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Vol. 27 No. 542
DECEMBER, 1951

PRACTICAL WIRELESS

EDITOR:
F. J. CAMM

IN THIS ISSUE

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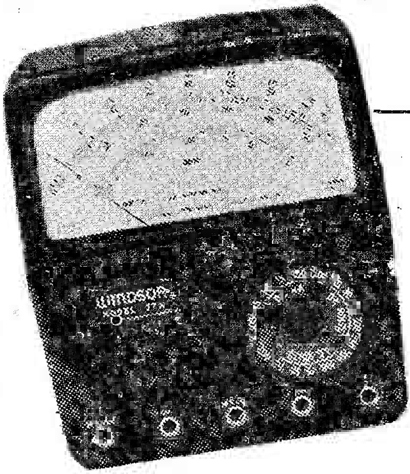

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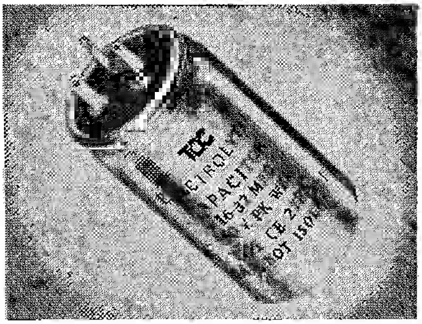

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8-16	450	2⅜in.	1 in.	CE34PEA
32-32	450	4½in.	1⅜in.	CE37PE
100-100	350	4½in.	1½in.	CE36LEA

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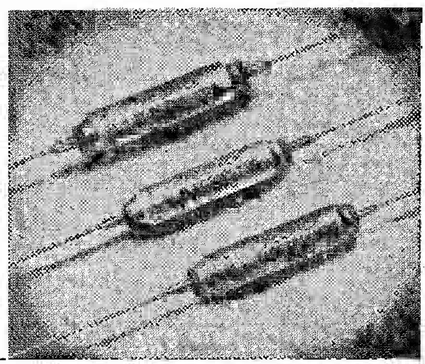

Capacity µF.	Peak Wkg. Volts	Dimensions		Type No.
		Body Lgth.	Dia.	
8	6	1 1/16 in.	.25in.	CE72A
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30	15	1½in.	.43in.	CE71B
10	25	1½in.	.34in.	CE30C
5	50	1½in.	.34in.	CE30D
2	150	1½in.	.34in.	CE30G
1	350	1½in.	.34in.	CE30N

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Practical Wireless

EVERY MONTH
VOL. XXVII. No. 542 DECEMBER, 1951

Editor F. J. CAMM

19th YEAR OF ISSUE

COMMENTS

By THE EDITOR

ON BBC CRITICS

ALMOST every newspaper in this country has a radio and television critic, and for nearly thirty years that criticism has, on the whole, been adverse. The BBC also has its own internal critics and, of course, its listener research department. Yet after thirty years of criticism the number of licences has steadily increased from a few thousand to 12 millions.

This raises the question of whether criticism of BBC programmes is of value. If we can take the theatre as an ordinary example, it would appear that the answer is in the negative.

Bad shows are still put on, and the critics give their opinions when it is too late. Why not invite the critics to see shows before they are put on the air or on the stage ? The bald fact is, as far as radio is concerned, that people will buy a radio licence even though the programmes are uniformly bad, just as in the same manner they will have the telephone laid on even though the service after all these years is full of imperfections.

The BBC is thus in the happy position of being able to ignore criticisms in the full knowledge that it will not affect their licence revenue, and they can fortify that attitude by the inexorable and ineluctable fact that the critics must be wrong and the BBC right, in view of the continued growth in the number of listeners.

Everyone likes to have on tap an instrument for listening to important news. No one has yet given up a licence because the programmes are bad.

It has been suggested that competitive programmes radiated by commercial broadcasting stations would keep the BBC on its toes. We do not think so. The BBC cannot make a loss ; its turnover has consistently increased and that is sufficient answer to the critics. This argument does not, of course, apply to the live theatre.

RESALE PRICE AGREEMENTS

THE Government (the one in force at the time this goes to press) in its efforts to delude the public into believing that the high cost of living and the high cost of essential items such as radio receivers and batteries is due to profiteering on the part of the manufacturers instead of to the monstrous Purchase Tax of 66⅔ per cent., threaten to introduce legislation setting aside all of the existing Resale Price Agreements at present in force, and thus virtually destroying the main reason for the existence of trade associations. The policy adopted by the Government is not to abolish such agreements, but to give retailers the right to sell below such minimum prices if they so wish, without fear of disciplinary action being taken by trade associations.

There has been no call on the part of retailers to be permitted to break their agreements with suppliers, nor is there any evidence that retailers charge more than the fixed price.

Proposed legislation is an attempt to reduce the cost of living by taking away some of the reasonable retail profits.

As such agreements have been drawn up at the express desire of retailers, the Government evidently intended to present to the public the impression that trade associations were octopus-like organisations whose tentacles reached to the remotest depths of the purchaser's pocket.

Fortunately, there is not a retailer in the country who will undersell price-maintained goods, if indeed it is ever introduced. Resolutions all over the country have been passed calling upon the Government to refrain from introducing it. Equally, we call upon the Government to reduce and in some cases remove its profiteering Purchase Tax.—F. J. C.

ROUND the WORLD of WIRELESS

Radio Servicing Examination, 1951

THE Radio Trades Examination Board and the City and Guilds of London Institute recently announced the results of the Radio Servicing Certificate Examination.

One hundred and seventeen of the 290 candidates, who appeared for the examination held in May, were able to satisfy the examiners in both the practical and written tests. Forty-six candidates, passing the written test only, were referred in the practical, while 19 candidates who had been referred in the practical test in last year's examination, completed the test this year.

Chemical Exhibition

AN impressive Chemical Exhibition, entitled "One Hundred Years of Chemistry," was held on September 27th in the Manchester Civic Centre to mark this year's Dalton Lecture of the Royal Institute of Chemistry. The exhibition, which was presented by eight large north-western industrial companies, was based on the same theme as the "Festival" Lecture and was delivered by Lord McGowan, K.B.E.

Among the exhibits depicting the history of the science in various fields was one by Chloride Batteries, Ltd., following the development of the lead-acid storage battery.

Death of Gramophone Pioneer

WITH the death of Frederick W. Gaisberg, in his 79th year, at his Hampstead home on September 2nd, a link with the fascinating history of the gramophone was broken.

Fred Gaisberg was born in Washington, D.C., and began his professional career as a chorister in a local church. At the age of 21 he became assistant to Emile Berliner and helped him to perfect the disc record. In 1895, in Philadelphia, he was largely responsible for persuading a group of shareholders of the Pennsylvania Railroad Co. to subscribe 25,000 dollars with which the Gramophone Co. (later to become H.M.V.) was founded.

During 1898 he was appointed chief recordist with the newly formed Gramophone Co. in London and, in 1925, with the coming of modern electrical recording, he was appointed International Artists' Manager to the Gramophone Co. All the great personalities of the gramophone world passed through his hands, including Tamagno, Patti, Melba, Chaliapin, Peter Dawson and, of course, Enrico Caruso.

Although Fred Gaisberg made London his home and the centre from which he made many world-wide recording expeditions, he retained his American citizenship to the end.

Radio at the Motor Show

AT this year's Motor Show, E. K. Cole, Ltd., showed a full range of car-radio models.

Models were mounted on the dashboards of famous cars, such as the Austin "Princess" and "Sheerline," Alvis three-litre, Daimler, Bristol and Jaguar.

The C.R.117, a six-valve superhet with provision for pre-set medium-wave stations and free tuning on long and medium wavebands, was exhibited in variations for Ford, Daimler and Alvis and a version designed to operate up to four speakers.

On view also was the C.R.61 short-wave model, incorporating such radio requirements as band-spread tuning, seven short-wave ranges, push-pull output and three-position tone control.

Sound Recording and Reproducing Equipment Exhibition

AT the Portsmouth City Council Chambers on Thursday, October 11th, was held an Exhibition of Sound Recording and Reproducing Equipment organised by the local centres of the British Sound Recording Association and the Institution of Electronics.

Eleven exhibitors took stands in the Minor Hall and demonstra-

At the Post Office Research Station at Dollis Hill, a piece of quartz is being sliced by a diamond wheel in the process of making H.F. crystals.

tions of the latest magnetic tape and wire recorders, as well as high-quality pick-up, amplifier and loudspeaker combinations were given between 5 and 10 p.m. In the main Council Chamber Mr. J. W. Clark demonstrated a tape recorder, as supplied to the Admiralty, which is capable of twin-track recording at 1⅞in. per second.

World's First Wireless College

OCTOBER 12th marked the 50th birthday of the first wireless college in the world. It was opened by Marconi's Wireless Telegraph Co., Ltd.

It was moved to the Chelmsford works in 1904 and was re-established at its present site in Arbour Lane in 1920. It has since become one of the finest technical colleges in the world.

Facility for Amateurs

PROVIDED that no interference is caused to Government services, radio amateurs in the United Kingdom will soon be allowed to use Frequency Modulation on frequencies within the band 144.5 to 15.5 Mc/s.

This follows negotiations between the G.P.O. and the Radio Society of Great Britain, and the progress and situation will be reconsidered after one year.

Broadcast Licences

THE following figures show the approximate numbers of licences issued during the year ended August, 1951 :

Region	*Number*
London Postal ..	2,359,000
Home Counties ..	1,656,000
Midland	1,757,000
North-eastern ..	1,921,000
North-western ..	1,621,000
South-western ..	1,074,000
Welsh and Border Counties ..	733,000
Total England and Wales	11,121,000
Scotland	1,113,000
Northern Ireland ..	210,000
Grand Total ..	12,444,000

The above total includes 933,050 television licences.

B.I.R.E.

THE following meetings of the Institution will be held during November, 1951 :

London Section.—Wednesday, November 21st, 6.30 p.m., London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1 : "Developments in High Frequency Transmitter Cables," R. C. Mildner (Telegraph Construction & Maintenance Co.).

North-eastern Section.—Wednesday, November 14th, 6 p.m., Neville Hall, Westgate Street, Newcastle-on-Tyne : "Television Aerial Design," G. L. Stephens (Belling & Lee).

Scottish Section.—Thursday, November 8th, Institute of Engineers and Shipbulders, Glasgow, 7 p.m. : "The Brain as a Piece of Communication Equipment," H. W. Shipton, A.M., Brit.I.R.E. (Burden Neurological Institute, Bristol).

The above three meetings will be held jointly with the Scottish Sections of the Institute of Physics.

South Midlands Section.—Wednesday, November 14th. To be held in Rugby. Details may be obtained from the Local Honorary Secretary.

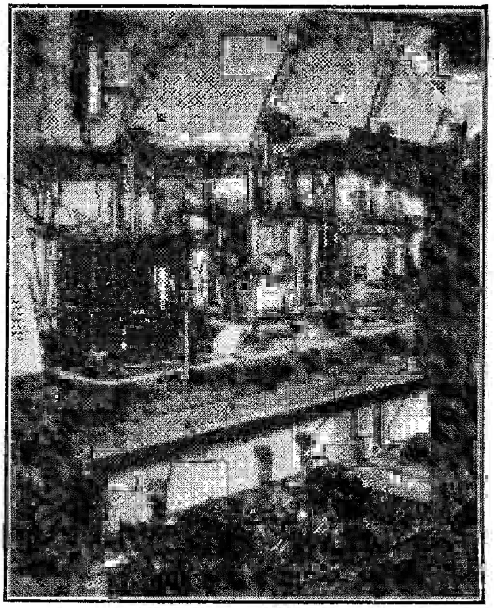
West Midlands.—Tuesday, November 27th, 7 p.m., Wolverhampton and South Staffs Technical College. Details may be obtained from the Local Honorary Secretary.

British Dry Batteries Standard

THIS British Standard prescribes the dimensions and performance of a range of dry batteries for domestic radio receivers and allied equipment. Experience has shown that the information in B.S.397 : 1946, "Leclanché-type Primary Cells and Batteries," in respect of dry batteries for radio receivers, is inadequate in the light of present-day needs and it was, therefore, decided that requirements for such batteries should be the subject of a separate British Standard.

This Standard, therefore, has been prepared and embodies the relevant data from B.S.397 together with details of the sizes of radio battery plugs and a description of the connectors. The provisions of B.S.397, in so far as they apply to radio receivers, are therefore superseded by the standard.

Copies of this standard may be obtained from the British Standards Institution, Sales Dept., 24, Victoria Street, London, S.W.1, price 2s., post free.



In this part of the G.P.O. Research Station water-soluble piezo-electric crystals are being "grown" in various solutions.

Royal President

IT is announced that H.R.H. The Duke of Edinburgh, K.G., F.R.S., has graciously accepted the office of President of the City and Guilds of London Institute for the Advancement of Technical Education. He was elected at a Special General Meeting of the Members of the Institute on September 21st, 1951.

B.S.R.A.

ON Friday, November 16th next (7 p.m.) at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, a Lecture on "Electrical and Mechanical Problems of Record Reproduction" will be given by K. R. McLachlan and R. Yorke under the auspices of the British Sound Recording Association.

FREQUENCY MODULATION

A NEW SERIES

3.—FURTHER TECHNICAL NOTES AND AN INTRODUCTION TO F.M. RECEIVERS

By J. F. Golding

(Continued from page 517 November issue.)

A CERTAIN amount of A.M. is superimposed on the F.M. output from the transmitter. This arises from two sources, the modulated oscillator itself and the amplifying stages.

The A.M. from the oscillator is produced because when the gm of a variable-mu valve is altered by the grid voltages the anode resistance also varies by a small amount. This has the effect of placing a varying resistive load across the oscillator and, by so doing, modulating its output voltage. It can be reduced to a minimum by using a balanced reactor circuit consisting of two reactor valves in push-pull, one acting as a variable inductance and the other as a variable capacitance. It can be seen from Fig. 2 that the capacitance of a capacitive reactor is directly proportional to its gm whereas inductance of an inductive reactor is inversely proportional. With the A.F. signal applied in anti-phase to the grids of the valves the effects of their reactance changes are additive while the changes in anode resistance cancel each other.

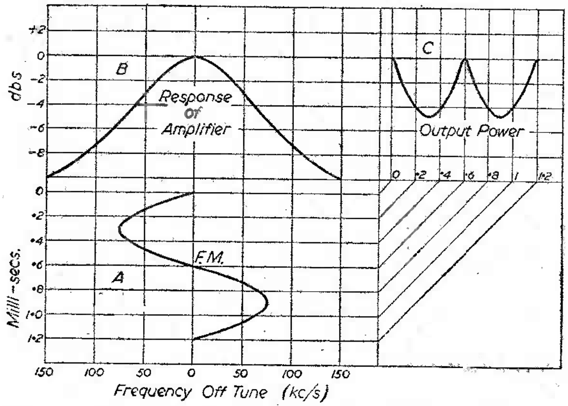
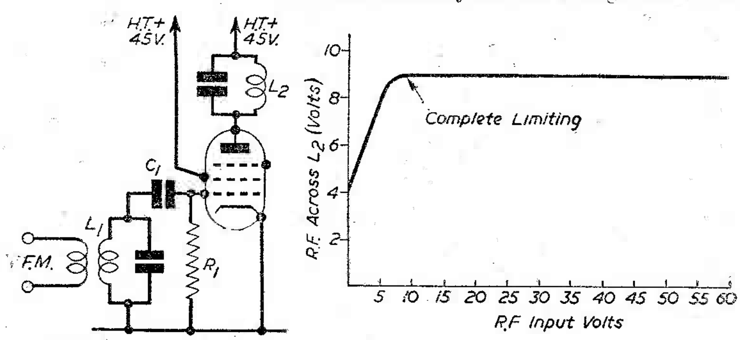


Fig. 5.—Composite graph, illustrating the introduction of A.M. on an F.M. signal when passed through a tuned stage having a response as shown in A. Note that the output power waveform in C is really the shape of the resultant amplitude modulation envelope.

