 2μF are required. The resistance and by-pass condenser are the decoupling components.

Choice of suitable values will depend to some extent on individual requirements, but excessive voltage drop should be avoided. This method will provide freedom from motor-boating effects with stability in operation, if correctly applied.

In an early issue of PRACTICAL WIRELESS, the writer described a regenerative three-valve receiver the low-frequency amplifier of which consisted of two stages of choke-resistance coupling. This receiver, which was used for quite a long time, had a very good signal-to-noise ratio.

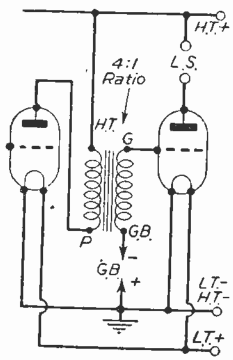


Fig. 1.—Straight transformer coupling.

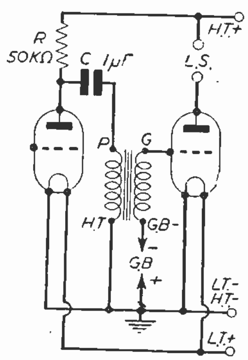


Fig. 2.—Resistance feed 4:1 step-up ratio.

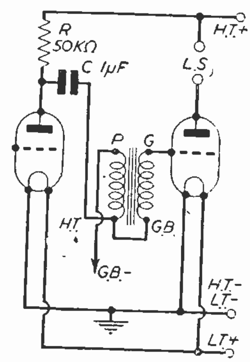


Fig. 3.—Resistance feed 5:1 step-up ratio.

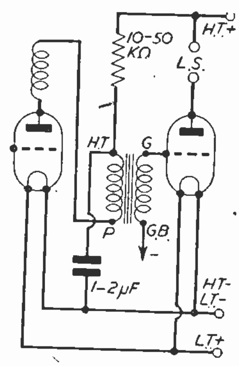


Fig. 4.—Decoupled L.F. transformer.

The theoretical circuit is shown at Fig. 5 and may interest those who are interested in the headphone reception of C.W. signals. Another of its advantages is, that due to the use of L.F. chokes in place of resistances, voltage drop is avoided.

The volume obtainable is, of course, less than would be obtainable with an R.C.C. L.F. transformer combination, but is nevertheless satisfactory, and the quality of reproduction very good.

Suitable Values

The grid leak and fixed condenser values as specified will ensure smooth reaction, from ten metres to one hundred and sixty metres, providing

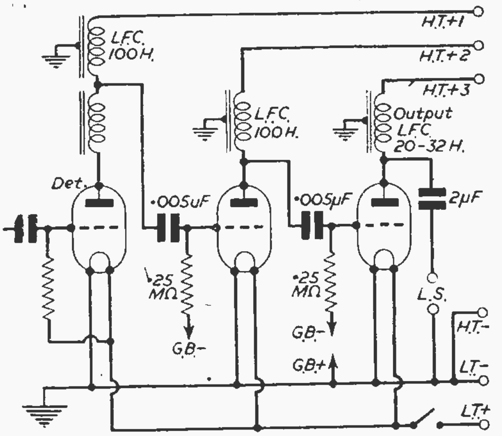


Fig. 5.—Choke R.C.C. L.F. amplifier.

that a suitable high-frequency choke is incorporated in the receiver, together with suitable detector valve.

At one time, it was common practice to build simple regenerative, and T.R.F. receivers. in which two stages of L.F. transformer coupling was incorporated. Although, with careful design and layout this can be done successfully, it is not a practice to be recommended. There is no doubt that much of the trouble experienced due to instability could have been avoided if the first stage transformer had been replaced with R.C.C.

The L.F. Pentode

The introduction of the L.F. pentode has been of considerable benefit to short-wave experimenters. By its use, we are enabled to obtain a little extra L.F. amplification in a very simple manner, and free of complications.

At Fig. 6 is shown a regenerative detector followed by an R.C.C. L.F. stage. If desired, the second valve could be an ordinary L.F. type, or one of the low-power type. All values are given, and this arrangement will provide a very satisfactory signal-to-noise ratio.

Tuned and Untuned H.F.

When additional amplification is desired at high frequency, the constructor has the choice of either a tuned, or untuned stage. The untuned stage is used by some as a buffer, and as a cure for dead spots in tuning. It is not always a cure for the latter. In any case, it provides but little in the way of amplification.

We can, of course, use a so-called semi-tuned stage which includes a tapped coil, instead of an H.F. choke or resistor, respectively. This idea was satisfactory in its day, but is in my opinion obsolete. The same applies to untuned high-frequency stages.

On the whole, the use of untuned and semi-tuned H.F. stages under present-day conditions are not to be recommended.

To use either a screened grid valve, or an H.F. pentode to the best advantage, the stage should be tuned. In any case, the additional gain, sensitivity, and selectivity will be well worth the extra outlay.

We cannot improve the selectivity beyond certain limits, and in this respect, even the best T.R.F. falls far short of superhet standards. It is policy, therefore, to make the best use of the material we have to hand.

Audio Filters

As the superheterodyne fraternity are turning their attention to the use of audio filters, there is every reason why the T.R.F. user should do likewise. That is, of course, if he is interested in amateur phone and C.W. reception. So far as the S.W. B.C. listener is concerned, a filter sometimes helps to clear up QRM when listening for station announcements, and can be cut out of circuit for programme listening.

I would suggest to those who are interested, and who can obtain an FL-8-A ex-service type audio filter, that a few experiments may prove worth while, especially on the amateur bands.

A Useful Guide

Published DX logs as found in amateur publications are, among other things, a useful guide as to the most popular types of commercial communications type receivers. They also display the results obtained with less complicated and less efficient types of receivers. It is rather surprising to note that various forms of regenerative receivers enjoy a measure of popularity. Surprising, because they are used under far different conditions from those existing during the early days. The results obtained by the average operator using regenerative receivers, prove that despite their limitations, they are worthy of consideration.

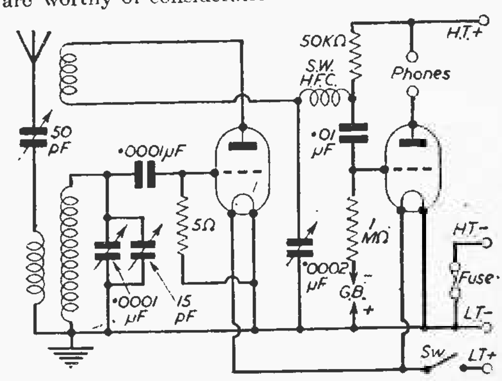


Fig. 6.—Detector and R.C.C. L.F. stage.

Self-compensating Linear A.C. Meter

A Handy Test Instrument for Voltage and Current Readings

By G. F. CRAVEN

THE usual method of measuring A.C. by means of a moving-coil instrument is to include a full-wave bridge rectifier in the circuit. If the instrument is to be used for A.C.+D.C. measurements, certain inherent defects arise which are due to the non-linear characteristics of the rectifier over a percentage of the meter scale. With a full scale reading of, say, 15 volts, the non-linear percentage of the reading is negligible, but for full-scale values below this value the non-linear percentage may be in excess of 50 per cent. One method of overcoming the non-linearity of the scale at low voltages is to include a potential transformer which raises the input voltage to a value which is outside the non-linear range. This method is successful where comparatively heavy currents are flowing, but for light current work the voltage drop due to the current drawn by the transformer introduces serious errors. Similarly, on A.C. current measurements it is impossible to use a rectifier-moving-coil combination across a shunt as the meter is then operating as a low reading voltmeter and has a very bad scale shape. Here again a transformer is used, the design of which is extremely difficult where small bulk is required with accurate results.

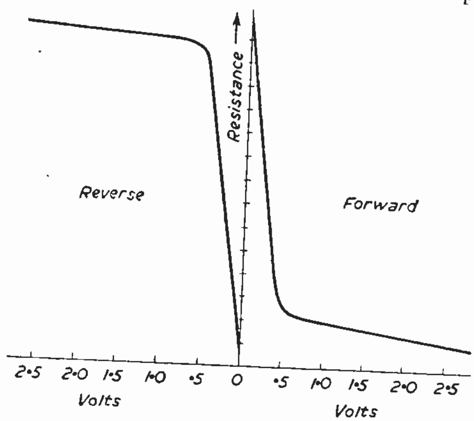


Fig. 1.—Rectifier characteristics.

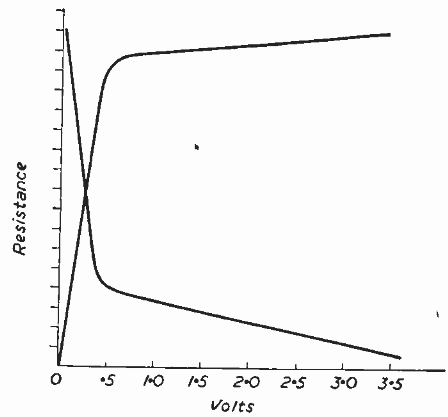


Fig. 2.—Compensated rectifier characteristics.

Defects Overcome

To overcome these difficulties and to provide a scale which is absolutely linear on any A.C. voltage or current measurements, a circuit has been evolved which is entirely suitable for inclusion in a universal meter. It has the great advantage of using the same scale for A.C.+D.C. measurements without transformers and introduces no more error into the readings than any high-resistance meter with bad scale shapes.

Consider the characteristic curves of a copper-oxide rectifier. It will be seen that as the voltage

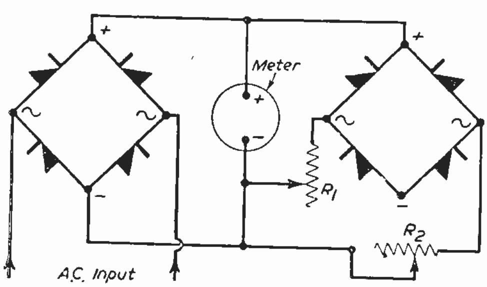


Fig. 3.—Compensated rectifier circuit.

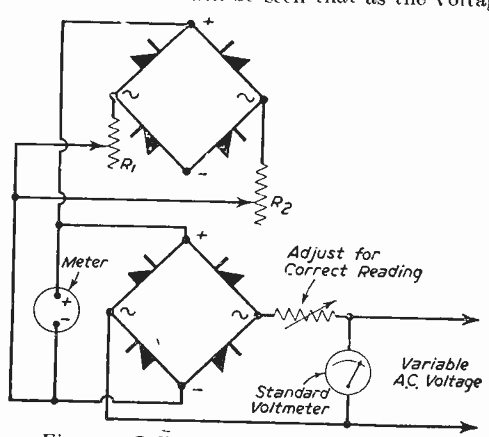


Fig. 4.—Calibration as an A.C. voltmeter.

rises, the resistance of the rectifier element falls in one direction and rises in the other according to the polarity of the voltage. It is these changes in resistance which provide the rectifying action, the impedance being very high for currents flowing in one direction and very low when flowing in the reverse direction. As will be obvious from the curves in Fig. 1, the changes in resistance are non-linear in the extreme.

Consider now Fig. 2. If one curve in which the resistance is decreasing is superimposed upon a curve where the resistance is increasing the resultant curve will appear as a straight line and will, therefore, give a linear scale. This method of compensation is the one used in the circuit about to be described.

The instrument and its conventional rectifier are coupled in the usual manner. A second instrument rectifier, identical in characteristics to the first, i.e., current rating, manufacture, etc., is coupled in parallel to the meter. The positive side of the compensating rectifier is taken directly to the positive terminal on the meter whilst the negative side is not connected. From each of the A.C. terminals on the compensating rectifier a connection is made to the negative side of the meter via a variable resistance (Fig. 3). The function of these resistances is to balance any slight discrepancies in the rectifier elements and may be adjusted to give perfect linearity. Once set, they need never be altered again. The values of these variable resistances should be variable from zero to approximately 10 times the meter resistance.

Setting Up and Calibrating Procedure

To calibrate the instrument as a voltmeter, the series resistance to give full scale deflection is very nearly 90 per cent. of that required to give full scale deflection on D.C. For accurate results, a variable resistance of value greater than is necessary is coupled in series with the circuit. A variable source of A.C. is required together with a reliable A.C. voltmeter. The equipment is set up as in Fig. 4 and the variable series resistance adjusted to give a full scale reading which agrees with that on the standard meter. Next, the linearity is checked by varying the A.C. supply from maximum to zero, the compensating variable resistors R_1 and R_2 being adjusted to preserve the linearity. When the meter is linear from zero to full scale, the series variable resistance is measured to give the value of resistance in series with the meter. This procedure is then carried out for all the other required ranges with the exception of the adjustments to the resistances R_1 and R_2, which are now set for all ranges. The value of resistance in circuit which is provided by the variable series resistor is the value required as a fixed resistor on each range.

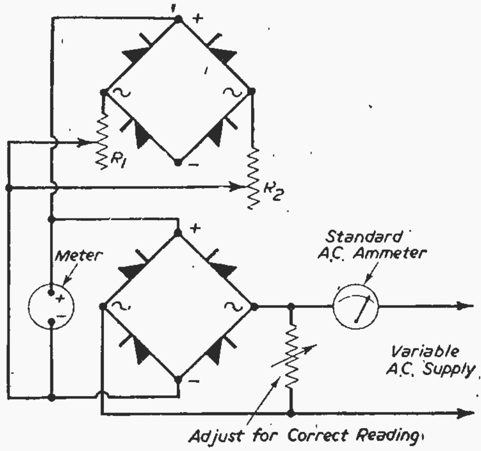


Fig. 5.—Calibration as an A.C. ammeter.

The instrument may be calibrated as an ammeter by coupling a variable resistance across the rectifier A.C. terminal and by using a standard A.C. ammeter in series with the variable A.C. supply leads (Fig. 5). A procedure similar to that of the voltmeter calibration is used and here again it is unnecessary to adjust R_1 and R_2. The value of resistance in parallel with the circuit is that which is required to give full scale deflection when the standard meter and the instrument being calibrated agree.

Listener and Viewer Research Combined

NOW that the work of the B.B.C.'s Listener Research Department extends to television, it has been decided to change the title of the department to Audience Research, thus including listeners and viewers alike.

The television panel, under the direction of Mr. R. J. E. Silvey, head of Audience Research, started work on January 15th this year. Its function is twofold: to provide information about the amount of viewing and what viewers think of the programmes they see.

A special "Likes and Dislikes" form has been prepared for Midland viewers, a copy of which will be sent to any viewer there who applies for it. This form carries ten simple questions on one side, while on the other there are spaces for each member of the family to express his or her individual opinions. The B.B.C. hopes to hear from as many Midland viewers as possible, and those willing to help are asked to write, on a postcard, "Midland T.V. Enquiry," adding their names and addresses, in block capitals, and post it to Head of Audience Research, 55, Portland Place, London, W.1.

Weekly Log

Members of the viewing public who join the television panel receive a "log" every Saturday of the forthcoming week's television programmes. This they are requested to fill in day by day with such details as the number of viewers on their set to a particular programme, their reactions to that programme, and so on, and then post the completed log back to the B.B.C. in the reply-paid envelope provided on the Sunday after the week has finished.

The strength of the television panel is stabilised at 600 families, 200 retiring and 200 new families joining every fourth week.

Broadcasting in Malaya

A First-hand Account of Progress and Development in the Far East

By PASCOE THORNTON

THE small island of Singapore (about the size of the Isle of Wight) is tending more and more to become one vast radio transmitting site. Already an appreciable fraction of its area is taken up by the aerials of Government and Services wireless stations, commercial cable firms, Radio Malaya, and the B.B.C. Only the two latter operate broadcasting services, and although there is no connection between the two organisations, the public often finds the situation confusing.