The A.M. introduced in the R.F. amplifier stages is due to the fact that, as the signal frequency is being swept through the hump of the amplifier frequency response characteristic, the gain of the amplifier is being effectively varied as shown in Fig. 5. This is a composite graph, in which the signal frequency is plotted against time in Section A, the response curve of the amplifier is shown in Section B, while Section C shows the resultant relative change in output power level. The diagram shows quite clearly that, as the deviation approaches maximum in either direction, the amplifier gain falls so that the peak of the response curve is traced out by the output power for each half cycle of the modulating frequency. This results in amplitude modulation at twice the frequency of the A.F. modulating signal.

This effect can be reduced to a minimum by using band-pass amplifiers of careful design, having a pass-band of three to four times the maximum deviation. The bandwidth of the BBC F.M. station at Wrotham is approximately 240 kc/s; maximum deviation is 75 kc/s.

This latter type of amplitude modulation is also introduced by the tuned stages of an F.M.



(a) Saturated Amplifier (b) Response of Saturated Amplifier

Fig. 6.—Basic circuit and typical response curve of an amplitude limiter of the saturated amplifier type.

receiver. For this reason and also to eliminate any spurious A.M. caused by noise voltages, a device known as an amplitude limiter is always included as the last stage before the demodulator. The action of this limiter is virtually to flatten the peaks of the R.F. waveform so that the output is of constant amplitude irrespective of the input variations.

Amplitude Limiter

The most common type of amplitude limiter is a saturated amplifier, a circuit of which is shown in Fig. 6 (a). It consists of a tuned amplifier using a short grid-base pentode, which is operated under class C conditions by the self-bias action of a grid-leak and capacitor. Here the grid and cathode behave as a diode with the grid-leak resistor as the diode load. During each positive peak of the R.F. voltage, this diode conducts and discharges the grid capacitor. At the negative peaks, however, the diode does not conduct so that the capacitor discharges through the resistor. This discharge current causes a negative voltage drop across the resistor, proportional to the peak R.F. voltage.

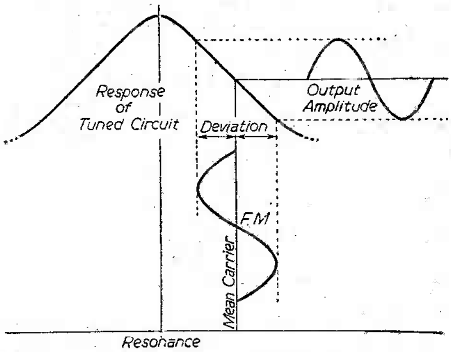


Fig. 7.—Using a mistuned resonant circuit to convert F.M. to A.M.

The valve is operated with low anode and screen voltages, sufficient R.F. voltage being applied to the grid to bias the valve to cut off at negative peaks and to saturate at the anode bend of the Ia/Eg characteristic at positive peaks.

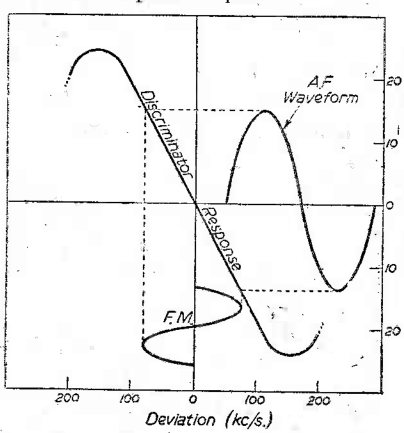


Fig. 9.—Response characteristic of amplitude discrimination.

It is important that the R.F. drive voltage is sufficient completely to saturate the valve or it will behave as a leaky-grid detector causing considerable distortion in the final audio signal. The curve in Fig. 6(b) shows a typical limiter characteristic. from which it can be seen that complete limiting first occurs for an input of 5 volts. The valve would normally be operated with an input of approximately twice this value.

Having passed through the limiter, the signal is now fit for application to the demodulator, which, in its simplest form, may consist of a single-tuned circuit resonating at a frequency above or below the mean carrier by an amount slightly exceeding the maximum deviation frequency, followed by a simple diode detector. The action of such a device is shown graphically in Fig. 7, from which it can be seen that the F.M. is simply converted to A.M., which may be applied to an orthodox type of detector. This method is not by any means satisfactory because the linear portion of the resonance curve is so short that, for any but the smallest deviations, considerable distortion is bound to occur.

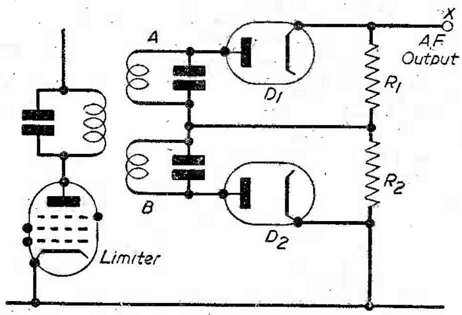


Fig. 8.—Basic circuit of amplitude discriminator.

One of the most commonly used types of demodulator circuit is the amplitude discriminator, which consists of two circuits of the type described in the previous paragraph, connected back to back, as shown in Fig. 8. Tuned circuits A and B are adjusted to resonate at frequencies symmetrically spaced above and below the carrier respectively, the spacing from the mean carrier being rather more than the maximum deviation.

Then, while the carrier is unmodulated the voltages across resistors R1 and R2 are equal and opposite so that the voltage between point X and chassis is zero. When modulation is applied, however, as the signal frequency deviates high, it

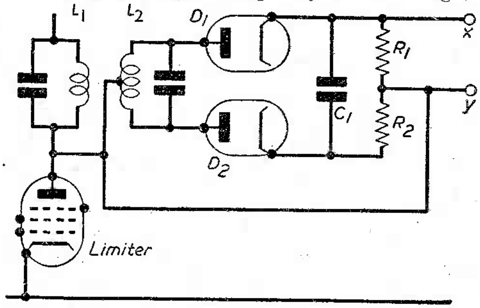


Fig. 10.—Basic circuit of phase discriminator.

approaches the resonance of circuit A, causing the p.d. across R1 to increase while that across R2 decreases to give a positive voltage at point X. Then, as it swings low towards the resonance of circuit B, the reverse action occurs with a resultant negative voltage at point X. The voltage at this point, therefore, varies directly with the signal frequency and may be fed to the audio amplifier stages. The response characteristic of this type of demodulator is shown in Fig. 9.

An alternative type of discriminator circuit is shown in its basic form in Fig. 10. This type is known as a phase discriminator, and operates by virtue of the fact that the voltages across the windings of a tuned transformer are normally 90 deg. out of phase. It has the advantage that only one tuned transformer is used, resonating at the centre carrier frequency.

When the carrier is unmodulated half the secondary plus the full primary voltage appears across each diode.

When the frequency swings off tune in either direction the secondary circuit reactance becomes either more capacitive or more inductive so that the voltage across L2 becomes either more or less than 90 deg. out of phase with that across L1. This throws the voltages across the two diodes out of balance so that an A.F. voltage between points x and y is directly proportional to the frequency swing.

In addition to this phase change, the amplitude is varied by the change in frequency. Up to a point these two effects are additive, but if the frequency deviation is too great, the amplitude change will reverse, having a negative effect, and distort the final A.F. output. Due to this amplitude change, the response characteristic is very similar to that of an amplitude discriminator, as shown in Fig. 9.

In order to improve performance and to provide for convenient connection into the receiver circuit, both of these basic types of demodulator are used in a somewhat modified form in actual practice. However, as it is necessary to consider the receiver as a whole in order fully to understand the reasons for these modifications, these points will now be dealt with.

Reception of F.M. Signals

A frequency modulation receiver differs from its amplitude modulation counterpart in only two major respects. A discriminator circuit takes the place of the usual detector and is always preceded by an amplitude limiter to eliminate any spurious A.M. which may be present in the signal.

Without being too pedantic, the limiter and discriminator may be regarded as a single unit and called the demodulator. This is an efficient but not very sensitive device because, as explained in the previous article in this series, an R.F. input of approximately 10 volts is necessary to ensure complete limiting. If the receiver is to be reasonably sensitive, it is obvious that the demodulator unit must be preceded by a high-gain amplifier. Since it is extremely difficult to amplify V.H.F. signals directly, particularly with variable tuning, a T.R.F. receiver cannot be used for broadcast F.M. reception, a superheterodyne being the only type suitable.

The block schematic diagram shown in Fig. 11 is identical with that of the equivalent A.M. receiver except that the composite F.M. demodulator replaces the simple A.M. detector. There are, undoubtedly, variations on this plan; for example, receivers situated close to the transmitter may well do without the R.F. stage preceding the frequency changer. Alternatively, some designers may favour a double heterodyne system, which certainly has its advantages and will be discussed later in this series. However, as the straightforward set up of one R.F. amplifier stage, followed by a simple superheterodyne circuit, has proved to be the most satisfactory for F.M. communication receivers and for the 45 Mc/s band broadcast work in the U.S.A., there is no reason to suppose that it will not prove equally satisfactory on the 90 Mc/s band broadcasts in this country.

The Receiving Aerial

Having broadly decided on the general arrangement of the receiver, we are in a position to consider each section in some detail beginning, logically, with the aerial.

It has now been definitely accepted, as a result of extensive tests, that for V.H.F. broadcast work, horizontally polarised waves do provide a more efficient link. It may, therefore, be taken that all F.M. broadcasts in the near future will use horizontal as opposed to vertical polarisation, three transmitting aerials of this type having already been erected.

The most suitable type of receiver aerial is, then, a horizontal half-wave dipole tuned to the centre of the frequency band in which it is intended to operate. Its overall length should be rather less than half the dimensional wavelength of its resonant frequency because, owing to a phenomenon known as the end effect, the effective length of a tuned aerial is about 5 per cent. greater than its physical length.

In order to cover the wave-band required as efficiently as possible, a folded dipole is sometimes used, in which the elements of the aerial are bent back on themselves to form a flattened loop.

These types of aerial are sensitive only to waves approaching from a direction at right angles to the aerial elements. They can be made uni-directional by the addition of a reflector rod rather more than a half wavelength long and spaced parallel to the aerial itself by about a quarter wavelength. The direction of sensitivity is, of course, away from the reflector.

(To be continued.)

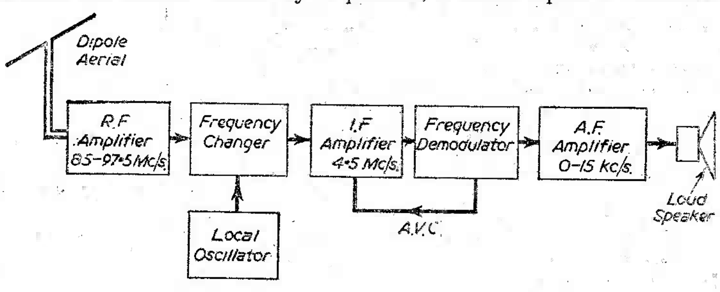
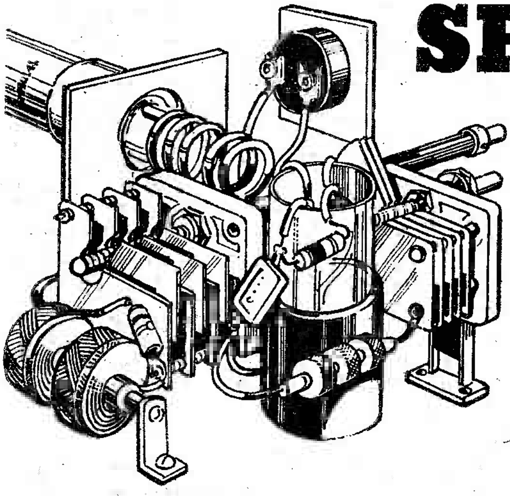


Fig. 11.—Block schematic of an F.M. receiver.



SHORT-WAVE SECTION

BREAKTHROUGH WAVE-TRAPS AND SHORT-WAVE ADAPTORS

By A. W. Mann

WHILE we never associate wave-traps with the modern selective broadcast type superhet, this old aid to selectivity can be effectively used in conjunction with the simpler types of short-wave receiver, such as the straight detector and untuned H.F. arrangements.

For example, it is well known that some top-band listeners are troubled with breakthrough from the local third programme transmitter. A wave-trap consisting of a suitable coil and tuning condenser capable of being tuned to the frequency of the offending transmitter, placed in series with the receiver aerial, will effectively remove the interfering transmission.

R1116, R1116A

Some of these receivers are prone to the defect of the reception of 40-metre signals while switched to the 80-metre range. On the other hand, some are not. These repeat points are not, in the writer's opinion, a straightforward case of second channel. While an I.F. trap circuit in series with the aerial or, alternatively, across aerial and earth sockets of the ordinary super would in most instances effect a cure, it is not so simple in this instance.

The R1116 is a double frequency-changing super, the I.F.s being 1,700 kc/s and 100 kc/s, and this rather complicates matters. While I would not claim at the moment that the defect is definitely due to one particular thing, I am of the opinion that the generation of spurious harmonics has something to do with it. At some future date I hope fully to investigate this problem.

The most satisfactory method of removal would undoubtedly be the addition of tuned H.F. stage. Those who experience this trouble, however, might care to try a series aerial wave-trap, consisting of a 100 pF tuning condenser and a 4-pin coil capable of tuning through the 40-metre band. If you have on hand one of the single winding TR9 receiver tuning coils, this is ideal for the purpose.

The procedure is as follows. Fit the tuning coil in series with the aerial lead, and parallel tune it with the 100 pF tuning condenser; if possible use a slow-motion tuning dial. Switch the receiver to the 80-metre range. Tune in the undesired 40-metre 'phone transmission. While doing this the wave-trap tuning condenser should be set at its minimum capacity. Next, tune out the undesired 40-metre 'phone transmission with the wave-trap.

This simple device will be found to be very effective. Once set, a considerable portion of the band can be covered without further adjustment, and it is not such a tiresome idea as might first appear.

Signal Strength Measurement

The best types of communication receiver are either fitted with a built-in "S" meter, or have provision for plugging in a suitable one which has been specially produced for use with the model.

Even so, the calibrated values as shown on the meter scale are only arbitrary, and S9, plus so many dbs as shown on the "S" meter scale of one particular receiver, may differ when compared with another of different make. This, however, is a controversial subject. Nevertheless, most amateurs regard their "S" meters as a useful guide and not as a precision instrument.

The simpler type of receiver cannot be fitted with an "S" meter, but use can be made of a calibrated volume control. The procedure to adopt in calibrating is to tune in the loudest transmission consistently received and calibrate in "R" strengths. Adjust the volume control until this signal just disappears. Call this R9 and follow up by searching for signals of proportionate volume, which will enable you to calibrate the volume control dial from R1 to R9.

Now this idea is easier to write about than to put into practice. The writer, however, did it with a fair measure of success some years ago. Some concentrated listening is called for and one must have a good idea with regard to relative signal strengths.

Admittedly, the use of a variable potentiometer or a variable resistor has disadvantages, but the advantage of the system is that one's idea of R8 does not vary from hour to hour and the entries in the log possess some measure of consistency.

One listener's idea of R8 may differ from that of another and much depends on individual ideas of relative signal strengths when first calibrating the control. Just as the "S" meter is a useful guide, the calibrated volume control is an improvement on sheer guesswork.

Receiver Calibration

The present trend is to calibrate directly on the tuning dial plate, specially designed dials being available for the purpose. Beginners, however, should remember that the graph method of plotting frequency against dial readings has much to recommend it and is, in some instances, more accurate than the direct method.

Doubts arise when the calibration of receivers which incorporate bandspread is under consideration. A well-known commercial type communications receiver of some years ago had two comparatively large tuning dials, one for band setting, and the other for bandspreading.