It is really quite simple. The B.B.C. in Singapore operates what is called the British Far Eastern Broadcasting Service, intended to bring the voice of Britain to non-British countries in the East. For the most part the programmes are relays from London, although some material is originated in the Singapore studios.

Radio Malaya, on the other hand, is only concerned with the inhabitants of British Territories—Malaya, Singapore, North Borneo, Sarawak and a few scattered islands. It is operated by the Federation of Malaya and Singapore Governments through the Department of Broadcasting, which has its headquarters in Singapore, although it serves both governments. Its function is to provide news, information, education and entertainment to its listeners.

PERSONAL NOTE: Pascoe Thornton recently returned from Singapore, where for the past three years he has been Programme Director of Radio Malaya. Before the war he was on the staff of the B.B.C., from 1934 to 1939, first as an announcer and then as a producer-script writer in the Empire Department. He joined the R.A.F. soon after the outbreak of war, and served as an intelligence officer until his demobilisation in 1947. In the course of his war service he ran Forces' Broadcasts in Iceland as a spare-time job; and later he organised broadcasts to ex-P.O.W. from New Delhi for Admiral Mountbatten. He has, therefore, an unusually wide experience of broadcasting in many parts of the world.

Broadcasting began in Singapore in the mid-thirties. The first signals, I believe, were sent out by Mr. E. C. Yates, a radio technician who is still in business in Singapore. Soon, however, the Malayan Broadcasting Company was formed, financed by the manufacturers, and the present Director of Broadcasting, Mr. J. S. Dumeresque, went out to Singapore as general manager—and also as chief engineer, programme director, and everything else as well!

A studio and office block was built on a hill on the edge of the town, the transmitters being some fifteen miles away. Additional staff were recruited, and Radio Malaya was well on the road.

Then came the war. The M.B.C. was taken over by the Ministry of Information. Emergency studios were prepared in the newly-completed skyscraper block of flats known as the Cathay Building, and broadcasting was carried on from these up till the very entrance of Japanese troops into the city itself.

With the defeat of the Japanese, the British Military Administration took over control of Radio Malaya, operating it until one year later when civil government was restored and the Department of Broadcasting took its present form.

At this time Radio Malaya was still using the Cathay Building studios. Their own old building was still occupied by what is now the British Far Eastern Broadcasting Service of the B.B.C., but which was then the Far Eastern Bureau, first of the Ministry of Information and later of the Foreign Office. The Cathay Building studios were too small for post-war requirements and were thoroughly unsatisfactory in many ways. It was therefore proposed that a new building should be erected and plans were approved last year for this to be built next to the old building. When it is completed, both buildings will be jointly used by the Radio Malaya and B.B.C. staffs. The building is expected to be ready for use in the latter part of this year.

Programme Side

Radio Malaya's task is no mean one, both from the programme and from the technical points of view. To take the programme side first: there are four major racial groups in Malaya — the Malays themselves; Muslims, with their own traditional music and culture; the Chinese, speaking a wide variety of dialects as different from each other as English is from Russian, and with almost as many styles of music and drama; the Indians, Tamils from the south, Sikhs, Bengalis and others from the north, deeply divided according to their allegiance to India or to Pakistan; and last, but by no means least, the Europeans and Eurasians, mostly English-speaking and looking to the west for their traditions and culture.

To serve this multifarious audience, with very limited resources, is not easy. Two "networks" of transmitters are operated simultaneously, one carrying English programmes for the greater part of the time, and the other shared between the Malay, Chinese, and Indian programmes. This arrangement has been adopted because it has been found that the majority of listeners are English-speaking—English is rapidly becoming the lingua franca of the educated classes—and therefore the English programmes are listened to by a wider audience than any of the vernacular programmes. The actual division of time is approximately 50 hours per week in English, 30 in Chinese, 20 in Malay, and 20 in Tamil.

On the technical side the difficulties are equally great. Except for Singapore, with its densely packed population, the Malayan listeners are spread comparatively thinly on a narrow peninsula some 400 miles long. The country is very mountainous, and the service area of medium-wave stations is severely limited. Noise level is high and forbids the use of long-wave transmitters in tropical countries.

Much of the country must therefore be served by short wave, although the distances are too short for this to be altogether satisfactory. Experiments have indicated that a frequency in the neighbourhood of 9 Mc/s. would give the best results. No frequencies in this band are available, however, and in practice the frequencies used are of the order of 5 to 7 Mc/s. Results in general are fairly satisfactory, although conditions at dusk—unfortunately a peak listening time—are always difficult and unreliable. More power is the only answer; and that means more money, which Malaya at the present time can ill-afford.

There are at the moment four stations throughout the country. Singapore has two medium-wave transmitters and three short-wave. Kuala Lumpur has two medium- and one short-wave; Penang and Malacca have medium-wave only.

Reception reports of the short-wave transmissions from Singapore have been received from listeners in England. DX fans might care to try 7,200 kc/s. from about 15.00 hours G.M.T. On Saturdays the station closes at 16.30 G.M.T. instead of the usual 16.00, so success is more likely on that day, as reception improves as the time grows later.

Listeners' Problems

Now what of the Malayan listeners' problems? He does not always find it so simple as it is in most parts of the British Isles. If he lives in Singapore, Kuala Lumpur, Penang or Malacca he should have no difficulty in receiving his local station. Here his main trouble is likely to be man-made static; in fact, there are districts in Singapore where D.C. fans and other gear make listening practically impossible. If he lives outside these towns, and less than 200 miles from Singapore, he may be unlucky, because he will be inside the skip of the short-wave transmitters and yet outside the medium-wave service area. Hills and valleys again may produce bad local blind spots. Ipok, an important tin mining centre, is a notable example of this.

But perhaps the most serious difficulty, and one which may hamper the spread of listening facilities throughout the country, is that of the lack of power supplies. Few of the smaller towns and villages have electricity; to have an accumulator charged may mean a whole day's trip to the nearest place with charging facilities. Dry batteries do not have a good shelf life in tropical conditions, and replacements are, therefore, not always easy to come by. Some British manufacturers are fully alive to this problem, and are endeavouring to solve it in various ways.

In a country like Malaya, where illiteracy is still commonplace, the spoken word has an even higher value than in countries like England. The radio can be of the greatest assistance to the Government in spreading objective news and information, and in countering Communist or other unfriendly propaganda. And so any money spent on making listening in Malaya easier and better will be money well spent in the cause of democracy.

The question of money, in my view, is the crucial one for the future of broadcasting in Malaya. More money is urgently needed for developing both the technical and programme services. Many of the Asian staff in particular are very poorly paid in comparison with equivalent jobs in commercial firms, with the result that good men are hard to get. Communications throughout the country are poor, and something better must be contrived if full economical use is to be made of the available staff and resources.

Where is the money to be found? Radio licences have been in force for over a year, and are now well on the way to the 100,000 mark, which is considered to be somewhere near the maximum (though I believe that good, *cheap*, and really easily-maintained battery sets would increase that figure by at least 50 per cent.). But the licence fee at $12 (28/-) can hardly be increased, and the most that licence revenue can be expected to produce is therefore of the order of one and a half million dollars. This is less than half Radio Malaya's present budget. The balance is at present found from general Government funds—most reluctantly and grudgingly found. It seems clear that no more can be expected from this source.

There remains the possibility of some form of advertising, now prohibited. This suggestion was made by a Government committee set up last year to explore "the possibilities of effecting economies in Radio Malaya." They found that no economies were possible, and proposed that schemes for introducing some system of commercial broadcasting should be investigated. I hope that the investigators will report in favour, for I can see no other way of obtaining for Radio Malaya the revenue which it must have if it is to develop the full service for which its listeners quite justifiably clamour.

The second question affecting Radio Malaya's future is that of its constitution. At present it is a Government department. That, I am convinced, is a grave handicap. It means that the Director of Broadcasting is not free to control his department's expenditure as he considers best; that the fees offered to artists cannot encourage good work; that everything has to be fitted into routine Government methods which are completely incompatible with the efficient running of a broadcasting station. Enterprise is strangled.

At the same time I do not consider it would be right to allow Radio Malaya to pass into the hands of commerce. (This was also suggested by the committee mentioned above.) The political situation in South-east Asia is far too critical for the Government to relinquish altogether its control over so powerful a weapon as radio.

The answer, therefore, must be a corporation on the lines of the B.B.C., accountable to the Government, but independent in its internal management. This system has worked remarkably well in this country; I see no reason why it should not work equally well in Malaya.

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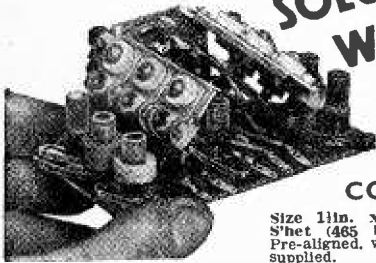

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Variable I.F. Band-spreading

A Useful Idea for Use on the Amateur Bands

By W. NIMMONS

THE normal process in a superhet designed for the short waves is for the signal frequency and the oscillator frequency to be tuned together. The two variable condensers necessary for this purpose are on the one shaft, and if things are nicely balanced the ganging holds from one end of the range to the other.

In the normal set the tuning is very sharp, stations being received and lost within a small fraction of one degree of the condenser scale. This led to the introduction of band-spreading, in which a small portion of the band is explored with a small supernumarary variable condenser or condensers, which apparently spreads out the stations over the small band selected.

With this arrangement the tuning is still carried out on the signal and oscillator frequencies. The intermediate frequency remains fixed, and the acceptance and subsequent passing on of the signal depends on the accuracy with which the combined signal and oscillator frequencies combine to form a new frequency, which is the frequency of the I.F. transformers.

I have been experimenting with a new method of band-spreading which is of great help in congested bands such as the amateur bands. With this method a small portion of the selected band is spread out over the scale, and stations occupy two or three degrees, with consequent ease of tuning.

In this method the signal and oscillator sections remain stationary, tuning being carried out by varying the I.F. This calls for an altogether different technique; the I.F. "trimmers," for example, must be orthodox .0005 μF. variable condensers, operated from the panel. The signal and oscillator tuner, also, must be capable of being operated from the panel, in order that we may be able to select the particular band required. So the whole thing boils down to two main operating knobs, one to select the band and the other to explore it. At the same time searching may be carried out by manipulating the condensers which control the signal and oscillator frequencies, by setting the I.F. condensers at a fixed frequency and ignoring them. Thus we have the advantage of the ordinary technique combined with the conveniencies of the new, which may be used at any time by simply transferring from one knob to the other.

Discerning readers will by this time have recognised (I hope) the converter plus broadcast receiver in the arrangement. With a converter we have the signal and oscillator sections, whilst the variable I.F. is comprised in the broadcast receiver, which is tuned to the long waves.

Users of this arrangement will doubtless have noticed that they can tune from one station to another by manipulating the broadcast receiver knob, when the converter knob is left untouched. But the "acceptance" will be very small if any inductance is included in the anode circuit of the frequency changer valve, due to the sharply-tuned nature of the circuit. What we want is a broadly tuned frequency changer stage. The I.F. can be as selective as we like; in fact it is an advantage to have it as selective as possible in order to separate the stations. For this reason it is an advantage to have the "broadcast receiver" part of the apparatus of the superhet type, thus using a double superhet as the final outcome. But this is by no means essential to success, and good work can be done with a three-valve circuit (in addition to the frequency changer) comprising one H.F. stage, detector, and output stage. With battery valves it would be an advantage to employ two H.F. stages, though this again is not essential.

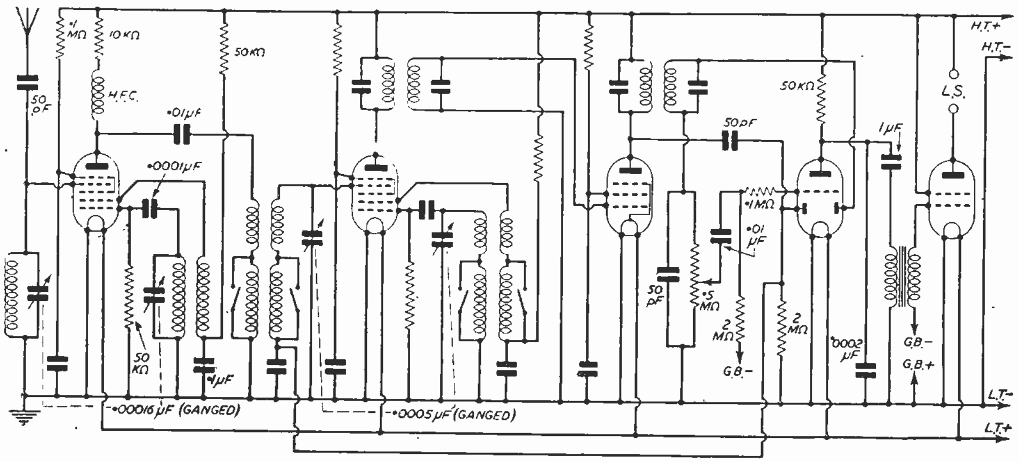


Fig. 1.—Complete combination of receiver plus additional frequency changer.

Circuit Arrangement

Reference to Fig. 2 will show that there is an H.F. choke in series with a 10,000 ohms resistor in the anode circuit of the frequency changer valve. This is essential so that the stage may have as wide an acceptance as possible. If the H.F. choke were replaced with an I.F. transformer the circuit would be sharply tuned and would resonate at one frequency only. This would be excellent if tuning were to be carried out only on the frequency changer, the I.F. remaining fixed; but since we intend to tune on the I.F. for a special purpose it is essential that the circuit should not be sharply tuned,

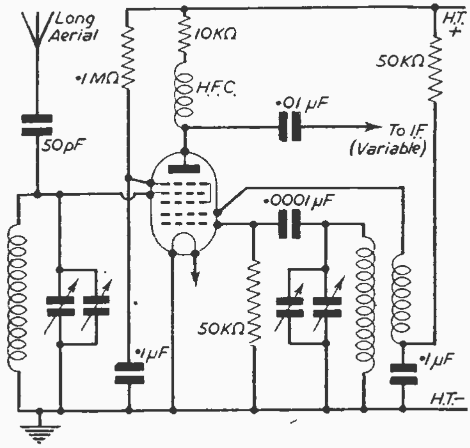


Fig. 2.—The frequency changer stage.

otherwise it would be impossible to receive stations off resonance. To aid this a 50 pF. fixed condenser is included in the aerial, and this value should not be much reduced.

The line-up now is: a choke-coupled frequency changer stage followed on to either (a) an ordinary one- or two-stage H.F. amplifier; or (b) a superheterodyne receiver. If the constructor decides to build a complete battery set, such as Fig. 2, ordinary coils can be used for I.Fs, providing the long-wave sections are efficient. As the band-spreading works on the long waves it is absolutely essential that the long-wave sections of the coils should be reasonably efficient. I mention this because there are many sets with inefficient long-wave bands.

By " coils " I mean also the associated trimming gear. The coils themselves may be O.K., but they are thrown out by inefficient trimming arrangements.