This was an ideal arrangement in a big receiver in which the front panel was of comparatively large size. In the case of the simpler and smaller home-constructed receivers this method would call for rather smaller dials and, in the writer's opinion, would make direct calibration somewhat difficult.

The best method is, I think, to use one large dial for direct calibration, and a smaller one fitted with a 100 or 180 deg. scale. The first point we must consider is which dial should be calibrated directly—the bandspread or the band setter. I very much favour the latter. This will allow us to tune to a definite part of a band, and then bandspread via the degree scale tuning dial.

The reason for making this suggestion is that in order to calibrate a band-spreading dial covering all bands from 10 to 160 metres the dial plate would have to be a comparatively large one.

Ganged tuning condensers with built-in bandspread units were common to certain American-made communication receivers in pre-war days.

Similar types are being produced in this country. They are at present, I understand, for export only. Models suitable for inclusion in home constructed T.R.F. and superhets, when available on the home market, should prove to be very popular.

S.W. Adaptors

In a recent article we briefly discussed short-wave converters for use with receivers in which one or more H.F. stages are used. Above is shown a suitable circuit for use with the regenerative detector type.

The layout should follow on the lines of the simple one-valve regenerator receiver, several of which have been described in this journal.

The four-pin plug can be made from a discarded four-pin battery valve type base, and a three-wire flex lead used as the coupling medium, the detector valve which has been removed from the set being replaced with the four-pin plug.

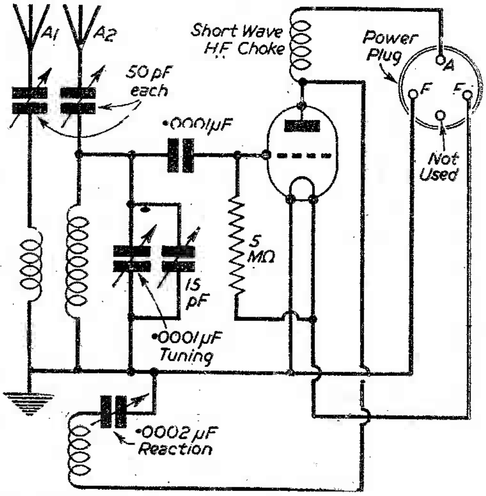
Check up the filament connections of the set and make sure which is the earthed side. The lead from the appropriate pin should be coupled to the earthed side of the adaptor filament.

Note that only the anode and filament pins of the adaptor plug are used. There is no connection to the grid pin of this plug.

Follow this by fitting the detector valve into the adaptor valveholder. Remove aerial lead from the aerial terminal or socket of the set and transfer it to the aerial terminal of the adaptor.

It will be noted that in plugging in the adaptor we have cut out entirely the detector stage of the receiver and only use the L.F. amplifier section, all tuning being carried out by means of the adaptor tuning controls. Two things should be checked, however, before the adaptor is built. First note if the set L.T.— or L.T.+ is joined to earth. Whichever it happens to be, the adaptor should be wired up the same way. While I mention this point, it is many years since the L.T.+connection was in common use, and such receivers would, in my opinion, back-date a little too far to be worth considering for use.

A few remarks relative to adaptors may be of interest. Lay out the components and wire them up so that the wiring is short and as direct as possible, keeping grid and anode leads apart. A unit of this type can be built on a metal-faced baseboard, although a small chassis would be better. Do not, however, cramp the layout. On the other hand, don't arrange the components so that excessively long leads are required. Fit slow-motion dials for tuning and regeneration.



An H.F. stage for use with a regenerative detector.

While selectivity will only be equal to that of the average regenerative detector type non-H.F. receiver, good results are possible otherwise.

Some years ago the writer decided to build a short-wave adaptor on ultra-short-wave lines. This proved a success as it tuned down to 5 metres.

Furthermore, due to the ultra-short-wave technique adopted in its construction it was far ahead of anything else then in use on the higher ranges.

Short-wave adaptors are less popular now than they were in pre-war days, but as there may be some of the younger generation with an old B.C. receiver to hand who would like to try short-wave listening, I thought it worth while to comment on this subject as it will enable them to enjoy loud-speaker reception of the most powerful transmissions at low cost.

On Your Wavelength

By Thermion

Interference

IN future those who complain to the Post Office of electrical interference with their reception will be handed a pamphlet which tells them how they can make simple tests to ascertain whether the trouble is due to a faulty receiver or inefficient aerial and earth system.

Interference due to such causes should not be referred to the Post Office Interference Investigation Service, but should be dealt with by the owner of the receiver, or his radio dealer.

None of my readers would complain to the Post Office, of course, without being quite sure that the aerial and earth system was in good order.

When it is known that the interference is due to causes outside the control of the owner of the set he should fill in the form at the end of the pamphlet enlisting the services of Post Office engineers to track down the source of the trouble.

I am informed that this new method of dealing with complaints of radio interference has been adopted because in a large proportion of the cases investigated by the Post Office, it was found that the cause was due to faulty receivers, or to faulty aerial and earth systems.

Heavy calls are made upon the P.O. I.I.S. and it is hoped by this new method to effect an appreciable reduction.

About Nickel

I WAS only able very briefly last month to deal with the criticism I had received from one who informed me that, if we detach a piece off a magnet, it will try to attach itself to any pieces of iron, nickel, etc. I said that nickel was a non-magnetic material. What I really intended to imply was, of course, that by comparison with iron, for example, it is only weakly magnetic.

I have a piece of pure nickel, which is only just attracted by a powerful car-magneto magnet. A piece of nickel supplied by the Mond Nickel Corporation just limply attaches itself to the magnet. According to the textbooks nickel has a saturation value of 6,150 gauss, and a permeability (H = 10 oersted/cm.) of 400. I am well aware that nickel is used in special alloys such as permalloy, nickeloy, and other of the nickel steels. It is, of course, a well-known fact that all materials are magnetic though most so feebly that to all intents and purposes they are practically non-magnetic or the effect is swamped by much larger paramagnetism or ferromagnetism. Many thanks to the three readers who wrote to correct me on this point. I am wiser now.

P.T. on Radio Batteries

I AM glad to note that at the Autumn Conference of the National Chamber of Trade attention was drawn to the anomaly created by the imposition of purchase tax on radio batteries, which are largely used by rural workers and others in areas where electric mains are not available. Requests have been sent to the Government to remove the injustice by abolishing purchase tax on batteries and accumulators used for radio receivers.

Competition from TV?

THE rapid strides at present being made in television might lead one to suppose that experimenters were deserting radio and devoting their attention to TV. Such, however, is not, in fact, the case. More people than ever are interested in building receivers. Each year there is a new influx of youngsters who become interested in radio for the first time. Technical journals are rather apt to overlook the needs of these beginners, and to omit articles of an elementary nature. The fact is that year by year the same old elemen ary story must be told. This may be distasteful to, or considered a waste of space by, the experienced man, but we must remember that we were all inexperienced once.

The proprietors of this journal publish a very elementary book on radio entitled "Everyman's Wireless Book." Its sales have reached enormous proportions and it is now in its tenth edition. It is an excellent primer for the very beginner, and indeed is used for that purpose in many schools.

Memorial to Baird

I AM pleased to note that the London County Council has decided to erect a commemorative plaque to John Logie Baird on the front of 22, Frith Street, Soho. This plaque is the 200th to be erected or re-erected by the Council since 1903. It will be circular in shape and the inscription in white letters on a blue background reads:

"LONDON COUNTY COUNCIL
IN 1926
JOHN LOGIE BAIRD
1888-1946
FIRST DEMONSTRATED
TELEVISION"

Baird was born in Scotland and was educated at the Royal Technical College, Glasgow. He moved to Hastings where a house in Queens Avenue bears a plaque recording the experiments in television which he conducted there in 1924. At the beginning of 1926 he occupied the attic laboratory in Frith Street, where the plaque is erected.

It was on Tuesday, January 26th, 1926, that he carried out the world's first demonstration of television before an audience consisting of about 40 members of a Learned Society. The image was transmitted from one room to another. The apparatus is now in the Science Museum.

Radio Receiver Design at V.H.F.—2

FADING : ATMOSPHERIC INTERFERENCE : OSCILLATOR STABILITY : TUNED CIRCUITS

By G. P. Lowther

(*Continued from page 508 November issue.*)

Fading

IT has sometimes been stated that V.H.F. transmissions are not susceptible to fading, at any rate until communication is attempted over greater than optical range, i.e., when propagation depends upon refraction of the earth's atmosphere. Actually, this statement should be slightly modified; no rapid fading is encountered, but there may be variations of several decibels with changes in atmospheric conditions, particularly when there are unmixed layers of warm and cold air above the surface of the earth. Whilst fading does not prove troublesome, multi-path propagation may do so, however. Fig. 4 shows how such conditions may arise.

Fortunately, such conditions do not usually

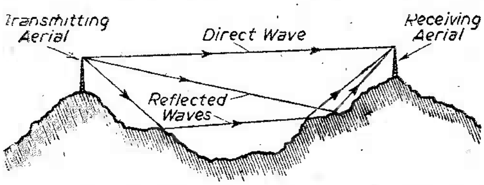


Fig. 4.—This diagram shows how a signal can be split up in radiation.

prove troublesome unless transmissions susceptible to phase distortion are involved, e.g., television, where multi-path propagation may produce ghost images, or multi-channel radio telephony in which cross-talk may be caused. In the case of such transmissions, aerial sites and ground slopes must be carefully selected, and antennae which discriminate vertically as well as horizontally (e.g., rhombics) should be employed. Single channel telegraphy or telephony such as the amateur is likely to use will not be appreciably affected.

Not only is transmission at V.H.F. optical, but it is considerably influenced by objects placed in the path of the radio waves. For instance, it was noticed in one case that reception was much better during the winter than the summer months, and investigation proved this to be due to the fact that the radio path was through a thin screen of trees, the foliage of which in summer caused an appreciable reduction in signal strength. Metal objects, buildings, etc., produce far more troublesome effects, and apart from giving reflections, may completely block reception if located in the optical path. When experimenting at V.H.F. it is therefore advisable to try various positions for the aerial until optimum reception is obtained. (This will not necessarily be the most obvious one.)

Atmospheric Interference

Atmospheric interference is seldom troublesome at V.H.F., but severe interference is often caused by man-made static such as motor-car ignition systems. Fortunately the radiation is chiefly over the surface of the ground and its effect is much reduced if the aerial is well elevated.

A rather peculiar form of interference is sometimes evident at V.H.F. and is often difficult to cure. It is found that metallic objects making loose or scraping contact, even though connected to no other apparatus, cause noises in the receiver, which can only be prevented by bonding the wires which give rise to the interference to earth or to each other or by separating the offending objects.

Above 30 mc/s

The advantages and disadvantages of working at frequencies above about 30 mc/s thus depend upon the conditions of transmission required and may be summed up as follows: If wide-band transmission is necessary, i.e., the band-width is of the order of 1 mc/s or greater, very high frequencies must be used even though this necessitates relay station working owing to the propagation being limited to optical distances. Where band-widths between about 50 kc/s and 1 mc/s are required, as in commercial frequency-modulated transmissions, it is impossible to make use of the short-wave band owing to selective fading if the sky wave is used, and while propagation on medium or long waves is theoretically possible, considerations of available ether space make this impracticable and once more recourse must be had to V.H.F. working.

Commercial narrow-band transmission for entertainment or cultural purposes is not, however, easily adapted to working above 30 mc/s, i.e., below 10 metres, because not only would such services provide only limited local reception, but tuning would be extremely sharp and calibration of stations would be almost an impossibility. For the amateur, however, these last two considerations are of far less importance and experimental work at these frequencies opens up a wide field of research. The cost of constructing suitable apparatus is not great and much work can be done with the help of a small local oscillator, the construction of which will be described in a later article, though even this is not essential.

Before discussing actual design considerations, one more question must be answered, the hoary problem of "straight versus superhet." While for long, medium and short-wave working no other type of receiver can compare with the superhet for sensitivity and selectivity, the problem is somewhat different at V.H.F. as the efficiency of frequency-changers falls off rapidly above about 50 Mc/s, and therefore apart from the reduction in gain, the performance deteriorates as the receiver is inherently more noisy as will be shown later. Also, since it is normally unnecessary to provide a large percentage change in the frequency to which the receiver is tuned, the advantages of fixed frequency amplification obtained with a superhet are reduced.

Oscillator Stability

Another difficulty is that of maintaining a sufficient degree of oscillator stability for narrow-band transmissions. Nevertheless, the superhet remains the receiver of choice, since it reduces to a minimum the number of circuits operating at signal frequency. The frequency-changer may be incorporated in a complete receiver or used as a converter with an intermediate frequency of 10 Mc/s-40 Mc/s.

It is, of course, possible to employ super-regeneration at V.H.F., and circuits of all three types of receiver will be described later.

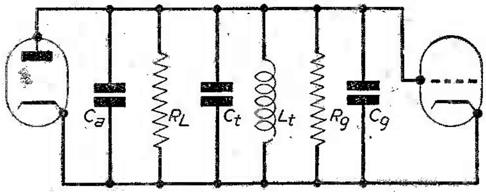


Fig. 5a.—Single parallel circuit.

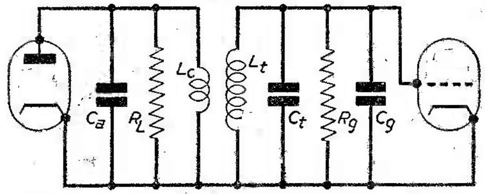


Fig. 5b.—An untuned primary is shown here.

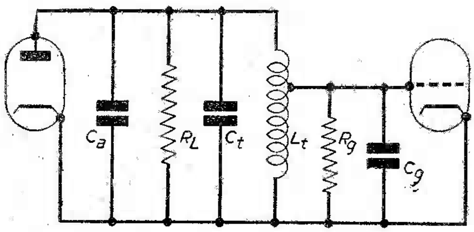


Fig. 6.—A tapped parallel circuit. The step-down voltage ratio = r.

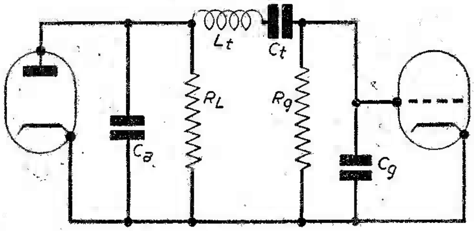


Fig. 7.—A series circuit.

The table below compares propagation at V.H.F. with that at lower frequencies:

Tuned Circuits

Not only is valve technique different, but tuned circuits must be treated rather more carefully at V.H.F. than at lower frequencies. They may be roughly classified as narrow and broad band, though what is called narrow at V.H.F. would be termed broad at lower frequencies. In other words, the narrowest band width that can be expected is of the order of several hundred kilocycles. Any greater degree of selectivity must be achieved in subsequent I.F. stages. For experimental amateur work it is clearly unnecessary to work with bandwidths of the order of megacycles, particularly as a reduction in gain would result, but since many commercial and other transmissions employ broadband working, suitable tuned circuits will be briefly described.

1. *Narrow band circuits.*
(a) Single parallel (Fig. 5a).
(b) Single parallel with untuned primary (Fig. 5b).
(c) Tapped parallel (Fig. 6).
(d) Series (Fig. 7).
2. *Broad-band circuits.*
(a) Double parallel (Fig. 8).
(b) Common inductance coupled-shunt (Fig. 9).
(c) Common inductance coupled-series (Fig. 10).
(d) Parallel staggered.
(e) Series staggered.