It should not be forgotten that if the receiver side (apart from the frequency changer) is trimmed on broadcast, with an ordinary aerial, it will be thrown out of trim when the aerial is taken off (which it must be, to be transferred to the frequency changer). To obviate this, we can (a) trim with a signal generator; (b) trim with the least possible pick-up between aerial and set, such as by employing a very small aerial condenser, or by simply hooking the end of the aerial on to an insulated wire going to the grid of the first H.F. valve; or (c) adopting a compromise between maximum efficiency on the band-spreading arrangements and the normal broadcast reception, presuming that the constructor wishes to use the set as a broadcast receiver as well as a band-spreading arrangement in conjunction with the short-wave frequency changer.

It has been stated that we want the greatest possible "acceptance" between the frequency changer and the rest of the apparatus. To effect this the fixed condenser between the anode of the frequency changer valve and what would be the aerial terminal of the broadcast receiver is made very large. The normal condenser on medium waves for this purpose would be about .0001 μF, in order to increase the selectivity. On long waves it might be made a little larger, say, .0003 or .0005 μF. In our case it can be anything from .001 to .01 μF, or even .1 μF. The loss in selectivity does not matter—in fact, it is the very thing we want, for the reasons outlined. The selectivity is made up in the rest of the apparatus, preferably through the use of a superhet as the remaining link.

Operation

In use the broadcast receiver part of the apparatus would be set in the middle of the long-wave scale, and the short-wave converter trimmed for maximum efficiency, as denoted by the loudest signals.

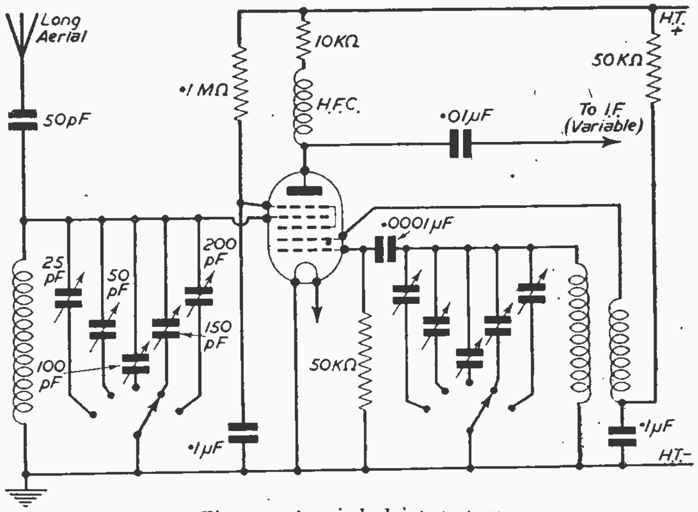


Fig. 3.—A switched input stage.

Presuming we are trimming on 40 metres, set the volume control of the B.R. to a low level and see if the strength can be brought up by bringing the signal and oscillator frequencies to the appropriate distance apart. Thus, if we have the B.R. set at 1,500 metres, which is the middle of the long-wave band, we aim to get the signal and oscillator frequencies this distance apart, i.e., 200 kilocycles.

As a practical measure, however, it would be best to avoid a precise 1,500 metres or 200 kilocycles, because this is the frequency of Droitwich, and with its increased power even a few inches of aerial picks up sufficient energy to cause a heterodyne. So we set the B.R. to be clear of Droitwich and trim the frequency changer from there.

It is likely that interference from Droitwich will persist whatever frequency we trim on, but only on 1,500 metres. This may mean the loss of a few short-wave stations, but this is the extent of the interference since it is extremely unlikely that any other broadcast station will have sufficient strength to override the signals brought forward from the frequency changer.

If the short-wave unit is trimmed on, say, 1,400 metres, or 214 kilocycles, by leaving it at that and manipulating the knob of the B.R. (not forgetting the volume control) the short-wave stations will come in on the B.R. over a large part of its scale.

From 1,000 to 2,000 metres, or from 300 to 150 kilocycles, that is a difference of 150 kilocycles, there would be room for 15 stations with 10 kilocycle separation. In a set marked with a 100 degrees scale this would mean that we would have to turn the scale through six degrees to tune in and tune out a station—surely band-spreading enough for anybody.

On the other hand, the whole gamut would occupy only two degrees on the short-wave condenser scale, or a little over one-tenth of a degree per station. Once set we do not have to alter the trimming of either the short-wave unit or the broadcast receiver, presuming, of course, that the former's ganging holds reasonably well over the full extent of the vanes' movement.

In the normal way we could tune on the short-wave condenser, setting the knob of the B.R. at approximately its mid-way position. When a band of short-wave stations was encountered we could then leave the short-wave knob and proceed to tune on the knob of the B.R. In this way, it is surprising how stations which were overlooked on the short-wave dial are heard: not that the mere changing over from one knob to the other produces more stations, but simply that the band-spreading reveals more, as they were apparently too sharp to be picked up on the short-wave unit alone.

As an alternative to the above, there is much to be said for having the short-wave unit pre-tuned on certain selected bands. The advantages of this are that searching is reduced to one knob, another knob being used as a band-setter, and that on each particular band the setting is always the same, which is a tremendous advantage when one wants to find a particular station. This cannot be done quite accurately when the short-wave condenser is "free." As a rule four or five selected bands on each set of coils is all that is required (see Fig. 3). This again has the disadvantage that stations between the bands cannot be received.

It is an advantage, on this particular arrangement, to use a rather long aerial. A short aerial will give results, but the band-spreading may be rather restricted. So long as the frequency changer is not prevented from oscillating by excessive capacity in the aerial, the longer the aerial the better.

Special Amateur Equipment

ENCOURAGING news for radio amateurs and experimenters is that a wide selection of high quality equipment is being made available to bona fide amateurs at extremely attractive prices by E. M. I. Sales and Service, Ltd.

Included in this equipment are amplifiers of various types and a selection of microphones and transformers.

These items are all brand new and a limited quantity only is available.

The range of amplifiers, for which prices are quoted below, are all eminently suitable, by simple modification, for use as modulators in low and medium power transmitters.

Type	Description (Audio Output)	Price to Amateurs Each £ s. d.
Ra/Pa. 102A	30 w. amp.	34 0 0
Ra/Pa. 102B	30 w. amp. (As 102A)	34 0 0
Ra/Pa. 102C	30 w. amp. (Basically as 102A. No screening box)	34 0 0
Ra/Pa. 120M	30 w. Amp. (As 102C. Adapted for Marine use)	34 0 0
Ra/Pa. 118 M	Mic/amp.	17 0 0
Ra/Pa. 161C	12 w. amp.	19 0 0
Ra/Pa. 161	12 w. amp.	15 0 0
Ra/Pa. 181C	20 w. amp.	19 0 0
Ra/Pa. 164	15 w. A.C./D.C.	17 10 0
Ra/Pa. 169	3.5 w. Mobile amp. 12 v.	12 0 0

Type	Description (Audio Output)	Price to Amateurs Each £ s. d.
Goodman Industrial Loud Speakers		1 7 6
P.M. 205	Mic. /(M/C)	4 0 0
PM. 237	Mic. (Carbon)	2 2 0
PM. 238	Mic. (M/C hand)	2 5 0
PM. 240	Mic. (Crystal)	4 10 0
PM. 241	Mic. stand	12 0
Ra/Pa. 170D	Power Unit	12 0 0

Additional items are as follows:

	Price s. d.	Packing & Postage s. d.
AD40—Mains Transformer 310-0-310, 4 v., 6.3 v. (200-250 input). 65-80 mA.)	13 6	1 6
AD. 41—Mains Transformer 325-0-325, 4 v., 6.3 v. (100-250 input). (100 mA)	19 6	1 6
AD. 42—Mains Transformer 310-0-310, 4 v., 6.3 v. (100-250 input). (80 mA)	16 0	1 6
AD. 16—Smoothing Choke Heavy duty (200 mA). D.C. Resistance 250 ohms	6 6	1 6
AD.5/6—I.F.T.'s 465 Kc/s Dust Iron Trimmed, High "Q"	6 0	6
AD 43—Transformer 100 : 1 (suitable for microphone or pick-up)	3 9	6
AD. 44—Transformer Pick-up matching type	9 0	1 0
AD 45—Transformer Output—Pentode to 5 ohm speaker	6 0	6

Remittances should be made payable to "E.M.I. Sales and Service, Limited," and addressed to: E.M.I. Sales & Service, Ltd. (Amateur Division), Hayes, Middlesex.

Modern Qual

A Four-stage Push-pull A.C. Unit

By R. H

ONE must begin a design such as this with the output circuits, and the modern conception of quality demands a multi-stage audio circuit of high intrinsic gain, reduced by the application of a high degree of feedback from the secondary of the output transformer to the input circuit. Clearly, with an audio circuit so extensive as this, convenience demands that the amplifier, together with the power equipment, should be a chassis separate from the radio and intermediate-frequency circuits.

Attention was turned to a design, as a separate unit, of a high-quality audio amplifier. Various possible designs were studied, but, as the desire was to evolve a circuit requiring the minimum of adjustment when first set up, and which would be self-adjusting for changes in operating characteristics as the valves age, complicated methods of setting up a D.C. balance of the push-pull circuits and of securing an accurate signal balance were turned down in favour of a self-balancing circuit. Nor was it intended that special or very expensive components be needed. A good 12in. speaker in the normal price-level was to be used, but not one of the very superior (and very dear) units. The resulting circuit (Fig. 1) exceeded expectations for quality of reproduction. The unit has proved a very versatile amplifier and is described as an independent unit suitable for anyone requiring really good quality at reasonable cost.

There are no controls on the amplifier itself. It is intended that the feeder unit used, whether pre-amplifier or radio tuner, should carry all controls required by the complete equipment. This is the most convenient method because then the amplifier can be tucked away in any place inside the cabinet and is remotely controlled from the unit which would need to be mounted in an accessible position for the purpose of tuning, mixing, etc. But, generally, it is more convenient to terminate the mains input in the amplifier chassis, and this is done in the present case, but allowing for an extension of the switching to the associated panel.

Theoretical Operation

The input is taken, via a coaxial socket, through C1 and R2 to the grid of V1. R2 is a grid stopper and R1 is the usual grid leak. R4 is for cathode bias and is by-passed by C2 so that, from the audio signal point of view, these two components can be ignored. Because the grid leak is returned to the bottom of R4, the D.C. component across R5 is not applied as bias to the valve. In any case, the value is so low as to be negligible and the purpose of this resistance is to permit voltage feedback.

V1 is a high gain amplifier stage using an R.F. pentode of the non-variable mu type. R3 and C3 in series are introduced across the anode load to reduce the gain within the feedback loop, so far as super-audio frequencies are concerned, to prevent spurious oscillation such as may occur if there is sufficient phase shift at these frequencies to make the feedback voltages positive instead of negative.

C5 couples the output from V1 to the first half of the double triode V2. If R10 were shorted this circuit would be normal, with R12 as grid stopper, R9 as grid leak and R16 as cathode bias resistor common to both halves of the valve. The second half has its grid effectively shorted to earth for audio frequencies by C8; R18 is only a grid stopper. It will be noticed, however, that R10 is common to both cathode circuits so that, in effect, the second half is cathode coupled to the first half. The purpose of R17 is to complete the grid-cathode D.C. path without shorting the signal to be applied to the cathode; the grid leak, in fact, being comparable to R9.

Now assuming that the two halves of V2 are operating in push-pull, as is the obvious intention (i.e., with signals of opposite phase at the anode) and that they were in perfect balance, then the signal across R10 developed by virtue of its place

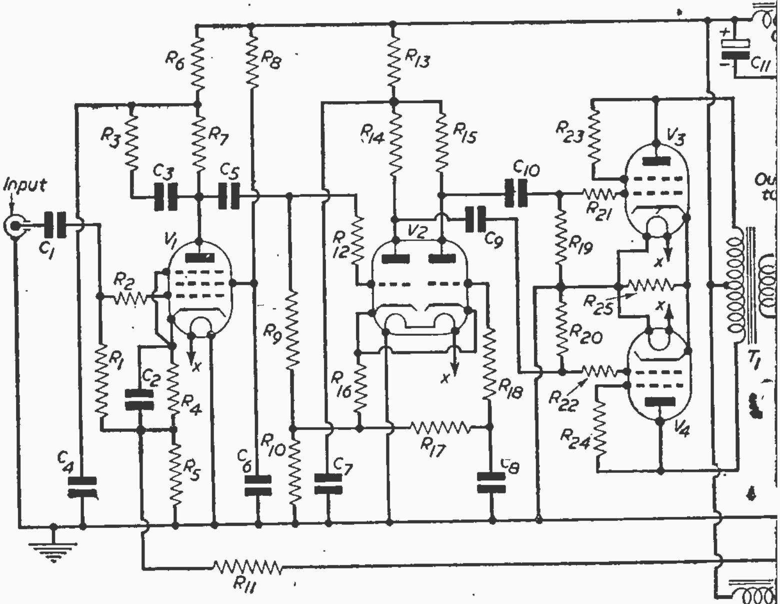


Fig. 1.—Theoretical circuit of the Amplifier.

.ty Amplifier

r High-quality Reproduction

DLE

in the anode-cathode circuit of the first half of the valve would be exactly balanced out by the anti-phased signal due to the anode current of the second half. There would, therefore, be no signal across R10 and thus no cathode input to the second half. If this is so, then there can be no signal at the anode of this half. But the argument assumed a signal at both anodes, so clearly the postulated state of perfect balance cannot exist with this circuit.

On the other hand, assume considerably more signal is fed to the first half grid than to the second half via the cathode coupling. Then the signal across R10 will be predominantly due to the anode current of the first half. This signal will be in phase with the signal at the grid of the first half, and being applied to the cathode of the second half will produce a signal large in amplitude at the second anode but opposite in phase to that at the first anode. But we pre-supposed a small signal input to the second half and we find that we have a large one! Again we have a *reductio ad absurdum* —a state of serious out-of-balance cannot exist.

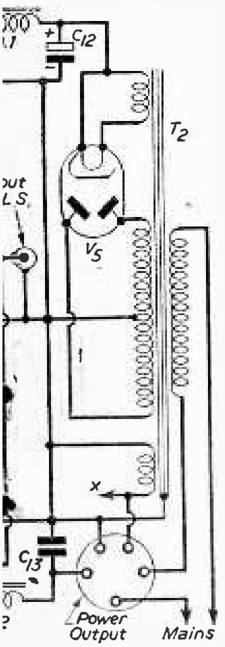
What happens, in actual fact, is that the valve settles in a state of equilibrium such that the two halves are very nearly in balance, but not quite, the amount of unbalance being that required to give across R10 a signal input to the second half sufficient to maintain the equilibrium. Should the signal shift in favour of either half, then negative feedback across this valve (this is not the feedback across the whole amplifier) will reduce the input signal to the favoured half, and positive feedback will increase the signal to the other half, restoring the almost balanced state again.

This self-balancing feature is valuable in maintaining a stable state of affairs even if the valve sections age unevenly, and permits one to "fit and forget" the resulting amplifier. The amount of the unbalance is determined by the stage gain but is, in fact, no worse than is experienced in apparently symmetrical circuits, unless complicated precautions are taken and adjustments periodically made.

The two halves are decoupled by R13 and C7, but the audio component in the common resistor R13 is already reduced by combining the two anti-phased outputs, and the decoupling effect of C7 is increased thereby.

The two anti-phased outputs are fed to the push-pull output valves. Though these are tetrodes, they are connected and worked as triodes. R23 and R24 are parasitic oscillation stoppers. Common bias is used, developed across R25, and no condenser is used across this, so that it tends also to pull the opposing circuits into balance.

Voltage feedback is taken across the whole of the amplifier, R11 being chosen to cause a fraction of the output from the secondary of the output transformer to be developed across R5, which is in series with the input. The resistances together are large enough to prevent appreciable power loss in spite of the low value of R5.



COMPONENT VALUES.

C1, C5, C8, C9, C10	.1 μF,	350 v.
C2	50 μF	12 v.
C3	200 pF	350 v.
C4, C7, C12	8 μF	450 v.
C6	.25 μF	350 v.
C11	16 μF	450 v.
C13	32 μF	350 v.
R1, R8, R19, R20	220 KΩ	½ w.
R2, R3, R12, R18, R21, R22	47 KΩ	½ w.
R4, R16	1 KΩ	½ w.
R5	10 ohm	½ w.
R6, R10	10 KΩ	½ w.
R7	47 KΩ	1 w.
R9, R17	1 Meg	½ w.
R13	10 KΩ	1 w.
R14, R15	33 KΩ	1 w.
R23, R24	100 ohm	½ w.
Ch. 1	20 H	150 mA.
Ch. 2	20 H	50 mA.
V1	6SJ7	
V2	6SN7	
V3, V4	6V6	
V5	5Z4	
T.1	18 : 1 for 15-ohm load. 45 : 1 for 3-ohm load. (but see text if an extension speaker is to be used)	
T.2	350-0-350 v. 150 mA. 6.3 v. 4 A. 5 v. 2 A.	

Feedback Values

The value of R11 is determined by the voltage amplification between the input socket and the output transformer secondary and will thus vary according to the peak power output and the speech coil impedance. In the present case, R11 should be 4,000 ohms for a 15-ohm speaker and 2,000 ohms for a 3-ohm speaker. For any other speech coil impedance the appropriate resistance can be worked out if it is remembered that it varies according to the square root of the impedance.

Construction

A detailed scale drawing of the original is not given because it is not likely to be exactly duplicated by any constructor. The circuit is not so critical that the exact components used in the original should be used; indeed, it is an ideal circuit into which to incorporate good quality components already to hand. The larger components used in amplifier construction vary so much in size and shape from one maker to another that it is unlikely that they would fall exactly into the same space and cut-outs used in the original.

There is given in Fig. 2 a layout diagram illustrating the preferred relative positions of the components and it will be as well to conform to this unless the constructor has had experience in high gain amplifier design.

Do not start construction until all components are available. Then lay them out on a piece of drawing-paper in the relative positions indicated, leaving room to work between components and space between valveholders to allow for the associated resistors and condensers. A group board is mounted between the valveholders to provide firm anchoring points, but remember that, where possible, components should be connected directly to the valve pin, using the group board only for the ends remote from the valve and for such components as decoupling resistors that are not to be directly connected to a valve pin. With the components in these positions on the paper, visualise the run of the leads carrying the signal until satisfied that they are short and will not give rise to undesirable couplings. Now pencil round the components and use the sheet for determining the exact chassis size to be used and as a guide when mounting the components. The size of the chassis used in the original model was 12in. by 10in. by 3in. deep, and, unless the components used by the constructor are exceptionally large, this should suffice.

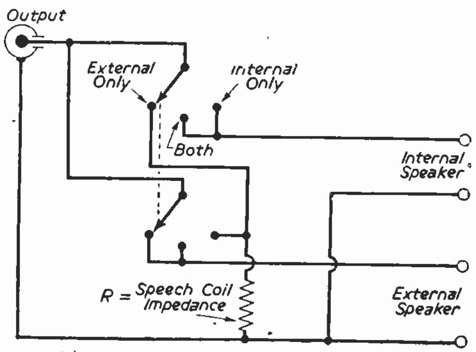


Fig. 2.—Switching for loudspeaker.

Provision is made for the supply of H.T. and heater current to a feeder or pre-amplifier panel, but if anything very ambitious is contemplated, care should be taken to see that the safe load of the mains transformer chosen is not exceeded. The original model supplies some 40 mA of H.T. and 1 Amp. of heater current to the tuning panel. It may be worth suggesting that if a super-efficient feeder unit is to be used, or a very high gain pre-amplifier, an entirely separate power circuit is worth while. This could well be built on to the amplifier chassis. If the mains transformer has sufficient reserve, a second rectifier could be fed in parallel with the main rectifier, with an entirely separate smoothing circuit, of course. A metal rectifier would be very suitable and would avoid the need for an extra heater supply. The advantage of this is that the problems of decoupling are very much simpler than where a common H.T. supply is used. In any case, the chassis fed from the power chassis should each have 8 or 16 μF across the H.T. input point to earth.

Switching

The mains switching is extended to the feeder chassis via the plug and socket carrying the H.T. and heater current. Care must be taken, therefore, that the insulation of the plug and the connecting cable used will stand the mains voltage. A Belling five-way power plug and socket proved quite suitable.

Instability

It should be realised that if the output transformer is connected to the feedback line in one direction positive feedback will result and the amplifier will go into self-oscillation when it is switched on. The right way is found by trial and error; if when first connected oscillation results, then reverse the connections from the transformer secondary to earth and to R11.

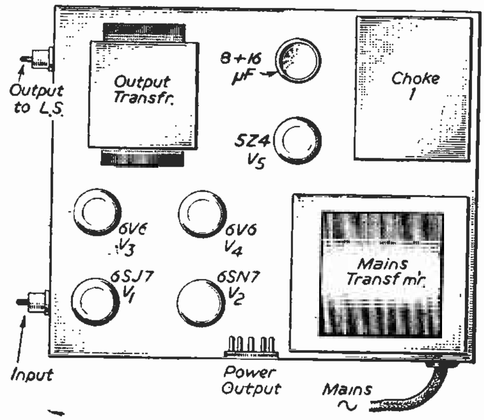


Fig. 3.—Suggested layout.

If the amplifier is unstable no matter in which direction the feedback is connected, then there is a phase-shift within the loop circuit (i.e., the circuit between the source of and application of the feedback voltage) at some frequency for which the gain is greater than unity (a very wide range of frequencies in an amplifier of this type). C3 and R3 are intended to reduce the possibility of this form of instability at frequencies above audio level, but the process cannot be further arrested by altering these components except to the detriment of the higher audio frequencies. The probable cause of this trouble is the output transformer and, ideally, one should change this component for one of a better type. As a temporary expedient an increase in the value of R11 (reducing the amount of feedback) can be tried, but if a considerable change is necessary to stabilise the amplifier then the cause of the instability should be sought and corrected, starting, as has been said, with a change of output transformer.

Smoothing

The amount of smoothing required to give a quiet background is considerably reduced by the feedback and, in fact, this amplifier has no audible hum. Should any hum be produced in any part of the circuit within the feedback loop a hum voltage is fed back to the input such as to produce at the point of production of the hum an almost equal hum voltage of opposite phase so, to all intents and purposes, cancelling out the original hum.

Input Hum

This safeguard does not apply to hum produced outside the feedback loop, which will be reproduced faithfully. The danger point is the amplifier input circuit and any feeder or pre-amplifier used before it. For this reason the signal is brought into the amplifier by means of a screened lead. A length of television coaxial feeder is ideal and is neatly and effectively terminated on a standard coaxial plug. The socket is positioned very near the first valve grid socket to cut down the length of unscreened lead to a minimum.

The amplifier is so sensitive to input pick-up (and in this it is no different from other amplifier circuits) that, when power is switched on, the amplifier can be tested by putting a finger on the uncovered input socket, when a pronounced hum is heard.

Use of Two Speakers

The constructor may desire to operate an extension speaker from the amplifier. Quite commonly a second speaker is wired in parallel with the main one, to be switched in or out as required, and the resultant mis-match to the output stage has little audible effect.

It will be realised that, in the present case, not only will this practice give a mis-match, but also the feedback characteristic will be altered if a second speaker is connected in parallel with the one for which the amplifier has been designed.

If, therefore, two speakers are to be used it is convenient to choose two with the same speech-coil impedance. The output transformer ratio must now be chosen to match the output stage to a half the impedance of the single speaker (i.e., the ratio must be 1.4 times that required for a single speaker). The feedback resistance, R11, should now be reduced to 3,000 ohms for 15-ohm speakers and 1,500 ohms for 3-ohm units.

Speaker switching should now be so arranged as to substitute a resistance in the positions where either unit is not required. A switching arrangement for either or both of two speakers of equal impedance is shown in Fig. 2 and the resistance used is equal to the speech coil impedance of the single speaker.

Control

No control, gain, tone or otherwise, can be included within the feedback loop because the feedback will attempt to counteract each adjustment made. Therefore if, in any particular application, it is desired to incorporate controls on the main amplifier, then they must be added before the V1 circuit. For instance, if a gain control is required, R1 could be a potentiometer of the same value, the moving arm being connected to R2.

Suitable feeder chassis, incorporating controls, will be described later.

V.H.F. Radio Network

THE V.H.F. radio network operated by the Manchester Corporation Transport Department is an excellent example of how valuable the use of radio telephone can be in the efficient operating of a large and complex transport system.

The installation consists of one fixed station and eight mobile stations all working on frequencies of about 70 Mc/s. Frequency modulation is used as experience has shown that this system is extremely effective in heavily built-up areas where man-made electrical interference with radio reception may be severe. A system of two-frequency simplex is used in operating the radio network. In this system the headquarters station transmits on one frequency to all mobile stations simultaneously. The vehicles all share a second frequency and only the wanted one replies to the headquarters call. There is no provision for the vehicles to speak to each other "on the air" because such a need is unlikely to arise. They can, however, have car-to-car messages relayed by the operator at headquarters.

The headquarters station has a power output of 15 to 20 watts and is located in the head office of the Corporation's Transport Department, at Piccadilly, Manchester. A mast on the roof of the building supports the single transmitting and receiving aerial, which uses vertical polarisation. The transmitter has its power supplied from the public mains and is remotely controlled from a radio room, which also houses the "traffic control" and "breakdown" sections of the organisation. "Traffic control" maintains telephone communication with the various transport termini of the city. All the loading and operation of transport is controlled by the traffic inspector on duty in the radio room and this official has control of the eight mobile units.

Traffic Cars

Four saloon cars are fitted with a combined transmitter/receiver mounted in the boot, with a small control panel, loudspeaker and telephone handset on the dashboard. The power output of the transmitters is 15 to 20 watts and the aerials are mounted vertically on the roofs of the cars. Two of the cars, which are manned by traffic inspectors, patrol in the northern sector of the city and two in the southern sector. In addition to the radio equipment, one car in each sector is equipped with public address facilities operated from the radio receiver, for directing intending passengers, etc.

Overhead Tower Wagons

Two tower wagons have been similarly fitted with V.H.F. radio equipment and are constantly out on the road on maintenance work. When required for emergency work they are called and directed by radio and when the emergency has been cleared the wagons report to Traffic Control and then resume normal maintenance work.

An Impedance Meter

This Instrument will Check Components and Their Values By T. HUTTON

IN most spares boxes there are often many unmarked components which are never used, chiefly because their characteristics are not known. It is, however, a simple matter to determine whether a particular item is either a capacitor, an inductance, or a resistor, and once this decision has been made, it is easy to measure its impedance, and hence its value of C, L or R. The total cost of this unit, if constructed from Government surplus equipment, is less than 15s. It indicates impedance directly, and will measure from 100 ohms

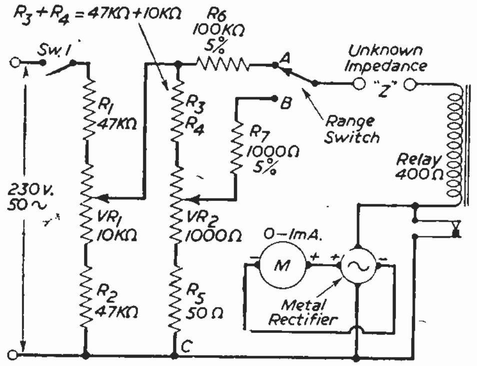


Fig. 1.—Circuit diagram of the meter.

to 10 megohms, the impedance merely being at the frequency of the supply.

Circuit

The circuit (Fig. 1) includes a relay for the protection of the meter. This is not an essential feature, and may be omitted. If desired, however, it is merely a modified version of an ex-Government 200- or 400-ohm relay. All of the contacts except one pair should be removed, and of these last two leaves the moving one should be partly sawn through with a hacksaw to increase the sensitivity of the relay. Similarly, the control spring may be removed and replaced by a weaker one, or omitted altogether. The contacts should close, after these modifications, at 4-6 mAs through the energising coil.

The sensitivity of the unit—its maximum impedance reading—may be increased by increasing R_6 to 200,000 ohms, and making the potential A to C equal to 200 volts. Then 15-20 megohms may be read with reasonable accuracy. Normally, however, the position of the *range* switch gives voltages from A to C or B to C of 100 and 1 volts, respectively.

It is advisable to use the specified 0-1 milliammeter, or else a 0-500 microammeter. If the latter is used, the resistors R_6 and R_7 must be doubled. A 0-5 milliammeter is not suitable, unless the relay is omitted, the meter rectifier changed for a 5 mA type, the values of R_6 and R_7 changed from those stated to 20,000 ohms and 200 ohms respectively, and the rating of R_6 made at least 2 watts. On no account may R_6 and R_7 be omitted.

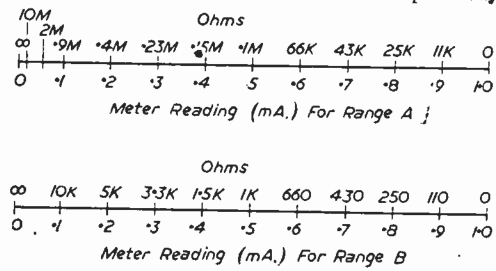


Fig. 2.—Conversion scales range A above, and range B below.

Alignment

When finished, the terminals or test leads for Z may be momentarily closed, with the switches Sw 1 and Sw 2 closed (on Range A). The meter will move to some random position. With the test leads shorted, the meter should be adjusted to full-scale deflection (F.S.D.) by means of VR_1. Then range B is adjusted to F.S.D. by VR_2.

Range A reads from 10,000 ohms to 10 megohms, and Range B reads from 100 ohms to 10,000 ohms, impedance at 50 cycles.

It is important that all the resistors employed in the meter should be non-inductive.

When the impedance of a component has been measured, its inductance or capacity may be established at once from a graph.

The indication is particularly satisfactory for L.F. chokes, but is not suitable for checking electrolytic condensers. It should be remembered, however, that the instrument gives a direct indication of the impedance presented to a 50-cycle supply by the component or apparatus under test.

Resistance Measurement

An additional refinement (found very useful for measuring wirewound resistors and insulation of coils) is to include a rectifier circuit, as shown in Fig. 3, in either of the supply leads from the mains. Sw 2 will short-circuit this arrangement, and VR_3 compensates for the voltage drop in the choke and rectifier. The rectifier has only to pass about 5 mA, but must be rated for 250-volt working, although otherwise the rectifying and smoothing arrangements are not critical.

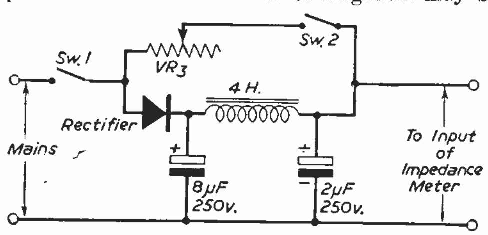


Fig. 3.—The rectifier circuit.

Accumulator Charging at Home—2

W. NIMMONS Discusses an Important Feature for the Battery-set User

HAVING obtained the equipment necessary for charging accumulators, either for your own use or for profit, the next thing you will want to know is how to charge, how to maintain the charge, and how to end the charge.