Figs. 5 to 10 show diagrammatically the most convenient circuits for use at very high frequencies. (H.T. blocking condensers, cathode resistors, etc.,

	Long waves 150-300 kc/s (2,000-1,000 m.)	Medium waves 500-1,500 kc/s (600-200 m.)	Short waves 3-30 mc/s (100-10 m.)	Very short waves 30-300 mc/s (10-1 m.)
Ground wave	Strong — absorbed very slowly	Absorbed more rapidly	Not normally used	Used over optical range
Sky wave	Same order as ground wave	Causes interference at night	Provides long-distance reception	Lost in outer space
Fading	Slow and slight	Troublesome at night	Considerable, varied and sometimes selective	Negligible over short distances
Power required	Very large	Large	Medium	Small
Aerials	Very large, usually non-directional	Large and usually non-directional	Medium, are usually beamed	Small, and easily made directional

are omitted as these do not normally affect the operation of the tuned circuit.) Before analysing them a simple example will be given to justify the statement that wide-band coupled circuits are only necessary in special cases.

Ct (tuning capacity) = 20 pF ($\mu\mu$F). Assume f = 40 Mc/s.

R_L (impedance of anode circuit to earth, including losses) = 40,000Ω.

C_a (output capacity of valve including strays) = 7 pF.

R_g (impedance of following grid circuit to earth, including losses) = 10,000Ω.

C_g (input capacity of following valve including strays) = 10 pF.

Then, as will be shown later, the bandwidth of the circuit shown in Fig. 6 (which provides good selectivity):

$$= \frac{1}{\pi r^2 R_g \left(C_a + \frac{C_g}{r^2} + C_t\right)} \text{ cycles.}$$

$$= \frac{1}{\pi \times 2^2 \times 10^4 \left[7 + \left(\frac{10}{2^2}\right) + 20\right] 10^{-12}} \text{ cycles.}$$

$$= \frac{1}{4\pi \times 29.5 \times 10^{-5}} \text{ kc/s.}$$

$$= 270 \text{ kc/s.}$$

If a higher frequency had been chosen, the bandwidth would have been still greater. It may

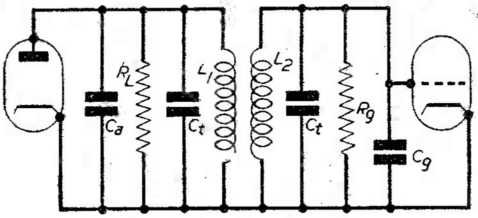


Fig. 8.—A double parallel circuit.

perhaps be remarked here that all numerical examples quoted are typical of conditions at V.H.F. and will give a good indication of the results to be expected.

Analysis of Fig. 5a

It is not thought necessary to prove the well-known formula that the gain of a stage $= \frac{\mu R_L}{R_a + R_L}$ where R_L is the total effective load. When R_a is much greater than R_L (a justifiable assumption at V.H.F.) gain $= \frac{\mu R_L}{R_a}$. But $\frac{\mu}{R_a} = G_m$ (these symbols representing the static characteristics of a valve). Therefore gain $= G_m R_L$ (approximately).

At low and medium frequencies the bandwidth of a circuit is usually taken 6db below the maximum response, but here it will be taken 3db for a reason shortly to be explained.

By definition $Q = \frac{\omega L}{r}$ (where r represents the series resistance of the circuit).

As may be shown fairly simply, but at some length, the effective parallel impedance (R) of a tuned circuit at resonance $= \frac{L}{Cr}$ or $r = \frac{L}{RC}$

Hence $Q = \omega L \Big/ \frac{L}{CR} = \omega CR$.

This is a much more convenient form as L and r are seldom known, whereas a fairly accurate estimation of C and R can usually be made. A well-known method of measuring Q experimentally is to note the bandwidth when the response is $\frac{1}{\sqrt{2}}$ (0.707 or 3db) below the maximum.

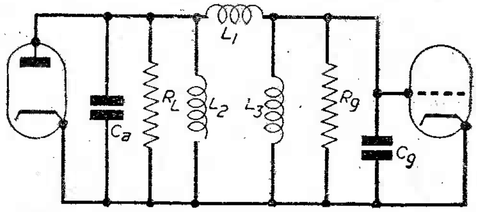


Fig. 10.—Common inductance coupled-series.

Then $Q = \frac{f_o}{2\delta\ f_o}$ where f_o = mid-band frequency and $2\delta\ F_o$ = total bandwidth 3db down.

Hence bandwidth $= \frac{f_o}{Q} = \frac{f_o}{\omega CR}$

$= \frac{1}{2\pi CR}$, again a very convenient expression.

In Fig. 5a, bandwidth $= \frac{1}{2\pi\ R_g\ (C_a + C_g + C_t)}$ and gain $= G_m\ R_g$, assuming in both cases that R_L is much greater than R_g, i.e., that R_g is the resistor limiting the gain and broadening the band. This condition is approximately fulfilled, but for accuracy R_g should be replaced in the gain and bandwidth expressions by R, where $R = R_g$ in parallel with R_L.

$$\text{Gain} \times \text{bandwidth} = \frac{G_m}{2\pi\ (C_a + C_g + C_t)}$$

(" Goodness " factor of circuit.)

As a typical example, assume R_L = 20,000Ω, R_g = 2,000Ω, C_a = 7 pF, C_g = 10 pF, C_t = 20 pF,

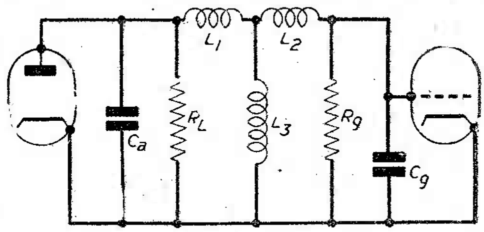


Fig. 9.—A common inductance shunt.

G_m = 6 mA/V, f = approx. 50 Mc/s, gain $= 6 \times 10^{-3} \times 1820$.

= 11 times, or 21db

$$\text{Bandwidth} = \frac{1}{2\pi \times 1820 \times 37 \times 10^{-12}} \text{ cycles}$$

= 2.4 M/cs.

These unsatisfactory figures are due to the heavy damping imposed by the grid circuit.

In Fig. 6 this is minimised by tapping the grid down the tuned circuit, which thus acts as an auto-transformer.

(To be continued.)

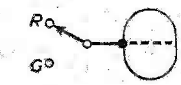
Radiogram Combinations

VARIOUS METHODS OF USING A PICK-UP WITH HOME-MADE OR COMMERCIAL RECEIVERS

By W. J. Delaney (G2FMY)

MANY amateurs are desirous of possessing a radiogram but already have a radio receiver—either home-made or factory built, and wish to utilise that as part of a complete installation. We are often asked if we can supply a blueprint for a radiogram, but actually, of course, there is no need for a print of that description. Provided that an amplifier is available, together with a motor and suitable pick-up it is a simple matter to combine them to produce a radiogram. It is not proposed to deal with the constructional work which can take any desired form—either a large cabinet housing the complete equipment, or a console radio receiver with a separate unit consisting of a motor and turntable with the pick-up. In an elaborate unit, of course, record storage space is also provided.

To-day it is possible to obtain simple motors running at 78 r.p.m. for standard records, or two or three-speed motors suitable for use with long-playing discs in addition to the standard types. If one of these is selected it will also be necessary to obtain a pick-up of the type fitted with interchangeable heads as these must also be changed when playing the different types of disc. Most modern pick-ups require a matching transformer



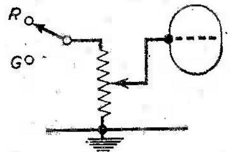
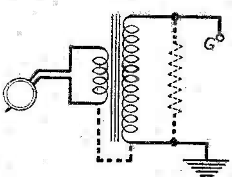


Fig. 1 (left).—Simple radiogram change-over switching. Fig. 2 (right).—Switching arranged to retain a single volume control operating on both radio and gram.



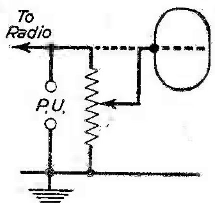
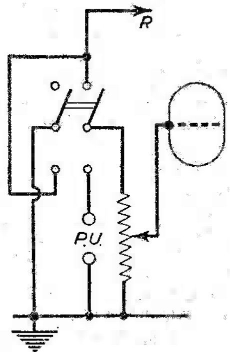


Fig. 3.—A resistor is sometimes necessary across the pick-up transformer secondary, and it is generally desirable to earth the primary winding. Fig. 3 (a) (right).—Pick-up sockets may be connected direct across a radio volume control if this is on the L.F. side.

to be used between them and the amplifier, and usually the makers are prepared to supply these with the pick-up. Suitable cabinets are easy to make to house the turntable and pick-up, and all that remains is to ascertain how to utilise the output from the pick-up. This is the principal stumbling block and it is the association of the pick-up with some amplifying system which introduces the major problems.

Pick-up Output

The output delivered from a pick-up varies according to the type and it is necessary to ascertain from the maker's data sheet whether or not this is so low that what is known as a pre-amplifier is required. Ignoring this type of instrument for the minute let us assume the use of one of the older types of instrument which has an output of just over 1 volt. This must be fed into a low-frequency amplifying stage followed by one or more stages to deliver sufficient output to operate a loudspeaker satisfactorily. Most commercial radio receivers are provided with sockets marked "Pick-up" or "Gram." It is usual for these to be included in or immediately following the detector stage so that the L.F. stages of the receiver may be used for record amplification. In its very simplest form this will consist of a pair of sockets, one of which is connected to earth and the other to the grid circuit, although there may be included a single-pole change-over switch as shown in Fig. 1. The radio components are terminated at the socket or point marked R in this sketch and the pick-up is connected with one side to earth and the other to the point G. Obviously, therefore, when the switch is on R the radio signals will be heard, and when



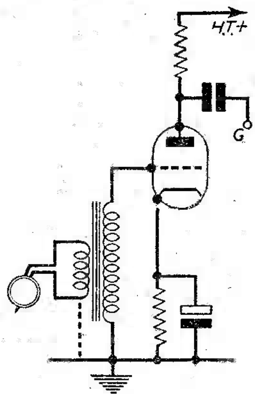


Fig. 4 (left).—A double-pole change-over switch arranged as shown here will enable radio to be silenced when using gramophone. Fig. 5 (right).—A simple pre-amplifier stage which is necessary with low-output pick-ups.

turned to G the radio will be cut out and the output from the pick-up will be heard. In many cases this is all that is required, and if there is no radiogram switch it is usually found that when a record is played the radio signal may be cut out, should it be heard in the background, by detuning the radio. If there are no pick-up sockets, the first thing to do is to ascertain why—there may be a very important reason for their omission. In an A.C./D.C. or D.C. receiver, for instance, special precautions are necessary to avoid a serious shock as a direct earth is not employed and the chassis may be "live" to one side of the mains. In many cases a simple fixed condenser may be included in each of the pick-up leads, but the makers of a commercial receiver should be consulted if there are no pick-up connections in order to make certain that the receiver is suitable for use with a pick-up.

Fitting Sockets

If the receiver is suitable and sockets or terminals are not provided they may be included by breaking

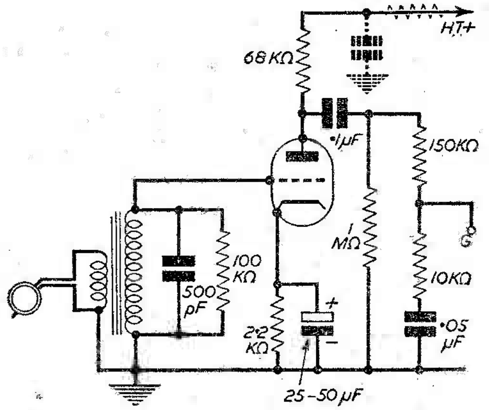


Fig. 6.—To provide bass compensation a tone-control pre-amplifier is desirable using a circuit similar to that shown here.

the connection to the grid of the first L.F. stage and fitting a change-over switch as shown in Fig. 1. If there is an L.F. volume control it is preferable to utilise this as the input arrangement, in which case the connections will be as shown in Fig. 2. The switch is, of course, a single-pole changeover component and may be of the simple toggle type. If the pick-up is of the type requiring an input transformer for matching, this should be included as shown in Fig. 3, where it will be noted that the secondary of the transformer is regarded as the former pick-up. The primary should, as a rule, have one end connected to the earthy end of the secondary, and to remove the risk of hum the connections from the pick-up to the transformer, and from the transformer to the input sockets, should be of screened lead. The transformer should be mounted as close to the pick-up as possible and usually a fixed resistor should be connected across the secondary, using a value recommended by the pick-up makers. To avoid having to detune the radio it is possible to use a double-pole change-over switch, making the connections as shown in Fig. 4. It will be seen here that when switched to gramophone the radio input to the switch is short-circuited.

Pre-amplifiers

The arrangements so far described are the simplest which can be adopted and will allow a reasonable output to be obtained. If the volume is insufficient additional L.F. stages will have to be employed. In many cases it will probably be found desirable to build a special amplifier and to cut out the L.F. side of the radio receiver, using the actual radio side, plus the gramophone pick-up in conjunction with the amplifier. In its simplest form an additional stage could be added as shown in Fig. 5, where a single L.F. amplifier is indicated and the output from this is taken, instead of the simple pick-up lead, to the input sockets. The valve will, of course, be alight all the time that radio is on unless a switch is inserted in the heater circuit to switch it off when not needed. The slight extra current, however, should not prove troublesome and it may generally be left in circuit without difficulty.

Compensation

As already mentioned, these are the simplest methods of using a pick-up, but as is well-known the recording characteristic of gramophone records is not straight and some compensation of the bass is necessary to obtain balanced reproduction—even if a tone-control is used. There are various arrangements which may be used and one which is very satisfactory with most ordinary types of modern pick-up is that shown in Fig. 6, and which is recommended by the makers of the Connoisseur

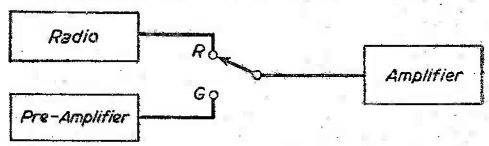


Fig. 7.—A radiogram consists merely of a radio tuner, a pre-amplifier and a main amplifier with input switching as shown in this block diagram.

pick-up. This gives a rising characteristic to the bass and slight amplification making it suitable for use before most types of amplifier. The output from this or any similar type is treated again, as in the case of the normal pick-up, and is shown diagrammatically in Fig. 7. If desired, additional tone control circuits may be added to the compensating circuit of Fig. 6 and all should be regarded, from the point of view of switching, as the simple pre-amplifier of Fig. 7.

Where one wishes to make up a complete radiogram as a domestic unit this may be done by building or purchasing as separate items an amplifier and a radio tuner. It is also possible to purchase to-day pre-amplifiers of various types as well as tone-controls built as separate units and containing the necessary valves to make up the loss which is incurred by the tone-control networks. In most cases plug-and-socket connections are provided on the separate units and those of different makes may often be combined to give a special combination.

Repairing Dial Drives

Hints for the Serviceman.

By J. S. KENDALL

THE subject of repairs to dial drives is one very rarely written about but is of great importance to the repair man and to the home radio enthusiast. Quite a number of manufacturers employ what at first sight are very complicated drives. The Philips is an example of this, but on examining them in a cool, collected manner they are found to be just a matter either of cords running over pulleys, or Bowden cables. First I will deal with the cord drives.

In the threading of the cord of cord drives the two tools shown in Fig. 4 are of very great use. These were designed by the writer in order to get the cord into inaccessible places. They are made out of two pieces of silver steel $\frac{1}{8}$in. dia. and 6in. long. The end half inch is filed flat to a thickness of about 1/16in., and one has a vee and the other a hook. Great care must be taken when filing the two grooves in the ends so as not to leave sharp ends or rough surfaces which will chafe the dial cord.

The choice of cord is very important, and I have found that the best is Allcocks No. 8079 pike line. This is fairly expensive, but it does not chafe easily and has a test strain of 20 lbs. giving a very good life and being free from stretch. There is nothing more annoying than to thread up a new cord, reassemble the receiver, try it out and find that the cord has stretched and that it is slipping and the job has to be stripped and done again.