These are all very simple. To charge simply connect the accumulators, right way round, to the source of current; maintain this charge until the charge is complete, and then take it off charge. The length of time this takes is determined by the ampere-hour capacity of the cell and the rate of charging, that is, the amount of current flowing through the cell.

Cells should be connected the right way round. This is to connect the positive terminal of the cell —usually red—to the positive pole of the supply. Serious harm will result to the cell if it is connected wrong way round.

The cells coming in will be in a discharged condition. The positive plate will be a light brown colour, and the negative a dirty grey. The specific gravity of the acid will be around 1.120, as measured by your hydrometer. The voltage will be 1.8 volts or less when measured under load.

By "under load" is meant when supplying current of the amperage the cell usually supplies. A meter is not a good test of a discharged cell, because it draws a very small current. If, however, you join up a sidelamp bulb, wait a few minutes, then test, this will give a good indication of the state of the charge. It will probably be 1.8 volts or under. While this test is not important in a discharged cell, it is very important for a charged one, since you are dependent on it for determining when to end the charge. In this case the voltage will be 2.6 volts. This, together with the rise in specific gravity of the acid to around 1.250, is the method of determining when the charge is complete.

When put on to charge, the voltage of the cell will rise to 2.2 volts fairly rapidly, and thereafter it will rise very gradually to 2.6 volts, when the charge is complete. The voltage can be around 3 volts when tested with the meter alone, but as previously mentioned this is not a reliable guide. The cell should be tested with a motor car sidelamp or, in the case of large cells, with a headlamp bulb. If it then reads 2.6 volts it is a sign that the charge is nearing completion, though it is unwise to rely on voltage reading alone; they should always be used in conjunction with hydrometer readings. In this case, when the hydrometer reading ceases to rise, and remains steady for three hours, the cell can be said to be completely charged.

This point is stressed because an incompletely charged cell will soon begin to lose capacity. Some of the active material in the plates will become converted to lead sulphate, which has no electromotive properties, and this will slowly strangle the cell. Incomplete charging is one of the root causes of failure in an accumulator. When fully charged the positive plate will be a deep chocolate brown colour, and the negative a bright grey.

Damaging Cells

Charging at too high a rate is very bad. When this is done, heat will be developed in the plate, the plate will buckle, and some of the paste will be loosened and fall to the bottom of the cell. Here it will accumulate and eventually it will reach the plates and short-circuit them.

A cell in this condition will discharge very quickly, and since you are almost sure to get one or more cells like this there is no satisfaction in charging them, either for yourself or for the customer. In this case inspection will tell whether it is worth while doing anything to the cell in order to mitigate the trouble. It is always the positive plates which crumble in this way, and observation will tell you whether the trouble has gone too far or whether there is still hope of saving the cell.

If the positive plate is not too badly dented, you can restore the cell by cleaning out the sediment. A charge should be made for this job—say 2s. 6d. First empty out the old acid and fill up with water. Shake the container gently and pour out. Continue in this way until all the sediment is removed. Then fill with new acid of 1.120 specific gravity and put on to charge. In this way the cell may be given a new lease of life.

Gassing will begin about half-way through the charge, and will continue until all plates are gassing freely. It is unwise, however, to rely on gassing as a means of determining when the charge is complete. This should always be done by the readings of the voltmeter taken in conjunction with the readings of the hydrometer. It is a bad sign if the cell begins to gas immediately it is put on charge. This denotes that the cell is badly affected by the enemy of the accumulator—sulphate. It is a moot point whether anything can be done to such a cell. You might try a long, slow charge at about one-third to one-half the normal rate—with consequent longer times, of course—but it is doubtful whether there is any cure but a new cell. Such a cell will put up a very poor performance on discharge, despite every care in charging.

The good, healthy cell will "drink in" the charge without any gassing until the charge is about half completed, and then will begin to gas with very small bubbles which rise very slowly. The bubbles will increase in size as the charge nears completion, and at the end the acid should appear cloudy owing to the mass of bubbles.

Car batteries, and the Varley "dry" accumulators have opaque cases, and consequently you cannot see inside them. The treatment for these is precisely the same as for the glass ones: charge until voltage rises to 2.6 volts under load, and the hydrometer reading is 1.250.

Evaporation

To make good the loss of evaporation only distilled water should be used. The acid does not evaporate—only the water. Therefore acid which has been allowed to fall by evaporation to below the mark will be too strong and may give rise to "treeing" and other troubles. Treeing is a sort of growth on the plates which may bridge them, with consequent short-circuits. If, after adjusting the level of the liquid at the end of a charge it is found to be still above 1.250, syphon out some of the liquid and replace with distilled water. Adjust to 1.250.

If below this figure on completion of charge, syphon out some of the liquid as before and add acid of 1.400 specific gravity to make up the difference. This is best done when the cell is gassing freely, as this mixes the water or acid with the rest of the electrolyte.

Sometimes you will get a cell with stuck terminals. Do not attempt to unscrew them with pliers. Instead, soak a rag with ammonia and place it around the stuck terminal, and let it remain there for about half an hour. If still stuck pour hot water on the terminal. This should shift it, though you may have to apply gentle pressure with the pliers. Complete the procedure by thoroughly drying and applying Vaseline or a smear of tallow to the shank of the terminal to prevent further lock-ups.

If you are handling many cells in the course of the week you should, of course, have some means of identifying them. To get mixed up is, to say the least, unbusinesslike. A printer will supply you with a duplicate set of cards, which are numbered, and one of which you give to the customer and the other you place on the cell by passing the terminal through the hole provided. But you can quite easily cut and number the cards for yourself, only be sure you don't get them mixed.

Minor repairs to terminals, etc., and repairs to celluloid cells by means of amyl acetate are quite within the province of the home handyman, but major repairs such as the burning on of new plates are beyond his scope, so need not be dealt with here.

Mechano-electronic Transducer

THE RCA-5734 is a triode transducer intended to provide a method of translating mechanical vibration into electrical current variations which can be observed and measured. It has a deflection sensitivity of 40 volts per degree deflection of the plate shaft. The part of the plate shaft within the tube has a minimum free cantilever resonance of 12,000 cycles per second permitting, with suitable mechanical coupling to the external and of the plate shaft, measurements of vibration up to 12,000 cycles per second. The moving element of the 5734 is designed to have very low inertia.

The 5734 weighs but a 1/16 of an ounce (1.75 grams), has a length of only 1-9/32in. and a diameter of 5/16in. Its small size and light weight provide flexibility of installation. Since its introduction to this country in late 1948, the RCA Type 5734 has proved itself to be a valuable and versatile research tool.

The following brief details will give some indication of the wide variety of uses to which this unique tube may be applied:

Oscillograph recording, through a diaphragm attached to the 5734 plate shaft, of tank pressures set up during the short-circuit testing of circuit breakers.

A sensitive method of amplification in the measurement of the fine limits met with in optical processes.

In neuro-surgery for the development of a miniature probe for comparison of mechanical movements of very small excursion and at frequencies within the audio range. In this application, the very small physical size of the 5734 is of the greatest importance as the probe must be capable of easy manipulation by the surgeon.

Research work in connection with stress evaluation and vibration phenomena in the motor, aircraft and shipbuilding industries.

GENERAL DATA

Electrical

Heater, for Unipotential Cathode:	
Voltage (A.C. or D.C.)	6.3 volts
Current	0.15 ampere

Mechanical

Mounting position	Any
Max. angular deflection of plate shaft	± 0.5 degree
Max. overall length (excluding flexible leads)	1.300 degree
Max. diameter	0.328 degree
Envelope	Metal shell MT-2-¼
Terminal connections	4 leads and metal shell

Maximum Ratings, Design-centre Values:

D.C. plate-supply voltage	300 max. volts
D.C. plate current	5 max. m/A
Plate dissipation	0.4 max. watt
Peak heater-cathode voltage:	
Heater negative with respect to cathode	90 max. volts
Heater positive with respect to cathode	90 max. volts

Typical Operation

D.C. Plate-supply voltage	300 volts
D.C. grid voltage	0 volts
Amplification factor*	20
Plate resistance*	72,000 ohms
Transconductance*	275 micromhos
D.C. plate current*	1.5 m/A
Load Resistance	75,000 ohms
Deflection sensitivity†	40 volts/degree; 2,300 volts/radian
Moment of inertia of plate	3.4 milligram cm
Rotational compliance of diaphragm	0.0013 x 10-3 radian/dyne cm.; 0.075 degree/gram cm.

* For plate shaft in undeflected position.

† Average change in voltage across 75,000-ohm, plate-load resistor when the plate shaft is deflected from −0.5 to +0.5 degree.

The plane of deflection of the plate shaft must coincide with the plane through terminal No. 5, and the axis of the tube.

Board of Trade authority has been granted for the importation of a small stock of these tubes for the benefit of approved institutions. Colleges, Medical Schools and Research Organisations interested in using this valuable research tool should apply for further particulars and price to RCA Photophone, Ltd., 36, Woodstock Grove, W.12.

For the Experimenter

Simple Experiments in Electromagnetic Induction

By "MICRON"

HAVE you thought of starting a modest experimental laboratory, not so much to try out circuits, but to study important electrical and radio principles, test pieces of apparatus, valves, components, or make simple measurements and calibrations which do not require expensive gear?

It can be an absorbing hobby. At one time when I was an electrical apprentice, I learnt to study my textbooks in a practical way. Having little else to do for hours on end when working night-shifts, I made good use of some spare switchboard instruments.

I knew enough to use them intelligently. There are grave dangers in putting expensive instruments in the hands of would-be "experimenters" before they have fully grasped the meaning of "I=V/R."

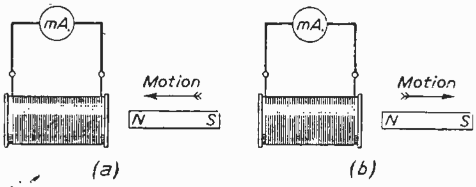


Fig. 1.—An "ancient" but interesting experiment.

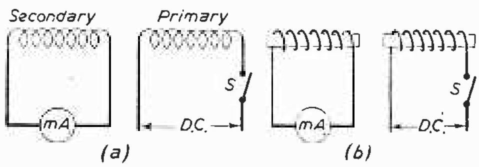


Fig. 2.—Principle of transformer and induction coils.

It is so easy to do such silly things as connecting up an ammeter like a voltmeter, or employing one without a shunt!

My Experiments

First, I used one of these meters, not for measurements, but as galvanometers or "indicators" to verify the laws of electromagnetic induction. The shop was equipped with an excellent variety of spares for the works, among which were a number of coils and solenoids. I made a few strong bar magnets out of old files.

So I started "night school" in earnest, setting out to check Faraday's experiments all over again! With one of the ammeters (really sensitive *milli*-ammeters when used without series or shunt resistances) connected across the coil Fig. 1a, I proceeded to "cut" the turns by "lines of force" emanating from a magnet. I plunged first the N-pole of a magnet into the coil.

The result was much more interesting than the textbooks. At once I got a large "kick" on the galvo., proving an induced voltage. But only as long as the magnet was *in motion*—an obvious fact to-day, but it took Faraday a series of repeated failures to realise that motion was necessary!

Withdrawing the magnet (reversing the motion, Fig. 1b), a reversed voltage was induced, the meter pointer giving a reverse deflection.

While, as stated, these facts are commonplace enough, there is something very strange about them. What *really* exists in the space around a magnet, and why should it give rise to a "voltage" or an electric current if set in motion relative to turns of wire? Seeing is believing, and it is not easy to realise fully what books on electricity and magnetism are teaching until the truths are checked by actually doing the experiments.

Of course, you have learnt why the induced E.M.F. reversed. "Lines of Force" (do they exist physically?) cut the turns of the coil, first one way,

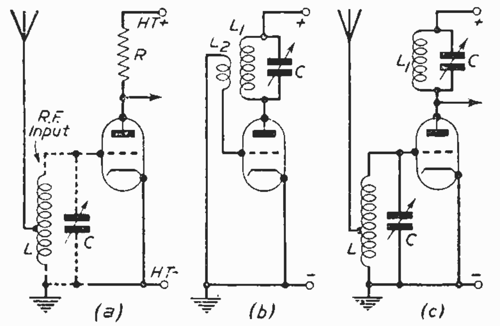


Fig. 3.—Simple experimental studies of "amplification" and "oscillation."

then in the opposite direction. But let us consider the matter.

How much does science know about these things? Here—around a magnet—is a highly mysterious sort of space, "twisted" or "warped" in some manner as to have "magnetic" properties. When this odd nothingness (?) "cuts" the turns of a coil of wire an "electric force" is generated—that is no abstraction, for it can be used to light cities, drive underground trains or, converted into high-frequency electromagnetic "waves" travelling with the speed of light!

Plenty of problems to ponder about. Anyhow, I spent many fascinating hours with these experiments on induction. A bar magnet was but a start. Next, I used a second coil as a "primary" (Fig. 2a), still employing D.C. from the mains or a battery. The galvo. behaved the same as in Figs. 1a and 1b when a current was started and stopped in the primary.

Iron cores were introduced into the coils, Fig. 2b, when the E.M.F. generated in the secondary was vastly increased. I could get a considerable deflection in the meter when the coils were many feet apart. I observed, too, in all cases that the induced E.M.F. when "breaking" the primary current was much greater than during "make."

Can you give the reason for this? The observation has important applications to "vibrator" devices, or induction coils and car magnetos.

Next, I managed to light a small lamp, momentarily, by connecting it across the secondary, the degree of brilliance being again much greater on breaking the primary circuit, tending, in fact, to blow the lamp if care had not been taken in adjusting the "coupling" between the coils, etc.

When a lamp of normal voltage (230/240v.) was put directly across the primary, it glowed normally, of course, when the switch was made, but sometimes blew out on "break." I should add that a highly-inductive coil was used as primary; the *self-induced* voltage due to "inductance" was much greater than 230/240v., though a "discharge resistance" of somewhere around the same value as the resistance of a metal-filament lamp will usually serve to limit the induction.

But I have seen plenty of lamps blowing when connected directly across the terminals of large electromagnets, with a switch or equivalent device forming a "break" on the mains side. It provides an important object-lesson: the danger of insulation breakdowns if simple "make-and-break" switches are employed in highly inductive circuits.

However, my present purpose is not so much to follow out these experiments in detail. As I said, they gave me a far better insight into Faraday's and Lenz's Laws than any amount of mere book-work. All sorts of interesting measurements to verify Ohm's Law and other principles followed, and I still think it an excellent policy to commence a "study" of electrical or radio problems by "beginning at the beginning."

Studying Simple "Circuits"

First, to make any visual observations, we shall have to use instruments—a voltmeter and/or a milliammeter or two, possibly not for measurements, but as indicators of maximum or minimum (or zero) currents, etc. Indeed, instruments themselves can provide a useful field for experiment, as will be outlined later.

Without any instruments—other than a pair of telephones or what amplifier-loudspeaker or receiving circuits already exist or can be hooked up—much can be accomplished "by ear" in observing *effects*: for example, amplification, oscillation, instability, rectification or detection (or what happens if there is none?), use of triodes, screened-grids, pentodes, observing "harmonics," making frequency-multipliers, study of frequency-changing (the *beat* principle), modulation of an R.F. "carrier" by A.F., smoothing and decoupling circuits, etc., etc.

Let us take the first two from this short list: "amplification" and "oscillation."

Consider the three "circuits" shown in Fig. 3. That of Fig. 3a will *amplify* an A.F. signal quite well, if R is made large enough. It *may* give some degree of amplification of an R.F. signal if used before a detector and amplifier, but the gain is apt to be extremely poor or, in certain circumstances, a *loss*. Why?

If the coils L_1 and L_2 are connected up in reversed "sense," the circuit of Fig. 3b will function as a *generator* of high-frequency oscillations. It will generate a "carrier" of very minute power, which can be tuned-in at some point on the tuning-scale of a receiver; if unmodulated, only a rushing noise will be heard, but if the receiver itself has an oscillator a *beat note* will be apparent on tuning to either side of "zero beat" exactly as when picking up a transmitted carrier. Alternatively, the carrier of "milliwatts" or "microwatts" power may be amplitude-modulated by the audio-output from a gramophone pick-up, another A.F. oscillation, or "50-cycle" from the mains.

If the values of L_1 and C are known, and the calibrations of the receiver-scale are reasonably accurate, the wavelength of frequency of the oscillation can be read-off, and a check made on the formulæ:

Wavelength (in *metres*) $= 1885\sqrt{L_1C}$,

where, L_1 = coil inductance in *microhenries*.

C = tuning capacitance in *microfarads*.

Or: Frequency (in *kc/s*) $= \dfrac{160}{\sqrt{L_1C}}$, approx.

Thus an oscillator of this type generates an

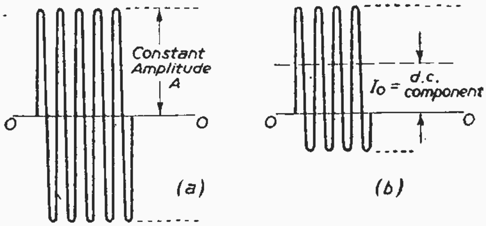


Fig. 4.—"Detection" of an unmodulated signal.

H.F. current which has a frequency corresponding to the "LC value" of the anode tuned circuit, i.e., the generated oscillation will be at the A.C. *resonant frequency* of the LC-circuit—more in the nature of a "coincidence" than any physical relation between the two things. In fact, the frequency of every oscillator must shift slightly "off" the LC-value, but it would require very exact measuring equipment to demonstrate the fact.

There is no end to possible experiments on oscillators, and the interesting things which can be done with them. It is hard for the newcomer to radio to realise a valve can be made to act as a "generator," and that this is really the basis of most types of low-power portable transmitters.

In Fig. 3c, the valve is not intended to act as an oscillator, but an H.F. amplifier. We have substituted for the anode resistance R, in Fig. 3a, a tuned-anode load, to ascertain if this effects any improvement in the gain at high-frequencies in Fig. 1a. It does, but we shall probably get "oscillation" all the same even without a coil L_2 in the grid-circuit.

Since it is an amplifier that is required, we say it is an *unstable* amplifier—generating unwanted oscillations and generally playing havoc with the reception of everything other than "C.W." morse signals.

You may try screening the anode and grid tuned-circuits. It is unlikely to prove effective because the triode valve itself offers a good "path." or "coupling." through which H.F. reaction takes place—via the anode-to-grid inter-electrode capacitance of 5μμF. or so.

Even with perfect screening, this capacitive path will have such a low A.C. reactance at radio frequencies as to give almost "tight" coupling from anode to grid.

The *gain* has certainly improved by employing a tuned-anode load, but it has served only to make the stage more unstable—more amplification increases the tendency to oscillate. "Stability," of a sort, might be got by applying palliatives to *reduce the gain*, when the "amplifier" would finally not be so much better than Fig. 3a.

Neutrodyning is still worth experimenting with, but we must skip it now. At present I am only indicating possible lines for practical work under various headings, and it is clear that a great deal more can be done even if we confined this (and other) articles only to the two subjects mentioned—amplification and oscillation.

Thus, in Fig. 3a, mention was made that R must be "large enough." How large? Is there any limit to the degree of amplification obtainable by increasing R? and, secondly, are there any other considerations which set a limit to the largest resistance that may be employed? Obviously, the answer is "Yes" to both questions. But, with a given valve, it would be useful to note at what values of load resistance the observable gain ceases to increase—or at what (higher) values it may actually start to fall off. In the latter event, could anything be done to restore matters?

Then, what about the valve? Presumably it will be a battery-type of which a few more may be available having different "constants": "μ," "gm," and "ra." *With a given load resistance*, what would be the effect of inserting a valve having a larger *mutual conductance* (gm)? Would the amplification be increased or otherwise if, all else being the same, we used a valve of larger *A.C. resistance* (ra)?

As the various valve factors are inter-dependent, such questions are not straightforward. For example: gm = μ/ra, whence, to get a larger gm, ra must be less in proportion to μ—which is quite consistent with μ being larger and ra constant. So, there is a little more to these experiments than just sticking in another valve and noting results. You must know your "valve constants." Still, it is a useful field for later work. As a first step, you might observe, say, the results of using two very different types of valves—one, an "L.F." type with ra around 10,000 ohms, and an "H.F." type of 20,000 ohms upwards.

Which gives the better *voltage amplification* if R is increased proportionately to ra? Be careful how you are going to observe voltage gain. It will not be much use sticking a pair of phones of impedance 2,000 or 4,000 ohms across a stage whose internal impedance is of the order of 20,000 ohms! If to be "loaded," a voltage amplifier should always be used to drive another valve of the "power" type—or inserted in front of a separate amplifier.

Checking Basic Radio "Principles"

In a way, all the above forms of experimenting are designed to verify "basic principles." In fact, under the present heading we shall only make use of more items outlined in our list.

Consider "*detection*" of a signal. No doubt you have learnt that a detector is essential in every receiver, for "separating L.F. from H.F.," or "*extracting* the L.F. modulation envelope"—the last being the more correct statement. From America, we have the term *de-modulation* for the process, which can and does mean other things than "extracting" modulation.

However, the first thing to realise is that a detector is essentially a *rectifier*: a device which partly or completely changes a pure alternating current into a "unidirectional D.C." As a result, we shall get a "D.C. component" of current—a "mean current," either absolutely steady, or *itself undergoing an alternating change at the frequency of modulation.*

If a steady (unmodulated) carrier-current is rectified, Figs. 4a and 4b, the resulting D.C. component will have the steady value Io, Fig. 4b., and in a valve circuit this may register as a *current-increase* (a *decrease* in some forms of detector) which may be indicated by a milliammeter.

Initially, the milliammeter might show a normal standing current of the valve when no signal is being received. Upon tuning-in the H.F. carrier, this reading increases because of the additional D.C. component Io. At the exact tuning-point, the amplitude of the incoming carrier voltage, and therefore the value of Io and the meter reading will be a maximum.

The simple facts described suggest experimental ways of observing the action of a lower-anode-bend detector, Fig. 5a.

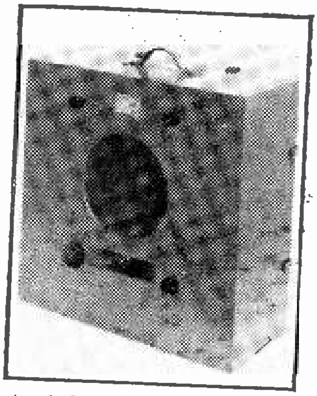
Suppose the grid initially biased to current cut-off, as in Fig. 5b. With no "signal" applied, the meter mA should thus indicate "zero current"—a small initial reading ("standing current") will not matter. As long as our bias-point is anywhere on the "bend" of the characteristic, rectification will take place; in fact, *cut-off* is not the best point where to get maximum rectified current.

As a "signal," the alternating E.M.F. from a 2-volt or 4-volt winding of a mains transformer may be used as shown—reduced further with the aid of a volume control. When this signal is switched-on, the milliammeter will register a D.C. component Io, which will be larger, the larger the 50-cycle E.M.F. applied to grid. Starting with the volume control at a low setting, the signal input can be gradually increased, when, after passing the lower bend, Io will rise *nearly in direct proportion.*

The explanation is the one illustrated in Fig. 4b. The alternating E.M.F., Fig. 4a, gives rise to *half-waves* of current in the anode circuit, having a mean D.C. value Io proportional to their amplitude—therefore proportional to the amplitude of the E.M.F. applied to grid.

(To be continued.)

EX. RAF 4 VALVE BATTERY RECEIVER



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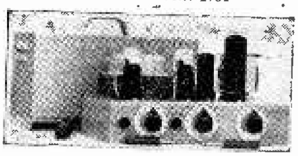

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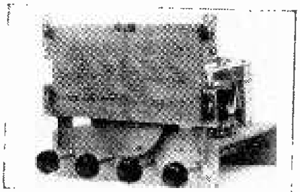

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MISCELLANEOUS. BASES. Amphenol octal, 6d. ; paxolin, 4d. ; B7G pax., 9d. ; droppers with FT and sliders, .3a 750 ohm or .2a, 1,000 ohm, 4/6 each. Chokes, 60 ma 20 hy., 6/3 ; 90 ma 10 hy., 8/-. Linecord, .3a, 60 ohms FT. 3-way, 1/- yard. Volume controls less Sw. 2/9 ; with Sw., 4/6. **All Goods New and Unused. No. W.D. Components Advertised.** C.W.O. or C.O.D. Post paid over £1. Closed THURSDAY.

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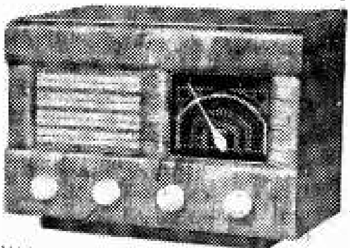
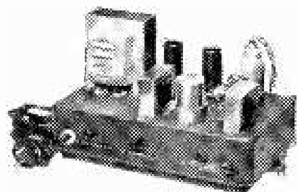


Walnut veneered cabinets approx. 12in. x 9in. x 7in. deep, 30/-.
Any type of cabinets made to your specification. (Send a sketch and full details.) Send 2/6 for lists and blueprints to build either a T.R.F. or Superhet Receiver in above cabinet.



4 and 4½ watt **A.C. Quality Amplifiers** with neg. feedback from **£5 3s. 0d.** 5 watt Universal similar to above from **£3 16s. 6d.** 15 watt Universal Quality Amplifier with Push-Pull output and neg. feedback from **£9 15s.** Full details on request.

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322, High Road, Wood Green, London, N.22. 'Phone : BOWes Park 5997.

2 volt Battery Superhets, 6-9 Mcs. Chassis taken from No 18 Tx/Rx. Tested ready for use. **18/6**, post 1/6.
New 1N34 Crystal Diodes, 5/3.
Meters, 4½in. 0-200 microammeters. First grade, **42/9.** 2in. 0.500 microammeters, **8/-.** 2in. M/c 0-300 v., **10/-.** 0-40 v., **7/6.**
Multimeters. 2½in. Supplied with black bakelite case, 6in. x 4½in. x 1½in., and resistors for D.C. ranges 0-30 v., 150 v., 300 v., 600 v. and 60 mA. Also scale reads ohms 0-5,000 with 1.5 v. battery, **16/6** each.
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New Brown's Moving Reed Headphones. Best in the world, **6/6.**
200-250 v. A.C. or D.C. **Motors,** about ¼ h.p., fitted with 2½in. x ½in. high grade grindstones, medium or fine, made by Nortons, **20/-.**
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Powerful Small Motors, 3½in. x 2½in. x 2½in., 24 v. A.C./D.C., with geared spindle, **8/6.** Transformer 230/24v. **16/-.**
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Programme Pointers

This Month MAURICE REEVE Deals with Some More Recent Programmes

THE B.B.C. is, in one respect, very reminiscent of the rugged, gale-embattled cliffs of old England. Centuries of wind and wave have left Land's End, John o' Groats, Flamborough Head, Beachy Head and what you will, absolutely unaltered and unimpaired in their magnificent inviolability. And our descendants a thousand years hence are as sure to find them as noble an inheritance as we have received them from our fathers. So untouchable are they under all the stress and strain of Mother Nature at her most vicious and enraged that their impregnability has embedded itself into the very characters of the peoples which shelter behind them.

If we change our noun from Britain to B.B.C. and our adjectives to form suitable contrasts and antonyms, we have a curiously similar picture. It is practically impossible to pick up a column of radio criticism and find the major portion thereof favourable and complimentary. They vary from about half and half to the almost entirely damnatory and condemnatory. Critics storm and curse, weep, plead and expostulate, but nothing ever seems to happen. Like our cliffs' reactions to storm and tempest, the B.B.C. seems quite unallergic to it all. The critics can't be wrong all the time.

Perfection is neither asked for nor expected. But a reasonable standard of efficiency, plus initiative and experiment, are. And when this is at the lowest ebb consistent with existence, criticism is no longer captious and finicky, but cannot be too full-blooded and throaty. For so many months that they must now add up to years there have been almost unanimous cries amounting to derision and indignation at the appalling bathos, pathetic ineptitude and general nitwittery of the variety programmes. Even to label them or class them under that ancient and classical heading has become a mockery and a misuse of terms. But nothing is done; the waves of criticism continue to beat quite in vain and the whole radio variety world, not even being content to remain at its lowest ebb, gets even worse.

Whatever "variety" there may originally be when the numerous acts and turns are first grouped together and labelled "Starlight Hour," "Henry Hall's Guest Night," or "Music Hall"—and, similarly, in the personal shows built up round a name or names, like "Take It From Here," "Much Binding" or "Up the Pole"—all are condemned at birth to the complete subjugation of their personalities by being produced on exactly similar lines and turned out of precisely the same mould. All are announced with a replica of each others' blurb, followed by an exact copy of their "signature tune"—the most culpably hideous row ever to emanate from musical instruments, quite indefensible on any count. Each individual item is greeted in exactly the same manner and, whether good, bad or indifferent, applauded with exactly the same volume of applause as near as matters, plus the same whistle from between the teeth. In the, what I have styled, personal shows every appearance or entry is preceded by the opening and shutting of the property door. The best jokes and wisecracks are invariably made against themselves. This is done to such an extent as to become, intentionally or not we do not know, a powerful form of self-advertisement, Tessie O' Shea coming in for the lion's share. One could enumerate other instances of needless standardisation under which all individuality must perish. Whether the show is finally labelled "Take It From Here," "Take It From There," or "Take It from Anywhere," all must be doomed to the uniformity and regimentaion of pork pies, the only variation being the quality of the pork, which, I fear, is exceeding great.

But we must keep on and hope that things will improve one day.

Sir Adrian Leaves

WHEN this article is in print, Sir Adrian Boult will have conducted his last concert as *chef d'orchestre* of the B.B.C. Symphony Orchestra, his final appearance having been postponed from early last year owing to the difficulties of finding a suitable successor. Director of Music 1930-42 and orchestral chief from then onwards, Sir Adrian has done, I suppose, as fine a job as anyone who ever entered Broadcasting House. He is by no means retiring from musical life, and we shall have the great pleasure of hearing him many times yet.

Musically the month was dominated by the usual Easter performances of Bach's great religious works, as accepted and looked-for items of the season as eggs and buns. I heard the B minor Mass under Sir Adrian, and the great work came over as splendidly as ever. Personally, I greatly missed this Easter the Good Friday Parsival Concert, glorious in every way and surely the most suitable of all Easter music. I know that, last year, they didn't turn people away from the Albert Hall, but they only do that on very rare occasions at any time. I hope we can have it next year.

Mewton-Wood is a very satisfying young pianist—more so than many with perhaps bigger names—and his performance of Schumann's rarely-heard Davidsbundlertanz was full of poetry and technically adequate. Chopin's even more seldom heard Sonata for 'Cello and Piano is surprisingly neglected by this combination of instrumentalists, seeing how small their repertoire of good things is. It was very well played by Thelma Reiss and John Wills.