Starting

In most drives at least one end of the cord terminates on a spring, but if only at one end, make off the cord, starting with the fixed end first. This can be done by taking the cord through a loop and tying it back on itself with two or three half-hitches. Another way of securing the cord, and much easier, is to thread on a tubular aluminium rivet so that the cord passes through it twice, then pinch as shown in Fig. 3. This method is used by several manufacturers and is to be recommended for its simplicity.

Once the cord is made fast at one end the required length is cut off; it is better to do this and waste a little than to get in a mess trying to thread on just the correct amount, as the fact that one end is anchored allows the cord to be held tight against the pulleys. This does not matter so much with the type of drive shown in Fig. 1, but is of great importance in threading the more complex type of drive. The drive pulley, or spindle, should have one-and-a-half to two turns, no more and no less. If too many turns are used they tend to ride up on to each other and bind, making the drive hard and greatly increasing the backlash. Awkward places can be threaded by means of the two tools described earlier.

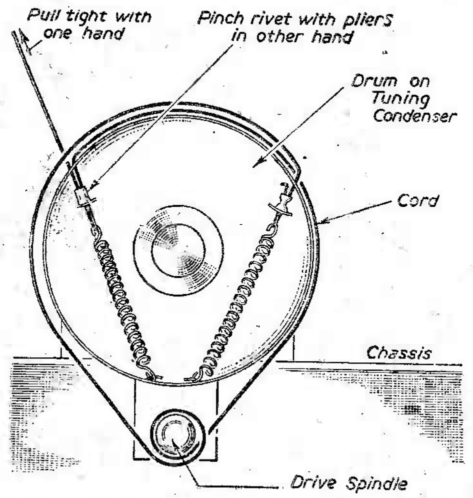


Fig. 1.—The simplest type of cord drive showing method of terminating cord.

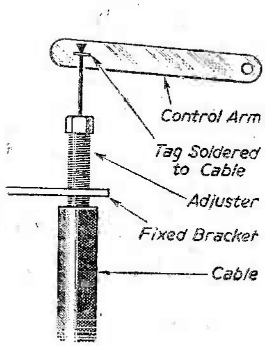


Fig. 2.—Construction of a Bowden cord adjustment.

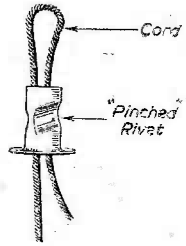


Fig. 3.—Method of making a loop in the end of a dial cord by using a rivet.

Finishing

The best way to make off the second end is shown in Fig. 1. This method has the great advantage over the more usual one as it only requires two hands and not three! After the dial is threaded the cord is pulled tight so that the spring is fully extended, and the tubular rivet is then pinched with a pair of pliers to secure it. The pinching has to be tight and a pair of pliers, not cutters, used, or the cord will be cut.

Cable Drives

The other type of drive is the Bowden cable. This is sometimes used for all the controls on the set! The main thing with this is to get some good cable and some suitable solder. In this respect I find that there is nothing to beat Arrax cored solder, as it tins steel cable very easily.

The method of threading is first to tin the end of the cable, this ensures that the loose ends do not catch when the cable is being threaded into the sheath. The make-off is usually a hollow brass thimble soldered over the wire to stop it slipping, and this thimble fits into a groove on the control, as shown in Fig. 4. The adjuster has the effect of shortening or lengthening the amount of space between the end of the sheath and the control arm. In some cases the cable can be made off with the aid of a tubular rivet in the same way as described earlier for the more common cord drives.

If the foregoing instructions are adhered to the matter of repairing dial drives becomes one of relative ease.

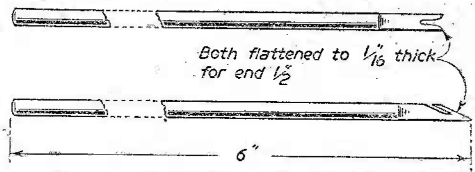


Fig. 4.—Threading tool for dial cord.

Improved Home Service

At present the BBC Home Service is satisfactorily received by about 92 per cent. of the population of the United Kingdom, though in some areas it is subject to interference from foreign broadcasting stations, especially during the evenings in winter. It is not possible to make any widespread improvement in coverage because of the shortage of wavelengths available for use by the BBC; these were allocated by agreement between the Governments of countries in the European Zone at a conference held in Copenhagen, and the resulting Wavelength Plan was put into effect in March, 1950.

BBC engineers have made a detailed study of reception conditions since the Copenhagen Plan came into force and have worked out a scheme for making local improvements in reception of the Home Service in certain parts of the country. This plan, which has now received the approval of the Postmaster-General, provides for twelve low-power transmitters to be brought into service in areas where they are most needed and will benefit the greatest number of people.

In finding wavelengths for these new stations, either wavelengths must be shared with existing BBC transmitters or use must be made of the International Common Wavelength which most countries have the right to use. There are objections to both these courses. When two transmitters share a wavelength an "interference area" is created in which reception is poor and may be intolerable. Stations which share a wavelength must, therefore, be chosen very carefully or the loss of population coverage may be greater than the gain. Of the two International Common Wavelengths, 188 metres is off the tuning scale of most receivers at present in the hands of the public and will therefore not be used in this scheme. The other, 202 metres, is of limited value because the power is restricted to 2 kilowatts by the Copenhagen Plan and the range is further limited by interference from the many Continental stations also using it. The present scheme for additional Home Service transmitters is tabulated below. It will be seen that in some areas it is not practicable for the transmitter to radiate the Home Service of its own Region for the reason already explained. It is expected that at least some of the transmitters will be in operation before the winter of 1951/52.

Unfortunately, reception conditions in Europe on the medium-wave band are likely to get worse as the number of broadcasting stations and their power increases. It is therefore of the utmost importance that listeners should realise the need to keep their receivers in good working order, because the slow deterioration in performance that inevitably occurs in the course of time leads to weak reception, fading, and interference from other stations. A good outdoor aerial should always be used whenever circumstances permit, to allow the receiver to give of its best.

ADDITIONAL TRANSMITTERS AND AREAS SERVED:

Location	*Wavelength*	*Frequency*	*Programme radiated*
Barnstaple ..	285 m.	1,052 kc/s	West of England
Scarborough ..	261 m.	1,151 kc/s	Northern Ireland
Bexhill ..	206 m.	1,457 kc/s	West of England
Folkestone ..	206 m.	1,457 kc/s	" " "
Brighton ..	206 m.	1,457 kc/s	" " "
Whitehaven ..	434 m.	692 kc/s	North of England
Barrow ..	202 m.	1,484 kc/s	" " "
Ramsgate ..	202 m.	1,484 kc/s	London
Pwllheli ..	341 m.	881 kc/s	Welsh
Cromer ..	330 m.	908 kc/s	London
Montrose ..	202 m.	1,484 kc/s	Scottish
Dumfries ..	371 m.	809 kc/s	"

Three of these stations—Brighton, Ramsgate and Hastings—were put into operation on September 16th.

Two more of the twelve proposed stations, making five in all so far, came into operation on October 7th, at Whitehaven and Barrow. Both transmitters radiate the North of England Home Service, Whitehaven on 434 metres (692 kc/s) and Barrow on 202 metres (1,484 kc/s).

Both transmitters will ultimately have a power of 2 kilowatts, but as the completion of the permanent installation will take some time, temporary transmitters of lower power will be used to provide a service before winter sets in. It is expected that these temporary transmitters will improve reception only in the immediate vicinities of the towns in which they are situated.

50 YEARS OF RADIO

SOME HISTORICAL NOTES ON THE POLDHU STATION, ERECTED IN 1901

MARCONI'S endeavour to span the Atlantic by wireless was planned in the face of predictions, by distinguished mathematicians, that communication by means of electromagnetic waves would be limited to a distance of about 165 miles.

Erection of Poldhu transmitting station commenced in October, 1900, and the plant was completed ready for preliminary experiments in mid-January, 1901. The original aerial system consisted of a ring of 20 wooden masts, 200ft. high and arranged in a circle 200ft. in diameter, supporting 400 aerial wires forming an inverted cone.

A gale on September, 17th 1901, wrecked the aerial at Poldhu and it was replaced by a fan shaped aerial of 54 wires suspended from a triatic at 1 metre intervals. Height 150ft.

Transmitting apparatus was finally arranged for the attempt: A 32 h.p. Hornsby-Ackroyd oil engine, driving a Mather and Platt 50 cycle alternator, output 25 kW. at 2,000 volts. The 50 cycle A.C. was raised in voltage by two 10/1 ratio transformers in parallel. This output was connected through H.F. chokes to a closed oscillatory circuit in which a condenser discharged across a spark gap through the primary of a H.F. transformer. The secondary of the transformer was connected to a second spark gap and condenser and the primary of a second H.F. transformer. The secondary winding of this transformer was in series with the aerial. Keying of the transmitter was effected by the short-circuiting of chokes connected in the output from the alternator.

The condensers mentioned were each constructed by placing twenty glass plates 16in. square, coated on each side with a square foot of tinfoil, in stoneware boxes filled with linseed oil.

Wavelength—No Record

The wavelength of the transmission was not recorded. In fact no means then existed of measuring high frequencies. From data available and results achieved it is estimated that the fundamental wavelength emitted was of the order of 1,000-2,000 metres.

A corresponding station had been commenced at South Wellfleet, Cape Cod, Massachusetts, but the circle of masts there suffered the same fate as those at Poldhu. It was decided thereafter to make a first attempt to receive Poldhu in Newfoundland.

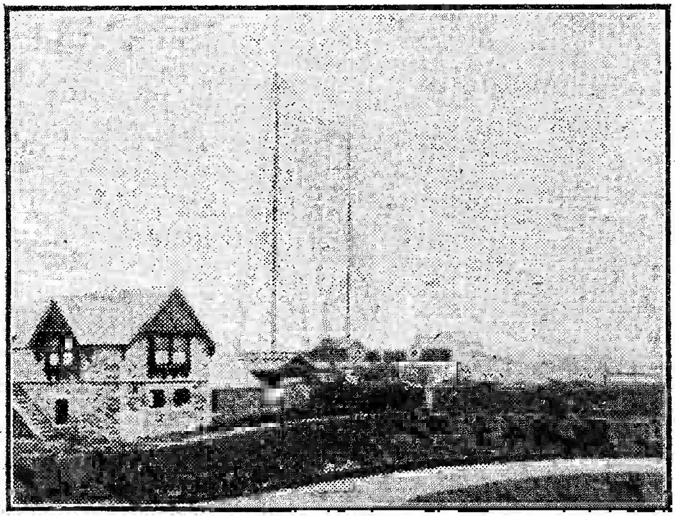
Marconi left England with his assistants Paget and Kemp on November 27th, 1901, arriving at St. Johns, Newfoundland, on December 5th. Every assistance was afforded him by Sir Cavendish Boyle, the Governor and Sir Robert Bond, the Prime Minister, a room in a Government building at Signal Hill being provided for Marconi's use as a receiving station.

The pre-arranged signal which Poldhu had been instructed to transmit was the letter "S" in

The granite column erected by the Marconi Company to commemorate the site of the former Poldhu Wireless Station at Poldhu Cove, Cornwall —November, 1937.

Morse (a succession of three dots) to be sent continuously from 3 p.m. to 6 p.m. Greenwich time, each day and, on Marconi's cabled instructions, this programme commenced on Wednesday, December 11th, 1901.

The receiving aerial at Signal Hill was supported in the first place by a balloon. Weather was rough and on its first ascent it broke away and was lost. On Thursday, December 12th, a large kite carrying an aerial wire was successfully flown to a height of 400ft. The rise and fall of the kite in the wind caused variations in the capacity of the aerial and this precluded the use of any of the syntonic receiving apparatus then available. The apparatus used was simply a self-restoring coherer in series with the aerial and a telephone earpiece.



170ft. masts with 60 wire fan-shaped aerial at Poldhu, used for Marconi's first Trans-Atlantic experiment in 1901. A power of 12 kW. was used.

Success !

Marconi's pocket diary carries the laconic entry for December 12th, " Sigs at 12.30, 1.10 and 2.20." On the following day, Friday, he records " Sigs at 1.38." A recognisable wireless signal had been sent across the Atlantic to the astonishment of a sometimes outspokenly incredulous world. Much, however, had yet to be learned of the laws governing the propagation of wireless waves, which to-day is common knowledge, before communication sufficiently reliable for the transmissions of coherent messages could be attained.

During the progress of the experiments, which continued for the following 12 months, a more powerful transmitting station was established at Glace Bay in Canada and Poldhu Station was used for reception.

On December 14th, 1902, Poldhu was at last able to report reliable reception throughout a two hour programme. The following day the first transatlantic wireless telegram was received at Poldhu. It was addressed to *The Times* in London but as Marconi desired that the Kings of England and Italy should each receive a message before anyone else, it was not forwarded until, on December 21st, these telegrams had been acknowledged and communication across the Atlantic was announced to the Press.

The variable reliability of communication was still the subject of much investigation and commercial operation of this channel was not yet practicable. In the course of these researches Marconi sailed on the 22nd August, 1902, in *S.S. Lucania* to New York, having arranged for both Poldhu and Glace Bay to transmit throughout the voyage. The news sent was published on board in a daily sheet called the " Cunard Bulletin " the success of which later instigated the general publication of similar newspapers on board ocean liners.

To meet this demand for news on board vessels—and as it had become plain that Poldhu and Glace Bay, as they stood, could not sustain a full transatlantic commercial service—it was decided to inaugurate a long-distance news service to ships from these two stations. The long series of experiments were continued elsewhere and Poldhu entered upon its career as the friend of transatlantic shipping in peace and war, in which role it will ever be remembered with affection by those whose need it served.

Progress

Progress in radio development was reflected in the various modifications to the Poldhu apparatus during these years until in 1920 experiments were made from there in telephony transmission to ships. *S.S. Victorian*, carrying delegates from the Empire Press Conference, sailed to Canada on July 20th that year and received music and speech throughout the voyage from Poldhu and Newfoundland, the experiments on board being conducted by Mr. Arthur Burrows (later " Uncle Arthur " of the BBC).

These trials, however, had soon to cease owing to the reports of what, in those days, was considered to be interference with Service communications.

Poldhu finally closed down for public transmissions on June 10th, 1922, and a series of experiments were commenced there under Mr. C. S. Franklin in methods of directional short-wave transmission in continuation of those which Marconi had made in Italy with Franklin in 1916.

At this time an elaborate scheme of high-power medium-wave Government stations to link the countries of the British Commonwealth was in hand. Contracts had been issued and in some cases work had actually commenced on the sites. But the success of these directional short-wave developments was such as to warrant dramatic eleventh-hour intervention by Marconi's Wireless Telegraph Co. Their proposal to provide the specified channels of communication at one twentieth of the cost, using one fiftieth of the power, was too sweeping to be disregarded. A contract bearing the most stringent guarantees was signed on July 28th, 1924, and resulted in the network of Marconi-Franklin Beam Stations which now link the Commonwealth.

A Memorial

After further experimental use "Poldhu" was dismantled in 1933 and to-day no trace of this historic station remains. A memorial column of granite marks the cliff-top site. The inscriptions on its four sides read :—

Plaque Number 1.—One hundred yards North East of this column stood from 1900 to 1933 the famous Poldhu wireless station, designed by John Ambrose Fleming and erected by the Marconi Company of London, from which were transmitted the first signals ever conveyed across the Atlantic by wireless telegraphy. The signals consisted of a repetition of the Morse letter "S" and were received at St. Johns, Newfoundland, by Guglielmo Marconi and his British associates on 12th December, 1901.

Plaque Number 2.—The Poldhu wireless station was used by the Marconi Company for the first trans-oceanic service of wireless telegraphy which was opened with a second Marconi station at Glace Bay in Canada in 1902. When the Poldhu station was erected in 1900, wireless was in its infancy; when it was demolished in 1933, wireless was established for communication on land, at sea, and in the air; for direction-finding, broadcasting, and television.

Plaque Number 3.—From the Marconi Company's Poldhu Station in 1923 and 1924, Charles Samuel Franklin, inventor of the Franklin Beam Aerial, directed his short-wave wireless beam transmission to Guglielmo Marconi on his yacht *Elettra* cruising in the South Atlantic. The epoch making results of these experiments laid the foundation of modern high-speed radio-telegraphic communication to and from all quarters of the globe.

Plaque Number 4.—The site of this column and some six acres of land on the edge of these cliffs together with the cliffs and the foreshore beneath them were given to the National Trust in 1937 by the Marconi Company to commemorate the pioneer work done at the Poldhu wireless station between 1900 and 1933 by its research experts and the engineers.

Some of the early apparatus at the Poldhu Wireless Station. On the extreme left are the transformers. The banks of condensers are carried in metal containers in the wooden rack. On the extreme right is the spark gap consisting of two steel spheres mounted on insulating rods. Used in sending first Trans-Atlantic signals, 12th December, 1901.

Speed of Light

LAST year it was announced that experiments at the National Physical Laboratory had shown that the figure normally accepted for the speed of light was inaccurate by eleven miles a second. The apparatus used in the experiments is on show at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, until November 30th, 1951.

The exhibit consists of a cavity resonator in which a radio wave is reflected backwards and forwards between the two ends. When the time of travel between the ends equals the time interval between successive waves, they build up to an electrical resonance which can be detected with very high precision. Visitors are able to do this themselves.

The time of travel is about one ten-thousand-millionth of a second (1/10,000,000,000). This means that the waves follow one another at a frequency of 10 thousand million per second, and it is necessary to measure this frequency with an accuracy better than one part in a million.

Brit.I.R.E. in India

MR. G. D. CLIFFORD, secretary of the British Institution of Radio Engineers, has been invited to spend some time in India for the main purpose of establishing sections of the institution to be operated under an Indian Advisory Committee. The Government of India has given all possible help in arranging the visit which has been sponsored by the Ministry of Natural Resources and Scientific Research.

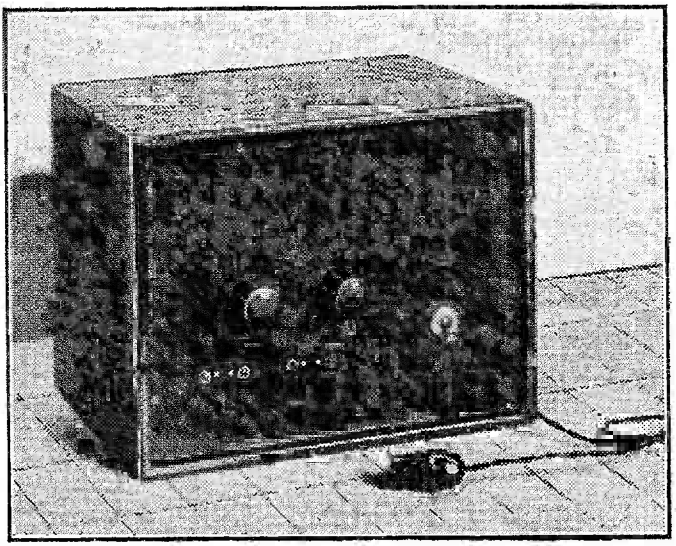
A convention of Indian members will be held in Bombay in February, 1952, for the presentation of local and other papers intended to show the development and application of radio and electrical engineering in India in both the communications and industrial fields.

Members in India are being advised separately of all arrangements for meetings, but other members who are visiting India and who wish to be advised of meetings should address their enquiries to: G. D. Clifford, British Institution of Radio Engineers, c/o Government House, Bombay, India.

A G.P. A

A UNIT FOR USE WITH RADIO

By F. C



The finished unit in its case.

An A.C./D.C. type circuit was used on the grounds of simplicity and low initial cost. A 2-pole mains switch is used so that when the amplifier is switched off the chassis does not remain live to the mains, as is usual in A.C./D.C. apparatus employing this type of circuit. As the completed amplifier was contained in a wooden radiogram cabinet it was not felt that any particular danger of shocks existed. It should, however, be noted that when the amplifier is switched on the chassis and any components or leads in contact with it will be connected to one mains-supply lead. This is always so with this type of circuit, and need not be regarded as particularly dangerous with

THOUGH this amplifier was built primarily for record-playing, and has been used for this purpose over a long period, its utility does not end there. Two input points are provided, each with its own volume control, and with an extra triode operative for one input. This first input point can be used with microphones or pick-ups giving a low output; it could also be employed when playing back from a tape recorder, the output of which is normally rather small. The second input point gives sufficient volume with the two best gramophone pick-ups which were used (one a crystal, and one a magnetic type). When this is done, the first input point can be employed for microphone, etc., and the volume from both microphone and records may be adjusted independently to the required level.

After the initial triode amplifier comes a 6SL7GT high-mu double triode, providing additional amplification and phase-splitting. This is followed by two output tetrodes operating in push-pull, and these give quality and volume ample for ordinary domestic purposes.

A somewhat similar effect to that obtained by negative feedback is obtained by omitting the cathode by-pass condensers from the output valves. Theoretically, of course, this is less effective than a conventional negative feedback circuit; but after practical tests over a period with by-pass condensers in circuit it was considered best to omit them. The same applies to by-pass condensers connected from the screen-grids of the output valves to chassis—the reproduction obtained with them removed was preferred to that obtained when they were connected. Hence they were omitted.

Ample anode decoupling was found helpful in reducing hum to a low level. This is provided by the 2 μF condensers and the 20,000 and 40,000 ohm resistors.

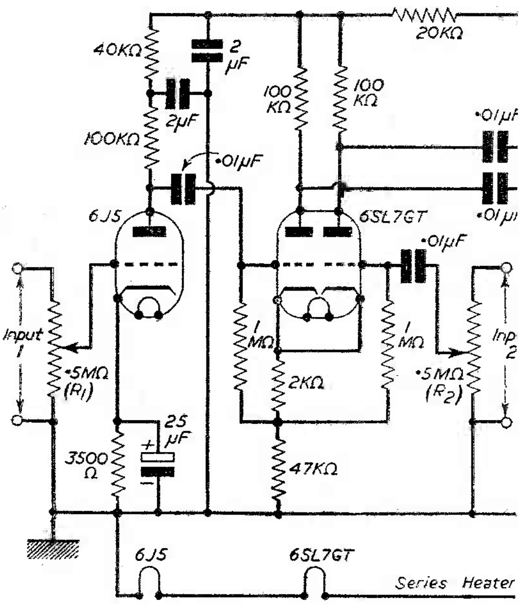


Fig. 1.—Theoretical cir

LIST OF C

5 Octal valveholders.
Smoothing Choke and Speaker Transformer (see text).
Resistors: 100 ohm; two 440 ohm; 2,000 ohm; 3,500 ohm; two 5,000 ohm; 20,000 ohm; 40,000 ohm; 47,000 ohm; three 100,000 ohm; two 220,000 ohm; two

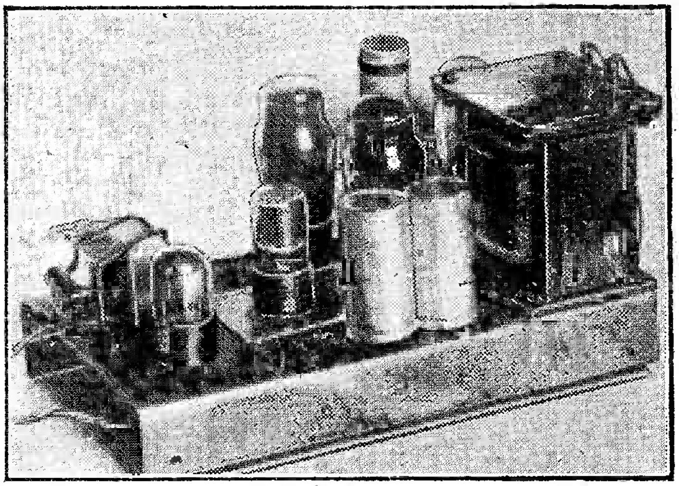
Amplifier

RECORDS OR MICROPHONE

Rayer

reasonable care. It is desirable to wire the mains-supply plug in such a way that the mains "Neutral" (or low-potential lead) is the one switched to the chassis.

Switch and volume controls were mounted on the motorboard, near the turntable. If a radio tuning unit is employed, a further switch could be used to bring it into commission, and the output should be taken to the second pair of input sockets, unless the final valve in the radio unit is a simple diode, when the output may be taken to the first triode in the amplifier.



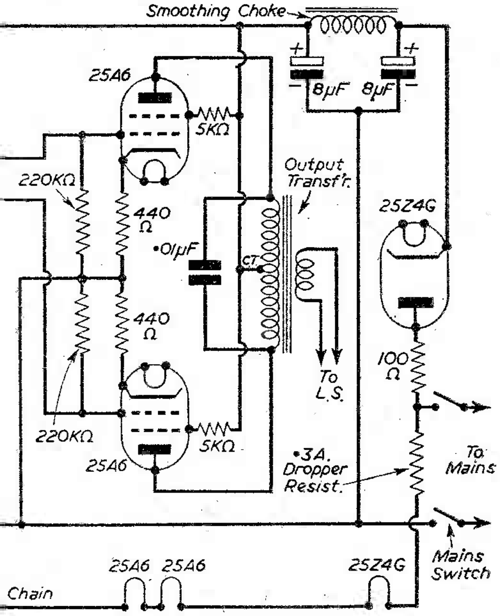
Top of chassis layout of the unit.

Constructional Details

The chassis was made from a piece of scrap aluminium 12in. by 10in. Two runners $1\frac{1}{2}$in. high were bent to form a chassis 12in. long by 7in. wide by $1\frac{1}{2}$in. deep. The dimensions are not critical, however, though a fairly large chassis is required. Holes for the valveholders are made with an adjustable cutter, and smaller holes drilled so that the other components, including the two 8 μF smoothing condensers, can be bolted down.

The location of the parts will be seen from Fig.2. If a small cabinet is used for the amplifier, the mains dropper should be well clear of its back, and ample ventilation should be provided. The rectifier and output valves also become quite hot after a period of use.

Fig. 3 shows the position of connections and components under the chassis, and the parts are so placed that most of the wiring is quite short and direct. The heater circuit should be wired up first, and the leads kept right against the chassis. The resistors and other small parts may be put on afterwards, and are kept an inch or so away from the chassis. Insulated wire is necessary throughout; some points are marked "M.C." and these are taken to tags bolted to the chassis. It should be noted that the 6SL7GT heater tags are close together, not situated at equal points each side the key-way, as is so with other valves.



uit of the amplifier.

MPONENTS

1 megohm. Two .5 megohm potentiometers. .3 amp dropper.
Condensers: Five .01 μF; two 2 μF; 25 V. 25 μF bias condenser; two 8 μF smoothing condensers.
Double-pole toggle on-off switch.
6J5, 6SL7GT, two 25A6 and 25Z4G valves.

Components Employed

All the resistors may be $\frac{1}{2}$ watt types, except for the 100 ohm resistor in the anode circuit of the rectifier, and the two output valve bias resistors (440 ohms each), where 1 watt components are required. The dropper is of the usual .3 amp. 600 ohm wire-wound type, with adjustable clip.

The four .01 μF coupling condensers are preferably of the mica type, though paper condensers known to be in good condition may be used. The 8 μF smoothing condensers only need be of the comparatively low-voltage working type intended for A.C./D.C. apparatus, though 350 or 500 volts.

working condensers can, of course, be used, if to hand.

The output transformer was a 90 : 1 component, centre-tapped, to match up to a 2-3 ohm, 10in. speaker. Many suitable transformers and speakers are obtainable. The smoothing choke should also present no special difficulty, any component capable of carrying 100 mA being suitable.

The valves are standard types. Should type 43 valves happen to be at hand, these may be used instead of the 25A6 valves, as they have the same characteristics. It would be necessary to employ UX 6-pin holders for the 43s, as the latter do not have octal bases. The 6J5 valve is also obtainable with the "GT" suffix. This is identical except for external dimensions, which are not important in the present case. If to hand, rectifiers such as the 25Z5 and 25Z6 may be used, with a UX 6-pin holder for the former, these having the same characteristics. The 25Z6 is an octal type, but has pin connections differing from the 25Z4G specified.

Notes on Operation

Two leads are taken directly from the output transformer secondary to the speaker speech-coil tags. Leads are similarly taken from input 1 or 2, as the case may be. With the amplifier switched on and working, voltages may be checked, and the following will serve as an approximate guide. (The actual readings obtained will differ somewhat with individual amplifiers, and also according to the ohms-per-volt characteristic of the meter.)

25Z4G cathode, 190 V. H.T. positive line, 185 V. 25A6 anodes, 180 V. 25A6 screen grids, 150 V. 25A6 cathodes, 15 V. 6SL7GT anodes,

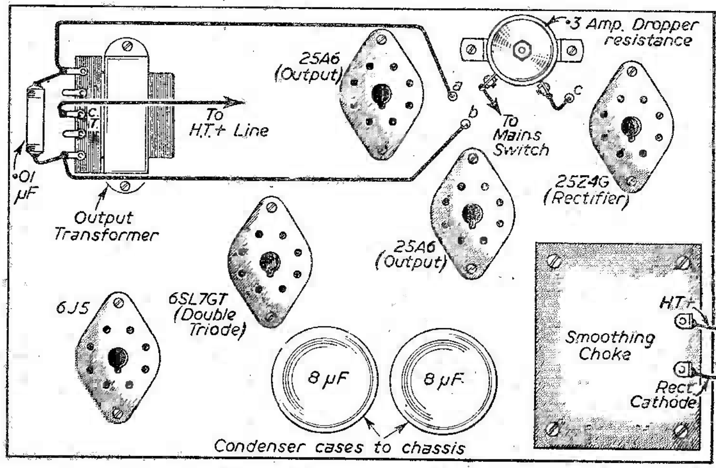


Fig. 2.—Top of chassis layout.

100 V. 6J5 anode, 80 V. These are D.C. readings; the following are A.C. readings, and all are made from the chassis in each case: 6J5 heater, 6.3 V. 6SL7GT heater, 12.6 V. First 25A6 heater, 37.6 V. Second 25A6 heater, 62.6 V. 25Z4G heater, 87.6 V. The mains-dropper should be adjusted from maximum value, switching off between each adjustment, until the heater readings are correct.

If the leads to R1 and R2 require to be lengthy, these should be screened, and the braiding earthed.

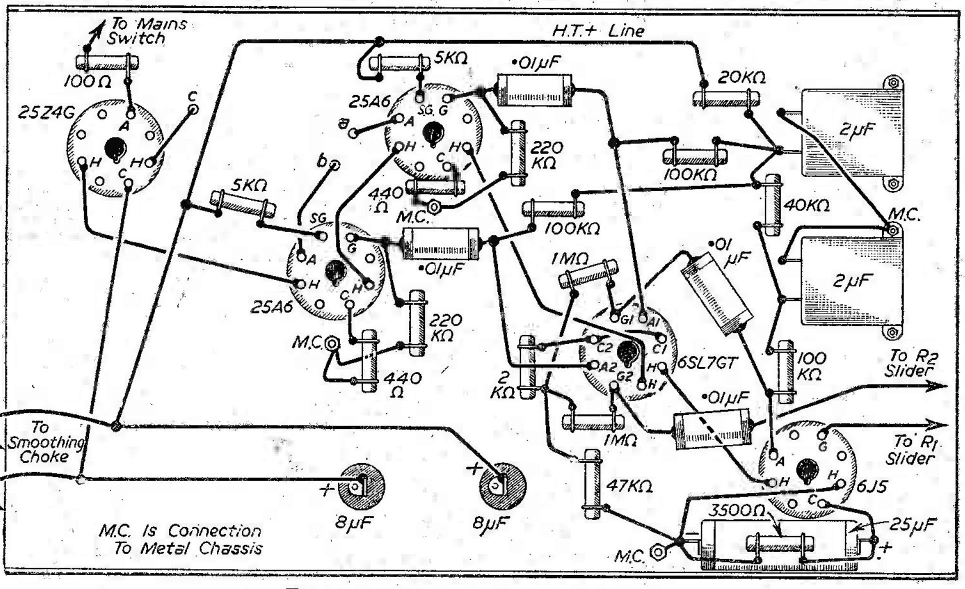


Fig. 3.—Under-chassis wiring details.