Priestley's Plays

PRIESTLEY'S "An Inspector Calls" made an ideal radio play: Priestley's plays invariably do. What it lost through the absence through illness of Sir Ralph Richardson we don't know. R. Williams filled the yawning chasm with very great assurance and effect. Like all good plays, the plot is sustained right through, with the climax actually coming with the final curtain. The story, briefly, is of a very self-satisfied prosperous family, the father of which seems about to realise many ambitions including a knighthood. A series of exciting events, however, reveals sin and corruptions, each member being worse than the last. The Inspector puts them through it the whole time. Each one, nevertheless, seems about to get off scot-free, as far as any public knowledge of events is concerned. All seems about to be whitewashed, the Inspector departs, the family retires, father heaves a mighty sigh of relief and pours himself out one to his knighthood when lo, there is a ring at the front door and the maid announces an inspector. No knighthood after all. Curtain. Very effective and dramatic.

Victoria Regina

HOUSMAN'S "Victoria Regina" is always charming in its early stages. Her romance with Albert is one of the most beautiful of all time, and the author touched it off to perfection, as did Gwen Ffrangcon-Davies and Olaf Olsen. But from the Prince's death onwards, through Gladstone, the Diamond Jubilee and the B.B.C. effects dept., it became very tedious and boring. When it describes states of mind and characters it was excellent, but when it narrated crude and not very interesting facts, it paled off.

News from the Clubs

LEWES AMATEUR RADIO CLUB

Hon. Sec.: M. B. Beck, 5, Grange Road, Lewes, Sussex.

CLUB nights are still well attended and it is hoped to start construction work soon. The high-light of club activity was the recent visit to the B.B.C. Third Programme transmitter, at Shoreham, where the engineer in charge, Mr. Evershed, ably explained and demonstrated the workings of the two transmitters.

STOURBRIDGE AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: W. A. Higgins, 28, Kingsley Road, Kingswinford, Nr. Brierley Hill.

AT the meeting held on Tuesday, April 4th. Mr. H. Porter, G2YM, of Wolverhampton gave an excellent talk on the past and future of amateur radio. He gave some very interesting and amusing experiences as a radio operator in World War 1.

Meetings are held on the first Tuesday and third Friday in each month.

WARRINGTON AND DISTRICT RADIO SOCIETY

Hon. Sec.: J. Speakman, Dark Lane, Whitley, Warrington.

DURING April talks were given by Mr. D. Clift, G3BAK, on "Aerials"; Mr. B. W. Webster, on "Metal Work in Radio Apparatus"; Mr. S. Palmer, G8IZ, on "A Hum-free Sound Amplifier"; Mr. S. Allen, G8TR, on "Pre-war Gear."

Included in future programmes are talks by Mr. S. Wood, G3EZX, on "Radio Simply Explained"; Mr. S. Allen, G8TR, on "Valves"; Mr. F. Rowse, G3LZ, on "Communication on 3 cms."

Meetings are held on the first and third Monday of each month at 7.30 p.m., at the Sea Cadet H.Q. New members always welcome.

THE MIDLAND AMATEUR RADIO SOCIETY

Hon. Sec.: G5LJ, 32, Pilkington Avenue, Sutton Coldfield Warwickshire.

THE MARS receiver was the subject of the last meeting and thanks are due to Mr. Rhodes and Mr. Brown for their very excellent piece of apparatus so nicely constructed. Several members are building these receivers from the society's blue prints and constructional sheets.

READING RADIO SOCIETY

Hon. Sec.: Mr. L. Hensford, G2BHS, 30, Boston Avenue, Reading.

THE annual general meeting of the Reading Radio Society, was held on Saturday, March 25th, when the following officers were elected to direct the society for the coming year.

President, Mr. Benhough; chairman, Mr. Owen, G3AKQ, vice-chairman, Mr. Watts, G6WO; secretary, Mr. L. Hensford G2BHS; treasurer, Mr. Weaver; scribe, Mr. Mercer, G3EGU; committee, Messrs. Pearce, G3FUO; Dee, G3BJE; Dolton and Keating.

The programme at other recent meetings included a talk on Valve Voltmeters, by Mr. F. Ruddle, and Time Sharing Multiplex Communication, by Mr. Treadwell, of S.T.C. Ltd

THE ECCLES AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: J. A. Evant, 160, Greenleach Lane, Worsley.

THIS society was recently formed and has now 30 members. Weekly meetings on Monday, at 7.30, have been supported by good attendance.

The evening commences with morse instruction by G3GGF. Constructional discussions and exchange of ideas are features of the meetings. Mr. B. Russell demonstrated his home-built miniature oscilloscope, resulting in 10 other members being anxious to take up 'scope building.

The full R.A.E. course for the winter evenings at the Technical College is proposed and being arranged.

THE BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: L. Holden, 17, Hartington Road, Brighton.

THE club night, Tuesdays, 7.30 p.m., will carry on throughout the summer and a full programme is arranged. Visitors to the district, on holiday, etc., will be welcome. Club H.Q. "Eagle Inn," 125, Gloucester Road, Brighton. Members are hoping to get out on portable working during the summer. The club circular, "The Brighton Link," is now in its new cover.

THE SOLIHULL AMATEUR RADIO SOCIETY

Hon. Sec.: W. Bastin, G2BFT, 386, Lugtrout Lane, Catherine de Barnes, Solihull.

AT a recent meeting our members enjoyed a series of films on the manufacture and uses of plastics. Mr. T. Benson gave a brief explanatory talk, and a lively discussion followed.

It is hoped to commence construction soon on the club transmitter, under the club call sign, G3GEI.

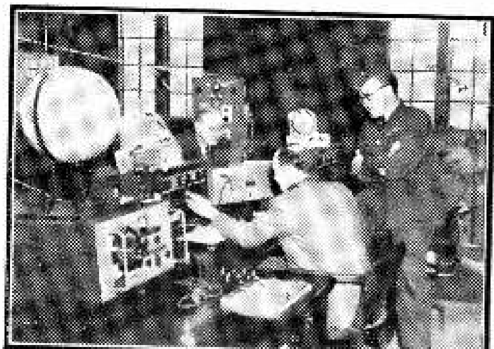
Meetings are held every alternate Wednesday, at the premises of J. H. Tucker & Co., Ltd., King's Road, Tyseley, Birmingham, and visitors and new members are assured of a cordial welcome.

HAM-FEST AT CRANWELL

THE Royal Air Force Amateur Radio Society held its first Post-war Ham-Fest, at Cranwell, recently. The attendance totalled some two hundred visitors.

After a tour of No. 1 Radio School, including a visit to the H.Q. Station of RAF-ARS (G8FC), the parties rendezvoused at the new N.A.A.F.I. Club for a most excellent tea and were addressed by the President, Group Captain H. A. Evans-Evans, and the General Secretary of the Radio Society of Great Britain, G6CL.

Membership of the R.A.F. Amateur Radio Society is open to any person who is interested in any phase of amateur radio and is either serving or has served in the R.A.F. A magazine is issued twice yearly. For full details write to Hon. Sec. (Admin.), RAF-ARS, No. 1, Radio School, Cranwell, Lincs, or join the RAF-ARS 'phone net with G8FC on any Sunday at three o'clock on 3,750 kc/s



G8FC, Headquarters Station of the R.A.F. Amateur Radio Society.

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The "ONE-VALVE PORTABLE." Slightly larger than the above but covers medium and long waves. 2/6

The "TINY TWO" Portable. Med. waves. Self-contained frame aerial, batteries and 2½in. Speaker. For "local" station "Individual Listening." 2/6

The "THREE-VALVE PORTABLE." This model is 9 x 6 x 4 ins. and has a 3½in. Speaker. Covers medium and long waves. Good speaker results on the "locals." 2/6

The "FOUR-VALVE PORTABLE." Slightly larger than the above. Med. waves. 5in. Speaker. T.R.F. Circuit. Greater range than the 3-Valver. 2/6

The "CORVETTE." A 4-Valve Superhet covering S., M and Long waves. Midget valves. Chassis approx. 5½ x 5½ x 2 ins. Ideal for Portable or House model. Fine range in any area. 3/-

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65/-

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COLLARO RECORD CHANGERS
9 gns.

Two brand new RC500 changers in makers' carton, 9 gns. each, carriage 7/6 extra. Crystal or Fidelity pick-up.

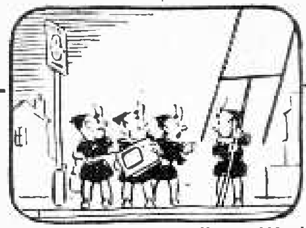
7-watt PUSH-PULL AMPLIFIERS
85/-

American type brand new push-pull miniature, measure 6in. square, in attractive satin finish cabinet, A.C./D.C., high gain, mike and pick-up input. Spare sets of valves, 12/6 only. De Luxe Model with Quality output transformer, 95/-.

VALVES, 3/- each: KTW61, KTW62, 6K7, VP23, P61, CV66, EB34, 954, 955. 4/- each: EBC33, MHLD6, 6F8, 6J5. 5/- each: 6F6, 6V6, PEN383, 12A6, 6A6, 5T4, 6K8, 12J7, 14H7, 7Y4, 7H7. 9/- each: U52, 5U4G, PENDD4020, 6L6.

Illustrated leaflets of amplifiers, TV equipment.

COLLINS RADIO, 24, Lilyville Road, London, S.W.6. RENown 4178.



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"A fine sight we look in this queue,
When the bus comes, what'll we do?
This set to FLUXITE
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But why bring the aerial, too?"

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Metal can electrolytics, 8+8+8, 400 v. wkg., 8+8 450 v. wkg., 3/6. Pair of 8+8+8 in carton with clips, 7/3.

Orders over 15/- post free, otherwise please add 3d. per valve or condenser.

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RECEIVER UNIT Type **18.** Battery superhet chassis. Frequency coverage 6-9 Mcs. Valve line-up: three of ARP12 and one AR8; and 465 kcs I.F. Transformers. In new condition but slightly store soiled, **18/6**, post free. Circuit diagram included.

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Pre-aligned midget 465 IFs, Q.120, p. & p. 6d., **8/6** per pair.

Chassis to fit Coil Unit and IFs, 11½ x 5½ x 1½in., **2/6** each.

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Wave Change Switches, 6 pole 3-way, 3 pole 2-way, 6 pole 2-way, 5 pole 3-way, **1/2** each, post 3d. each.

Standard 465 Kc. IFs air cored, Q. 110, per pair, **6/-.**

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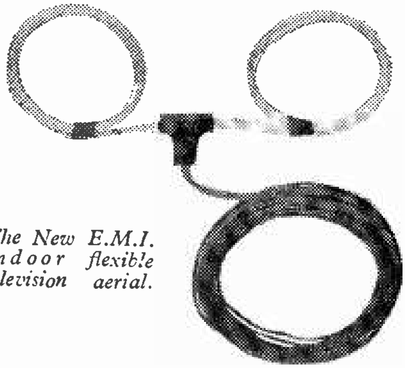
News from the Trade

Flexible Dipole Indoor Television Aerial

THE latest television aerial to be marketed by E.M.I. Sales and Service Ltd. is the Flexible Dipole, an indoor aerial possessing many features of special interest.

The Flexible Dipole is a full-sized television aerial, and when used in areas of good field strength will give results comparable with those obtainable with a standard aerial. Flat flexible conductors with polythene insulation form the elements of the dipole. Coaxial feeder cable is used to couple the dipole to the receiver via a specially designed transformer rejector.



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THE Homelab instrument is very moderately priced, and is designed to meet the needs of those requiring a good instrument for routine tests and measurements on radio and television receivers. Description :

R.F. Oscillator : A negative resistance circuit of proved stability and freedom from frequency drift is employed.

Audio Oscillator : The triode section of a double-triode valve is connected in a reversed feedback circuit and generates a 400 c.p.s. voltage for modulation of carrier and A.F. tests.

Buffer Stage : The other triode section of the latter double-triode valve is employed as a cathode-follower buffer stage. This has the advantage of isolating the R.F. oscillator and provides a low-impedance source from which the R.F. attenuator is fed. When the 400 c.p.s. voltage is required a switch connects this stage as a conventional triode amplifier.

Modulation : Modulation is applied to the buffer stage and the undesirable effects of the usual modulated-oscillator arrangement are completely eliminated. With the selector switch to the CW position, external modulation may be applied via the A.F. output terminal and its depth adjusted by the 400 c.p.s. voltage control.

Attenuator : The switched sections multiply the setting of the variable control by × 1, × 10, × 100, × 1,000 and × 10,000.

Shielding : The metal cabinet is substantially made in steel and aluminium, all corners are folded and welded. The R.F. oscillator is double screened.

Controls : Seven controls are fitted ; 1. Tuning ; 2. Audio voltage control ; 3. Fine attenuator ; 4. Coarse attenuator ; 5, Output selector switch ; 6, Range switch ; 7. Mains on/off switch.

Output Terminals : Two are provided, one for R.F. and the other for A.F.

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Homelab Instruments, 374, High Road, E.11.

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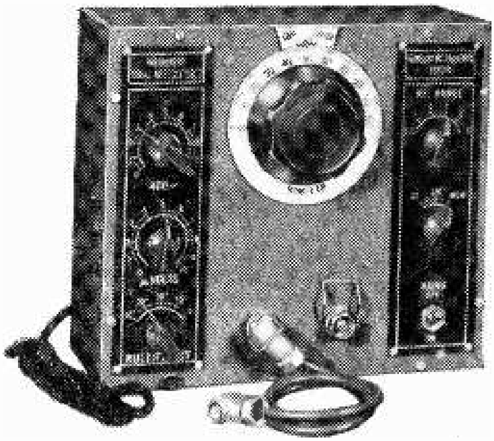
THESE power units have been specially developed to fill the demand for a supply of power sufficiently smoothed and suppressed to drive a universal A.D./D.C. television receiver in areas where no A.C. supplies are available. A novel feature in these units lies in the output, which is 240 volts D.C. with less than half a volt ripple.

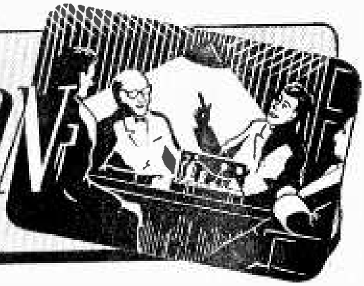


The Homelab signal generator

The circuit comprises a new and advanced design of vibrator capable of delivering up to 250 watts of D.C. This vibrator is of the self-rectifying type utilising no less than 16 large diameter main tungsten contacts and two smaller contacts in the driving circuit. The frequency of the vibrator is nominally 60 cycles per second, at which frequency the maximum efficiency is attained, consistent with good smoothing characteristics and long vibrator life.

Valradio, Ltd., 57, Fortess Road, London, N.W.5.

OPEN TO DISCUSSION



The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Repair Prices

SIR,—Some time ago there appeared in your columns a comment by Thermion upon the variations in prices asked by different radio repairers for carrying out the same repair to a radio set. The following case is not without interest in this connection. A friend of mine owns a radiogram of well-known make which he purchased in 1937 as a reconditioned set and which has given him good service for thirteen years. Recently the set refused to function. The valves were tested and three found defective were replaced. Still the set did not work and a well-known firm of radio engineers were asked to give an estimate for carrying out necessary repairs. The set was taken away to the workshop of the firm and after a delay of about fourteen days the following " Estimate " was received : " Owing to the age and condition of your —— radiogram repairs can only be carried out on a cost/plus basis, the charge being between £14 and £20 (fourteen and twenty pounds). We await your further instructions before proceeding." After the lapse of a further fourteen days the set was returned. This estimate somewhat shook my friend, who asked the advice of a radio-minded colleague. To cut a long story short, this colleague, in the space of two hours, examined the set, diagnosed the trouble as one broken-down condenser. This was replaced at a cost of five shillings and the set is now functioning perfectly. Comment is surely superfluous.—" VERB SAP." (S.E.27).

Second Thoughts on the Series-condenser Heater Circuit Receiver

SIR,—Some readers have found difficulty in obtaining certain of the components specified for the Series-condenser Heater Circuit Receiver (PRACTICAL WIRELESS, March, 1950, page 112), whilst others require to use loudspeakers which will not easily fit into the available chassis space. The author has accordingly drawn up a new chassis arrangement which permits practically any loudspeaker to be mounted on the chassis ; an energised speaker, which will also function as the L.F. choke, may be employed if desired.

The series condenser or condensers and the L.F. choke may now be mounted below the chassis, the depth of which has been increased to 2½in. in order that components of various sizes may be fitted.—E. N. BRADLEY (Cornwall).

RF24 Unit

SIR,—I think that some of your readers may be interested to hear how I am using the RF24 on both the 28 and new 21 Mc/s. band *without* any modification, and with great success. I am using this in conjunction with a BC455, and the method used is as follows :

The RF24 unit is connected to normal power supplies, and the I.F. output is taken from the Jones plug at rear, via co-ax cable, to the antenna and " ground " of the BC455. An aerial, preferably a dipole, is connected as normal to the co-ax connector on the front of the RF24. For 28 Mc/s band, tune the BC455 to around 7.5 Mc/s. and set the change switch on the RF24 to " channel 5." All that is necessary then is to set the oscillator (channel 5) trimmers until the centre of the 28 Mc/s. band appears to coincide with the 7.5 Mc/s. reading on the BC455. Once this trimming is done it is left there permanently, and the 10-metre band will be found, upon tuning the BC455, to occupy some 300° of the dial.

For the 21 Mc/s. band a similar procedure is adopted, with the switch set at channel 1 and the channel 1 oscillator trimmer being adjusted, of course. When compared with an RF24, which has been converted and a three-gang tuning condenser installed, the noise level of both models was the same and likewise the signal strength and selectivity.—ALAN J. GOODWIN (Pevensey).

Delivery Dates

SIR,—Re " Delivery Dates " discussion which has appeared in recent issues of PRACTICAL WIRELESS.

From my own experience, it is somewhat difficult to understand that such treatment, as related by some of your correspondents, exists generally. Having dealt with many various firms during the past 26 years or so, I can honestly say that I have never encountered such unbusinesslike methods. On occasions, of course, goods have had to be returned for some reason or another, but I have had replacements back in a reasonable time, corresponding to the reason for return, and without dispute.

A case in point occurred very recently. I purchased a mains transformer from Messrs. Southern Radio & Electrical Supplies, Salisbury, Wilts, who advertise most frequently, if not regularly, in your journal. This component was required for a power-pack I was constructing. Finally completed, the power-pack was tried out. Arcing occurred across the output tag board between 350 volts and 5 volts, which resulted in carbonisation and burning. No reason for this happening could be found, and I had strictly adhered to circuit details from an article appearing in a certain radio journal (*not* "P.W."). I approached the above firm for their advice, at the same time mentioning the particular circuit I had employed. Within 48 hours the reason for the fault was pointed out to me in a long and detailed reply. The designer of the circuit had specified an incorrect value of bleeder resistance! Thus, the damage to the transformer resulted. Now, although the onus for the damage was not their responsibility, this firm at the same time offered to replace the transformer upon return of the original. I accepted (with a somewhat, shall I say, guilty conscience, my knowing that they were not to blame), and by the return of post a brand-new replacement arrived, gratis. I would add that I have no connection with this or any other firm. I am just a generally satisfied customer.—W. BARTLETT (Cambs).

SIR,—I am surprised that your correspondent Mr. L. C. Baker, in his letter regarding delay in replacement of a rectifier valve, has had to wait for such a long time.

Enclosed are two valve reports for valves sent to the manufacturers on April 24th and 25th; one replacement has already arrived and the other I expect in a day or so.

I have never had to wait more than three weeks for a replacement, in spite of the fact that faulty valves to-day are the bugbear of the radio retailer.

The manufacturers are very fair and have not yet refused to replace a valve returned faulty within its guarantee period of three months. Under these circumstances a free replacement to the user could be made by the retailer. This is my usual practice, may I add.—P. C. TUCK (Dealer, Crewkerne).

Artificial Aerial?

SIR,—Listeners will doubtless have heard on occasion the testing of B.B.C. transmitters "after hours." This usually takes the form of a musical note, sometimes of one note only, but at others a series of notes on the octave scale, beginning with a very low note and ending with a very high one. The low note resembles a fluttering sound, and may be heard in all sets due to rectification. The last few octaves may not be heard at all in some sets, and with others may be felt rather than heard, particularly with a peculiar constriction around the throat.

Recently, however, I have come across a phenomenon which I have not experienced before. This is invariably encountered after the B.B.C. station has closed down, and takes the form of a very broadly-tuned note, which is also very faint. It occupies about half of the dial. I am wondering whether it is the station testing on an artificial aerial, and whether, if this is so, the B.B.C. is aware that the radiations from the artificial aerial are spreading to a distance of at least 13 miles from the transmitter, which is my own location. The note, it should be stressed, is very faint but quite unmistakable.—W. NIMMONS (Belfast).

Studio Audiences and Comedians

SIR,—Refreshing it is to find programme discussions in a technical journal. Studio audiences definitely provide atmosphere; but it is certainly amazing that the B.B.C. still tolerate and pay comedians to put over "jokes" that were worn out 25 years ago but still totter around in a ragged condition. Surely it does not need a very high standard of intelligence to think up new jokes? Especially as a comedian is *expected* to be a born humorist.

But, please, can't we have the general standard raised a little? It always seems such a cheap, mean way of raising laughs, to resort to "blue" or "near" jokes. It's really astonishing what *does* go on the air at times—much the sort of thing that uneducated people would say and smirk about, when they do not know any better. Bluntly, any fool can raise a "laugh" with a "blue" joke.

Not very long ago we were informed that a certain well-known person could not broadcast as arranged on account of shortage of scripts for so great an artist. Surely a comedian who cannot produce his own programmes is not an artist at all—merely a human gramophone?—A. J. SWEENEY (Stonehouse, Glos).

The "Simpliscope"

SIR,—I was very interested to read the "Simpliscope" article in the current issue of PRACTICAL WIRELESS, but feel your contributor, Mr. Pettit, rather stretches a point in explaining the "sync" action by declaring that a "spiky" pulse can be produced by passing a sine wave current through a differentiating coupling—however short the time constant! If a peaky wave *is* produced, it can only mean that the input pure waveform is distorted by V3, which is definitely undesirable as this valve is used as the "Y" amplifier.

However, I do not for one moment suggest that the "syncing" is less efficient than the writer of the article claims—in fact, I intend using this very compact circuit for a small 'scope built in the ex-Army S.L.C. indicator unit.

I would suggest, though, that the semi-squaring action of V2 is responsible for the ultimate sync pulse appearing through its coupling to V1.—R. J. MILLER (Barnet).

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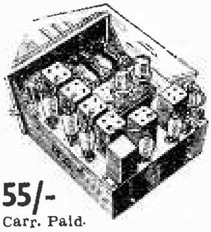

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Impressions on the Wax

Review of the Latest Gramophone Records

OF interest this month is the issue of a new Columbia album designed for the safe, convenient storage of records. It holds eight 12in. records, each in a separate strong pocket; its heavy board cover is part bound in blue rexine. It costs 12s. 11d.

In many cases the original type of orchestration used by Johann Strauss for his waltzes has grown obscure. We know that there existed a zither solo in the authentic version of "Tales from the Vienna Woods" and it is this version which has now been recorded by Herbert Von Karajan and the Vienna Philharmonic Orchestra, on *Columbia LX*1274. The "Third Man" film has certainly started a new—and it seems, lasting—vogue for this fascinating instrument.

As a contribution to mark the two-hundredth anniversary of Bach's death in Leipzig, the celebrated Greek pianist, Gina Bachauer, has recorded his "Toccata in C" (arranged by Busoni) on *Columbia C*3969-70. Often listed as the "Toccata in C Major," by which title it is identified on this occasion, it should be pointed out that for his piano transcription from the original organ score Busoni labelled the three movements "Prelude," "Intermezzo," and "Fugue." Gina Bachauer has included the work in her recent Wigmore Hall recitals.

A new addition to H.M.V. Record Library Series is Elgar's Symphony No. 1 in A Flat, Op. 55, played by the London Philharmonic Orchestra, conducted by Sir Adrian Boult, on *H.M.V. DB*21024-29. This work occupied Elgar's mind for some considerable time before he actually set to work upon its composition during the months of June and July in 1908. Of his three symphonies—the last unfinished—this first is, in many ways, the most characteristic of Elgar.

"Unknown Treasures of Music" is the title chosen by Parlophone to introduce a new series of hitherto unpublished or unrecorded works by the great masters, presented to the general public for the first time. The first item is Joseph Haydn's "Divertimento in F" for two violins, two cor anglais, two horns, two bassoons, in five movements, played by the London Baroque Ensemble, conducted by Karl Haas, on three sides of *Parlophone R*20578-9. On the fourth side is Haydn's "March for the Prince of Wales." The London Baroque Ensemble contains the most famous wind players of this country.

Another interesting release for music-lovers is Weber's "Concerto for Bassoon in F, Op. 75," played by Gwydion Brooke, bassoon, with the Liverpool Philharmonic Orchestra, conducted by Sir Malcolm Sargent, on *Columbia DX*1656-7. Although the adagio from this work will be known to a number of collectors, the entire concerto will come as a welcome stranger to most people.

Vocal

The late Maria Cebotari selected two of the most moving episodes from Puccini's "Madame Butterfly" in making this, *H.M.V. DB*6940, one of her last records. The first aria, well-known as "One Fine Day," needs little introduction. It is, perhaps, the second. "Death with Honour," which contains the greatest power of tragedy in the entire work. Her death, at the age of 38, barely a year ago, has left the world poorer by the loss of her artistry.

Ever since the British film "The Glass Mountain" was released last year, the fine music featured in it has grown steadily in popularity. Tito Gobbi, world famous baritone of the Scala Opera House, Milan, was featured in the film. Now, in response to a number of requests, H.M.V. offer two of the songs that he sang in the film, "Take the Sun" and "Song of the Mountains," sung by Gobbi, on *H.M.V. DA*1940.

At 69, as active and high-spirited as ever, Peter Dawson has embarked on a strenuous tour of Great Britain, the country in which he has sung most of his life. His latest release, with orchestra conducted by Frank Cordell, is "The Cry of the Wild Goose" and "That Lucky Old Sun," on *H.M.V. B*9913.

Variety

Dinah Shore presents this month renderings of two new American numbers. They are "Happy Times," from the Danny Kaye film "The Inspector General," and "Sitting by the Window," with quartette accompaniment. The record is *Columbia DB*2684.

Two tenors featured in the latest release are Monte Rey singing "The Rose I Bring You," and an old favourite, "Marta," on *Columbia DB*2686, and Josef Locke, who sings "Ireland Must be Heaven" and "It Happened at the Festival of Roses," on *Columbia DB*2688.

On *Parlophone F*2401 those popular duettists Bob and Alf Pearson initiated the "In Big Bits of Big Hits" series of medleys. They have now made a second record in this series on *Parlophone F*2410, with half a dozen of the most up-to-date, most requested hits.

Dance Music

Geraldo and his Orchestra this month introduce a song that has already climbed into the hit category. The title is "C'est si bon," which they feature on *Parlophone F*2409, coupled with "Enjoy Yourself."

"Old Time Dance Series" is continued by Harry Davidson and his Orchestra with "Dinkie One-step No. 2" and "Truro Gavotte," on *Columbia DX*1658, and Victor Silvester and his Ballroom Orchestra, continue their dance tempo recordings with "Waltz in My Heart" and "C'est si bon," on *Columbia FB*3559.

Finally, we have "I'd've Baked a Cake" and "Happy Times," played by Joe Loss and his Orchestra, on *H.M.V. BD*6068 and for swing fans "Royal Garden Blues" and "My Sweetie Went Away," played by Sid Phillips and his Orchestra, on *H.M.V. B*9904.

NEW R.S.G.B. "Amateur Radio" Publications.—Simple Transmitting Equipment, 52 p.p., **2/3.** Receivers, 96 p.p., **3/9.** Both fully illustrated. The Transmitting Licence (3rd Edition), **1/-** (below).

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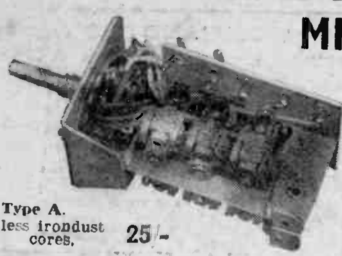

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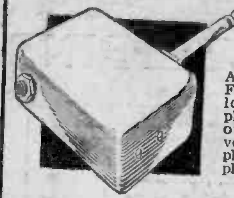
PHONE ADAPTORS



As illustrated. For matching low resistance phones to H.R. outputs. Convert your L.R. phones to H.R. phones.

2/- each plus 6d. postage.

A PAIR OF HIGH RESISTANCE PHONES for 5/3

Because of a special purchase of the impedance matching units illustrated above, we can offer a pair of brand new DLRI headphones and a matching unit for the bargain price of 5/3. The DLRI headphones are 30 ohms per earpiece, diaphragm type. By use of the matching units supplied they can be used for all applications requiring high resistance phones.

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DLRI Low impedance phones ONLY for 3/6 (brand new). Post, pkg. 9d.

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21 valve radar units six stage 14 mcs. I.F. strip. Space on chassis to construct a complete TV receiver (excluding EHT). Valves: one EA50, ten SP61, five EF36, three EBC33, one EF39, one EB34. (See "Short Wave Listener," May issue.)
Brand New in Transit Cases. **£3 10 0** carr. paid.

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These units give a 110v., 400 c/s output, at a rating of 45 watts, when used on 24v. D.C. For those having gear which employs a 110v., 400 c/s power unit, this alternator will provide the solution of unmodified operation. Brand New. **£4 0 0** (carriage paid).

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0/3v.	0/5000 ohm.
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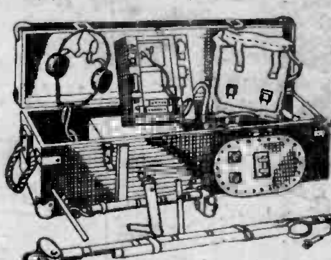
METAL (MINE) DETECTOR



FOR the detection of ferrous or non-ferrous metals, underground, under water or in animals, timber or chemicals, etc., etc., originally intended for detecting mines by one of our Allied armies. This equipment has never been used. We have to clear the warehouse in which these are stored, and, therefore, we are offering these complete Mine Detectors for less than the cost of the transit case alone. The equipment comprises a 3-valve battery amplifier in a steel case, a shoulder haversack, and long counter balanced search coil, short search coil, headphones, junction box, sensitivity measuring stick and operating instructions and circuit diagram. The original cost of this equipment was enormous, but as we have to clear our store, we will supply while they last at a very low figure of **22/6** plus 12/6 carriage.

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