For the Transmitter

SCREEN MODULATION

DETAILS OF ECONOMY CIRCUITS FOR SMALL INSTALLATIONS

By O. J. Russell, B.Sc., A.Inst.P. (G3BHJ)

ONE seldom obtains "something for nothing," and this is particularly true in the case of modulation systems. However, there are many cases where the so-called "efficiency" modulation systems are of value. Without here detailing the various "pros and cons" of high-level anode modulation versus efficiency systems of modulation, it is well known that the very small audio power requirements for efficiency modulation systems are their chief attraction. Thus, the modulation equipment required is quite modest, consumes negligible power, and requires no costly audio transformers of high power-handling capability. The actual carrier output obtainable with a given tube is, of course, reduced, but this is counterbalanced by the simplicity of the modulation amplifier.

One efficiency system of growing popularity is the screen modulation method. Perhaps this is a matter of necessity. Most popular transmitting valves nowadays are tetrodes, and unlike the pentode types no suppressor grid modulation is possible. Apart from normal signal grid modulation, screen-grid modulation is the only alternative to cathode or anode modulation. However, not all tetrodes are suited to screen modulation, and with some valves it is possible to modulate only to a depth of 60 per cent. or so before serious distortion occurs. However, the ever-popular 807 and the 6L6 are particularly suitable for screen modulation, particularly as the power requirements for modulating the screen are small. With these valves modulation can be carried to about 100 per cent. without serious distortion.

Before considering the circuit arrangements commonly employed, the operating conditions for screen modulation should be discussed. As the maximum permissible operating screen voltage sets a limit to the screen voltage swing, it is advised to adjust the screen-operating voltage to one-half of the normal operating voltage for Class C C.W. conditions. Thus, under modulation, the screen volts are swung from zero to full normal screen voltage when the peak modulation voltage equals the standing screen voltage. To be specific, the maximum screen voltage for an 807 is 300 volts. However, in normal C.W. operation 280 volts is a comfortable operating figure. Thus for screen modulation the screen volts would be 140, that is, half the normal C.W. figure. With 140 volts on the screen, full sine-wave modulation would be achieved with a peak sine-wave input of 140 volts to the screen, which for all practical purposes is almost exactly 100 volts R.M.S.

However, that is not quite the whole story. Like other efficiency modulation systems, the performance is dependent upon R.F. drive and aerial loading to a much greater extent than anode modulation systems. Thus it is advisable to have both the R.F. drive to the P.A. and the aerial loading fully adjustable, so that optimum drive and loading can be obtained. In this respect it is as well not to adjust for maximum output. As a guide it will be found that the R.F. drive is somewhat less than for normal C.W. operation. However, unlike control-grid modulation where the same electrode is used for both the R.F. and audio signals and the best adjustment is a compromise between the two factors, in screen modulation, the modulation is applied to a separate electrode, so that R.F. drive and audio drive can be adjusted independently for optimum results. Screen modulation is thus considerably simpler to set up. It must be remembered, however, that the screen represents an impedance into which the modulator works. For the very good reason that the screen impedance under modulation may instantaneously vary between wide limits, it is advisable to use a modulator having good regulation. This may be achieved either by negative feedback or, as the power requirements are so low, a small triode may be used as the modulator. The average impedance of the screen-grid may be obtained by measuring the screen current at the operating value of screen voltage. With an 807, the screen may draw some

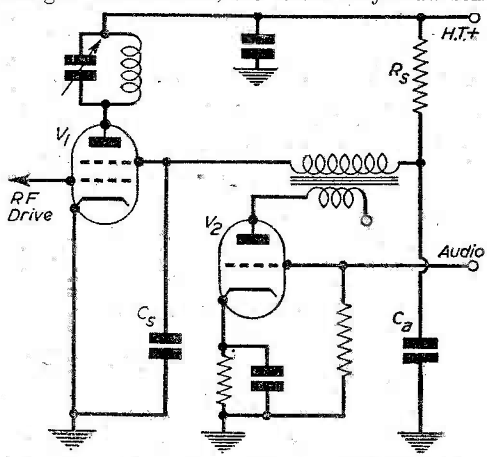


Fig. 1.—Transformer-coupled screen modulator.

Cs—.001 μF. V1—807.
Ca—1 μF. V2 and Rs—See text.

3 mA. to 4 mA. at 140 volts, and this represents an impedance of from 45,000 ohms to 35,000 ohms. With a triode modulator, however, it would be advisable to take a lower figure than this in view of the impedance variations under modulation. If a figure such as 15,000 or 20,000 ohms is taken, and the transformer ratio adjusted accordingly, it does not matter if the actual impedance is higher than this when using a triode. Distortion with a triode

occurs most seriously when the load impedance is lower than the optimum load, and is not at all serious if it works into an impedance higher than the optimum load. The modulating power requirements are slight. The theoretical power is half the D.C. input to the screen. This, under the reduced screen volts needed for screen modulation, is around half a watt. A small triode such as a 6C5 will usually be found adequate, and the writer has successfully used a 6C5 to screen modulate both 807s and 6L6 power amplifiers.

Alternatives

We can now briefly consider one or two circuit arrangements for screen modulation. The most simple and straightforward one is to use transformer

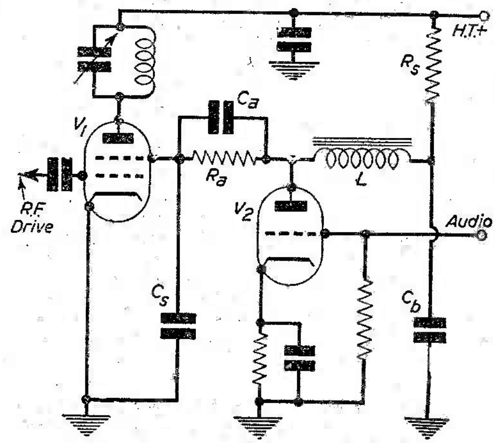


Fig. 2.—Choke-coupled screen modulator.

V1—807. V2—6C5, etc. Ra—30,000 Ω approx. Rs—20,000 Ω approx. Ca and Cb—1 μF. Paper. L—L.F. choke at least 10 H. Cs—.001 μF.

modulation. In view of the low power requirements, a small intervalve step-up transformer can often be pressed into service for screen modulation. Only the modulating valve itself is shown in these circuits, of course, and depending upon the microphone in use a certain amount of preamplification will be required. With a carbon microphone one R.C.-coupled preamplifier is adequate, while for a crystal microphone, two preamplifier stages will be desirable.

Fig. 1 accordingly shows a transformer-coupled triode used to modulate the screen of an 807. As the screen voltage is derived through a dropping resistance from the main H.T. line, its value will depend upon the actual H.T. line voltage. With a 500 volt supply the screen dropper will be 100,000 ohms approximately. However, with screen modulation, it is advantageous to operate the P.A. valve with a high anode potential, and with an 807 the H.T. can be increased to 750 volts. The value of screen resistor will rise to some 150,000 ohms with an anode voltage of 750. In setting up it is advisable to measure the screen potential with a suitable high-resistance voltmeter to make sure of the optimum conditions. Thus for the 807 the screen voltage should be approximately 140, and should certainly not exceed 150 volts. Lower voltages than 150 can do no harm, merely resulting in reduced power input. Excessively high screen voltages, on the other hand, may cause bad overloading of the screen on modulation. It is well to err on the side of caution therefore, and to use a screen voltage on the low side, and 140 volts is as good a figure as any.

The component values of Fig. 1 need little comment. The screen R.F. by-pass condenser Cs should not exceed about .001 μF. as otherwise it will cause excessive top cutting. The audio by-pass condenser Ca prevents modulation energy being wasted in the screen dropping resistance, and can be a 1 μF. high-voltage working condenser.

In view of the low power requirements, and the possibility of using a small triode as the screen modulator, it is even possible to use the simple choke modulation system shown in Fig. 2. No comment is needed, except that an additional dropping resistance, by-passed to audio, enables the modulator valve to operate with an adequate H.T. so that it can fully swing the screen without itself overloading. With 140 volts on the screen, the modulator anode should have some 280 volts. The value of R_a would then be adjusted to drop the screen to 140 volts, and would be approximately 30,000 ohms. The value of the main dropping resistor would be dependent upon the current drawn by the modulator and screen combined, and would have to be calculated or adjusted from the modulator and screen currents. With a 6C5, and a total high-tension supply of 600 volts, the

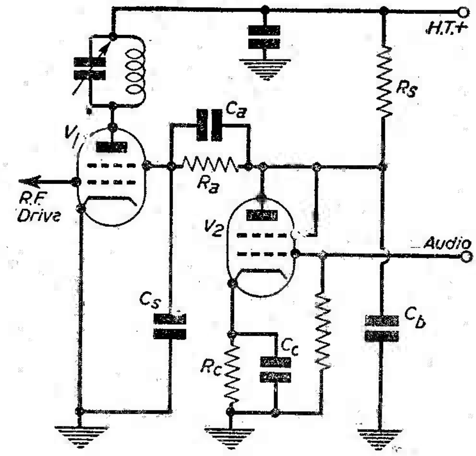


Fig. 3.—Resistance-coupled screen modulation.

Va—807. V2—6L6 triode connected. R_a—60,000 Ω approx. Rs—50,000 Ω approx. Ca and Cb—1 μF. Cs—.001 μF. Cc—25 μF. 50 volt working. Rc—2,000 Ω. 1 watt.

value would come out at approximately 20,000 ohms and a wattage rating of 10 watts. However, with other modulators a higher wattage rating might be necessary. This system should be set up with the aid of a meter to check the current and voltage figures so that the screen volts are at the recommended figure of 140 volts for the 807.

The circuit of Fig. 2, however, using a modulation choke, is only given here for illustration purposes, although, of course, it is perfectly practicable.

It serves, however, to make the system of Fig. 3 more understandable. This is simply a resistance-coupled version of Fig. 2, in which the choke is replaced by a resistance. The power requirements for screen-modulation are so small that it is possible to tolerate the wasted audio lost in the coupling resistor. It is, of course, impossible to by-pass the resistor, as this would prevent it acting as the coupling impedance allowing the audio to be developed on the screen. The auxiliary screen dropping resistance is by-passed. The value of this arrangement is that it can be improvised from the so-called "clamp tube" circuit used to protect the screen of a tetrode when the drive is removed from the grid. It is usual to find a triode-connected tetrode such as the 6L6 used as the "clamp tube." With a little auxiliary switching, it is readily possible to convert the clamp tube circuit into a screen modulator. The exact circuit constants will depend upon the tubes employed. With a triode-connected 6L6 and an 807 P.A., the values shown will be approximately correct, and can be adjusted to give correct screen operating voltage together with good audio coupling.

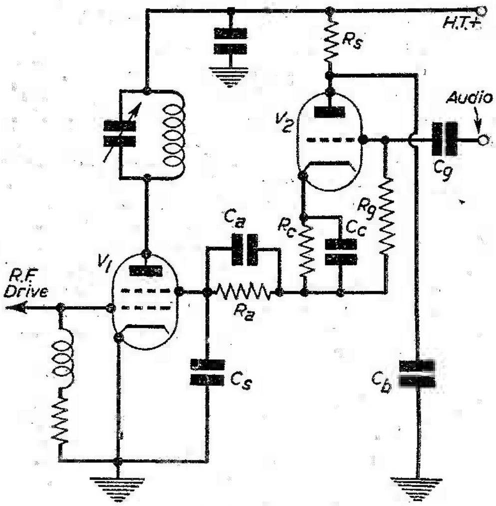


Fig. 4.—Series-screen modulator.

V1—807. V2—6C5.
Ra—20,000 Ω. 1 watt.
Rs—Adjust for correct voltage drops as in text, for Fig. 3.
Rc—1,500 Ω. 1 watt.
Rg—100,000 Ω. 1 watt.
Ca and Cb—1 μF. Paper.
Rc—25 μF. 50 volt working.
Cg—.01 μF.
Cs—.001 μF.

In view of the absence of a modulation choke in Fig. 3, at the expense of wasting some audio in the coupling resistance, it is also possible to avoid even that loss. In Fig. 4 we have what is in effect a series modulation circuit. The resistor can now be by-passed to audio, as it is merely a dropping resistor. The modulator tube is, in fact, operating as a variable coupling impedance whose value instantaneously follows the modulating voltage. There are several points to watch about such a system. It requires a separate heater winding for the modulator tube, as the cathode is some 200 volts above ground. Also the conditions need careful juggling to get the screen potential correct, together with sufficient drop across the modulator tube to allow of adequate modulation. Despite these difficulties, at least one amateur has been heard producing good results when using such a system.

Incidentally, while a single 807 has been shown in these circuits, a pair of 807s can be readily screen modulated, giving a really healthy carrier of some 40 watts. It should be noted that the screens are connected in parallel for modulation, irrespective of whether the R.F. anodes are in parallel or push-pull. As the two screens will draw twice the current of a single screen, the dropping resistors must be modified accordingly. In the simplest case, as in Fig. 1, this will merely mean halving the screen resistor, and possibly adjusting the transformer ratio to match the halved load impedance to the modulator valve. For obvious reasons, the simple transformer system of Fig. 1 is the one recommended to beginners. The choke-coupled system is a little more tricky, while the other two systems need considerably more care in setting up and adjusting. The warning about the necessity for R.F. grid drive adjustment should be remembered.

Synchrophase Sound Installation

A NOVEL type of sound amplification system is being installed in the Manchester Free Trade Hall by E.M.I. Sales & Service Ltd.

This new equipment is designed to overcome the unpleasant echo effect normally experienced in large halls due to the natural sound of a speaker's voice reaching the audience a fraction of a second later than the sound radiated from the loudspeakers in the body of the hall.

The echo (Haas) effect is eliminated by delaying the sound radiated by the loudspeakers until the natural sound has reached the audience so that sound from both sources is heard simultaneously. The Synchrophase Sound unit which effects the necessary delay incorporates a high-speed turntable, the edge of which is continuously coated with magnetic iron oxide.

Four magnetic heads (for recording, replay (2) and erasure) are situated so that the magnetisable edge of the turntable passes by each in turn.

The first head records the sound on the magnetic coating, the recorded portion of which then passes by the two replay heads, spaced from the recording head to give the necessary delays.

The spacing between the recording and replay heads is adjustable to give different delay times. After passing the two replay heads the recorded edge of the turntable then passes the erase head to prepare it for subsequent re-recordings.

Two delay channels are provided, each fed by one of the replay heads. The first channel can be adjusted for delays of between 25-100 milli-seconds and feeds the loudspeakers situated in the front part of the Hall. Delays of between 70-200 milli-seconds are provided by the second channel which feeds the loudspeakers at the rear of the Hall.

The Synchrophase Sound unit is used only for speech amplification, music reproduction, etc., being effected by a normal sound amplification system. A speech filter is also incorporated to improve intelligibility.

A total output of 240 watts is given by the installation.

Down from the Olympian Heights

A CONTRIBUTOR LOOKS BACK ON THE RADIO SHOW

SIR,—It was a good show—make no mistake about that—but something was missing!

Several thousand people were missing, of course, as the attendance figures showed, but there was also a more subtle difference which made every second person you met say "I don't know what it is, but . . . !"

Now, there are a large number of obvious reasons which might account for the fact that the glory has departed . . . some of them were even advanced as official excuses.

Change of Place and Date.—First there was the change of venue—Earls Court instead of Olympia. This implied a change of name, for the National Radio Exhibition could no longer be neatly labelled "Radiolympia." Change of name meant some loss of "good will" built up over the years. As against that Earls Court is a fine exhibition building which has housed many successful shows, and it is just as accessible, if not more easy to get to than Olympia. Indeed, the short link-line from Earls Court to Olympia was always a nuisance. By Underground you came to Earls Court first. Bus services and car parks are about equal.

This year they changed the date, too, making it a summer rather than an autumn event. In 1951 this was probably justified in order to catch the crowds already in London anyway for the Festival. On the other hand, the various Festival shows—South Bank, Battersea, Victoria and Albert and Stepney—were a considerable competition which must have seduced many of the public—especially the non-technical public from the attraction of radio and television.

Nor must we forget the big excuse put forward by the manufacturers and dealers—a crippling purchase tax. Undoubtedly 66⅔ was a nail in the Radio Show coffin . . . but it wasn't the lethal weapon that produced the corpse! The public, in spite of having less to spend, can still buy cars and cigarettes, can still drink spirits and go to the cinema . . . *if they really want to!*

The Idea is Out-moded.—If there was something wrong—and ask yourself if you got all the old excitement—it was not any of these things alone. It was all of these things plus the fact that the Radio Show idea is obsolete. It may have died with the war, or with Olympia, or with that symbol and inspiration, Alex Moody. But it's dead . . . a new idea is wanted based on the present place of radio and television in the everyday life of the people.

I suppose that the basic idea of having a show at all is to sell more sets . . . and probably in the BBC's case to preserve good public relations. Now does it want an Olympia, an Earls Court or a Castle Bromwich to do these things? I think not.

Radio, even television, has ceased to be a wonder. People buy it like they buy a hot-water boiler. They just expect it to work and few of them care much else. So I suggest that the manufacturers run one or two trade shows for dealers and service men, with, perhaps, a public day to round off, rather on B.I.F. lines. Simultaneously, I think the BBC should run an "at home" week—if you like, on the lines of the R.A.F. Battle of Britain week. The public, in regions, could be asked to visit studios and transmitting stations, administrative offices and, indeed, anything that they pay for and are entitled to see. These "at homes" could be glamourised by the presence of the programme "stars"—it might even be that a hall in the vicinity should be booked as the focal point . . . and it might even be that the manufacturers could make their trade show coincide with these "at home" weeks, perhaps to the extent of becoming a technical annexe to the main function.

The fact is that few utilities can afford a national show of their own—and, let's face it, broadcasting (sound or vision) is just a utility to this generation. Is there a national gas show, a national railway show, a drainage exhibition and a hot and cold water jamboree? Of course not, and you would not expect to fill Earls Court for 10 days if you organised them. But all these utilities, not without their glamour and interest in the hands of showmen, have their own ways of displaying their wares—let us do likewise and replace this Earls Court apathy with local and realistic enthusiasm.

Does it matter if a few radio dealers, manufacturers' representatives and exhibition club lizards are deprived of a week's holiday in London at the firm's expense? And the publicity boys can soon find another way of showing how clever they are. In short, who would worry if there never was another Earls Court, vainly trying to recapture days that have gone?—"ELECTRON."

"Practical Television"

THE current edition of our companion paper *Practical Television*, now on sale, contains practical and theoretical articles on this new hobby. Practical constructional details are given for a Pre-Amplifier with coil data for the existing three transmitters, as well as further notes on the conversion of the popular ex-Service unit the R.D.F. 1 which makes an efficient television receiver. Interference suppression is explained in two articles, one dealing with the Post Office Interference tracking service, and the other giving circuits which may be used in various types of receiver for removing the annoyance. A servicing article on Masteradio models T851, T852, T412 and T409 is also given, whilst other articles include Afterthoughts of the Show, The Design of V.F. Output Stages, Underwater Television and Colour Television.

Learn all about this new and fascinating science by placing a regular order with your newsagent for *Practical Television*, the only technical television periodical in this country. It is served by all the leading authorities, and practical articles on servicing commercial receivers, as well as constructional articles, regularly appear.

News from the Trade

Hadley Coin-operated Radio Equipment

THIS new coin-operated radio system is specially designed for Hotels, Holiday Camps, Hostels, Nursing Homes, Block of Flats, etc. Programmes are relayed to attractive room units from a central control.

The user merely puts sixpence in the slot and selects his programme from a choice of two or more. Normally, managements arrange to give 24 hours listening for sixpence, but the cancellation routine can be varied as required.

Maximum volume is controlled centrally, thus ensuring that users of room radio will not disturb others.

The complete system is available on Rental terms or can be purchased outright.—**Hadley Sound Equipments, Ltd., Cape Hill, Smethwick, Staffs.**

One of the new Westinghouse crystal rectifiers.

Westinghouse Germanium Crystals

THE Westinghouse Brake and Signal Company have introduced a wide range of germanium crystal rectifiers. These are of hermetically sealed ceramic construction and are only $\frac{1}{2}$in. long by $\frac{3}{16}$in. diameter. The range of types covers peak working voltages up to 100 volts and forward currents of 50 mA.

These crystal rectifiers are suitable for detectors, limiters, instruments and general purposes, the self capacity of all types being approximately 1 pF.

Each crystal rectifier is mounted on a colour-coded card giving the rating particulars. A leaflet, M.R.14 supplement 5, is available showing typical characteristics of all types and includes a tabulated list showing which type to select for each of the sixteen applications for which these germanium crystal rectifiers are particularly suitable. **—Westinghouse Brake & Signal Co., Ltd., 82, York Way, King's Cross, London, N.1.**

Regentone Price Changes

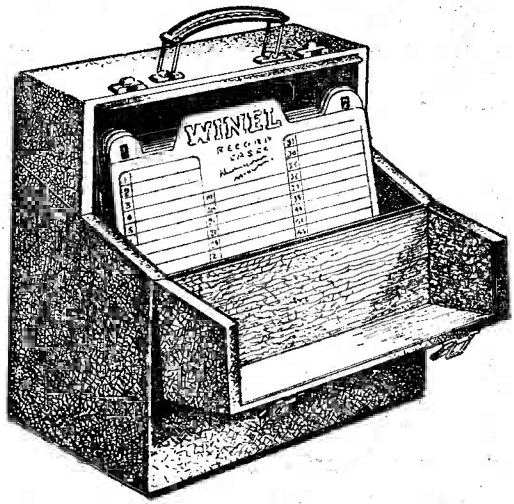
WE are asked to point out that the Auto "99" has been increased in price to 47 guineas, and the 3-speed version is now 53 guineas instead of 50 guineas as originally quoted.—**Regentone Products, Ltd., New Factory, Eastern Avenue, Romford, Essex.**

Southern Radio

A NEW edition of the popular illustrated catalogue No. 8 is now available from Southern Radio. This is a well-produced 50-page edition and is fully illustrated, covering all the well-known makes of component in alphabetical order. Copies are available to readers at 9d. post free from **Southern Radio & Electrical Supplies, 85, Fisherton Street, Salisbury, Wilts.**

Winel Record Cases

THE satisfactory storage of a large number of gramophone records often presents a problem, and unsatisfactory methods lead to warped or scratched discs. Messrs. Elwin have for years specialised in the manufacture of boxes of all types and have produced a wide range of record storage boxes ranging from small carrying cases suitable for picnics up to large units capable of holding 100 records. Separators and a large index card are provided and it is a simple matter to select any desired disc when required. In addition record albums are also available and designed to hold expensive discs in such a manner that not only are they satisfactorily protected, but the outward appearance of the albums is in keeping with the contents. Illustrated above is the Pyramid portable case designed for 50 records in two sections of 25. It is available in four colours, black, blue, red and green and for either 10in or 12in. records.—**Henry Elwin Ltd., Plumptre Street, Nottingham.**



A record case from the Winel selection.

Osmor—'Phone Change

OSMOR RADIO PRODUCTS, LTD., of Bridge View Works, Borough Hill, Croydon, Surrey, wish to inform customers and the trade that their telephone number has now been changed to Croydon 5148/9.

SURPLUS SILICON CRYSTALS

DETAILS OF POPULAR TYPES NOW AVAILABLE

By E. G. Bulley

THE reader may or may not be aware that these crystals are available on the surplus market. The types that seem to be in abundance are the CV101 and CV102, although other types of silicon crystals are available but are not so plentiful.

However, these crystals are to be had at reasonable cost and this does, therefore, enable the amateur to experiment in another field without much outlay.

The silicon crystal can more or less be compared with the thermionic diode as they have a fairly low resistance in the forward direction and a high resistance in the reverse direction. This perhaps can be clarified by remembering that as in a valve diode, the valve conducts on one half cycle, and does not conduct on the other half. This phenomena is similar to the forward and reverse direction of the crystal, respectively. As a point of interest the silicon crystal has more or less a negligible transit time, thus enabling them to be used at very high frequencies, an advantage over the thermionic diode.

Construction

The basic construction of crystals of this class consists of a silicon crystal or flake and a contact, the latter usually known as "the whisker," and this is made from pure tungsten or some suitable alloy. Both these electrodes are, however, found enclosed in a low-loss ceramic body.

The whisker is usually secured to the threaded portion of the crystal, but this naturally depends upon the crystal in question and its design.

Details

In crystals of this nature, there are, however, important parameters in their actual design, an important one being the diameter and shape of the whisker. This can be fully appreciated by the reader when he realises that the correct contact pressure against the silicon crystal is necessary to enable the crystal to function properly.

An essential requirement in silicon crystals is that of good conductivity, and this is ensured by either silver or gold plating the metal parts. The plating of such parts also prevents corrosion which must be avoided at all costs, otherwise the crystals will cease to function entirely or operate incorrectly.

Silicon crystals that are available on the surplus market lend themselves admirably to the experimenter for use in experiments on radio frequency and video detection, rectification and frequency conversion.

They are extremely useful in various measuring devices that the amateur may care to construct, such as field strength meters, etc. However, these are beyond the actual scope of this article, and various circuits utilising the crystals have already appeared in this journal, and will, no doubt, appear in future issues.

It is as well to mention, however, that crystals can be burnt out if they are not operated within their ratings, especially if they are subjected to a signal strength of excessive quantity. Another point of interest to the amateur is that the contact point of the whisker sometimes fuses, whereby the actual area of contact is increased and this in turn greatly effects the crystal.

Care

Crystals of this nature should be handled with care, remembering of course, that any mechanical knock will no doubt damage the crystal. One will note, that they are supplied in a lead cover, and this is for the sole purpose of safeguarding the crystal from stray R.F. fields which would do untold damage to the crystal. It is advisable, therefore, that the amateur should store such crystals in the lead cover when not in use.

Advisory Committee Formed

THREE Associations whose interests include matters relating to the development and production of radio communication and radar measuring instruments have collaborated in the formation of a joint committee which will advise their respective Councils on such subjects. The three Associations are the Radio Communication and Electronic Engineering Association, the Radio and Electronic Component Manufacturers Federation and the Scientific Instrument Manufacturers Association.

Membership

Membership of the joint committee, which is known as the Joint Advisory Committtee on Radio Communication and Radar Measuring Instruments, is open to any member of the three Associations who is concerned with the development or production of this class of measuring instrument. The joint committee will be in a position to consider both commercial and technical questions brought to its notice by members themselves, Government Departments and other external bodies. It is particularly expected that the provision of this single channel for consultation with Government Departments on matters of common interest will prove convenient both to the Industry and to the Government.

Address

The joint committee, which is not another trade association, is administered from the offices of the Radio Communication and Electronic Engineering Association, 59, Russell Square, London, W.C.1 (telephone: Museum 6905); the Committee Secretary is the Assistant Secretary of the R.C.E.E.A.

Programme Pointers

A MONTHLY CRITIQUE BY MAURICE REEVE

THE British have long been noted as watchers of games—as distinct from a nation playing them. Whether on the bowling green, the cock-fighting alley or the fisticuff ring, round which the squire, the parson and the fraternity would foregather largely as an excuse to guzzle and bet, to our own day which witnesses no fewer than a hundred and fifty thousand gathered at Hampden Park to watch the local Rangers and Celtic play for the honours of Scottish soccer, or scarcely fewer at Twickenham, Wembley or Lord's—multitudes watch whilst a handful act. As the years slip by, fewer and fewer take part, only to succumb to the ease of the ringside seat or the chair by the radio, which provides the biggest audience of the lot.

It is not unnatural, therefore, that the wireless, which has gathered unto itself most of man's and woman's activities and served them up for us as good, bad and indifferent entertainment, should have grasped games in its maw, and particularly those which it can play itself in its studios, and which our fathers and mothers—or was it our grandfathers and grandmothers?—were so fond of playing in their own drawing-rooms and parlours. Little did they imagine that long after their bustles and dundreary whiskers were old-fashioned even at Madame Tussaud's, their descendants would gather round microphones in millions listening—not watching, even, but just listening; eavesdropping, one might almost say—to unseen teams playing modern versions of their old loved games of Consequences, Question and Answer, and many another.

"One Minute, Please"

For many years now these parlour games—notably Twenty Questions, Any Questions and various quizes—have been favourite items in radio entertainment. And not unjustly, more especially when compared with some other alternatives we are given to choose from at round about their hours. They have now been joined by a new one, "One Minute, Please," on Tuesdays at nine-thirty. I would like to wish it, at the outset, a prosperous career. Built on the same lines as Twenty Questions, with a "keeper of the password" instead of Norman Hackforth's voice, it gives rather more opportunity for personal initiative than its forerunner, of which Gilbert Harding and others have not been slow to take advantage. (It should suit Anona Wynn and Richard Dimbleby admirably, though I hope as many new names as possible are kept for it.) What a wealth of fun can be extracted from both trying to find, and to dodge, the password in sixty seconds of solo oratory! Gerard Hoffnung is a distinct acquisition to this type of programme. Ian Messeter, deviser and producer, and Roy Plomley, introducer, are to be congratulated.

"The Big Show"

This must have been one of the most keenly anticipated programmes ever put over the air; it must also have had one of the biggest audiences. I thought that it was a first-class affair and, if strengthened in a couple, alas! of British, places, would be really top notch. The first, and major, reaction to it which I experienced was a consciousness of its vast superiority to the average B.B.C. "variety" programmes which are inflicted on us with such soul-destroying regularity. Admitting that it was in all probability a much more costly affair than could be afforded every Saturday night, it did serve to prove that not only is there an awful lot of dead wood—dead from the neck down and the feet up—in our native variety, but that the presentation and general arrangement of what good we have can be greatly smartened up.

Variety

"Music Hall," alas, is back. The recent inclusion of, or prefix of the adjective "Festival" to its title did little to raise its general level of banality and raucousness. According to its first de-festivalised presentation, it will return to its unhonoured level. I did think, and was led to believe, it was to be abolished, but the wish was, presumably, father to the thought. There is, of course, always the remedy of not listening to it which, now that I have done my duty and reported on it, I shall take.

Plays

What is a masterpiece? Presumably, something which, in its own particular genre, cannot be improved upon. When they are presented to us in other than their original media, a certain lessening of their original greatness is almost inevitable.

Ibsen's "Ghosts," a play, was presented to us in a radio version, also a play of Lance Sieveking's, and this suffered least damage. Hardy's "Tess of the d'Urbervilles," a novel, suffered in its conversion to a play, "from the novel" by Ronald Gow rather more harm. This was probably because its original texture is more delicate and refined metal than the rugged Northern work. Both are imperishable masterpieces and received most excellent treatment at the hands of all who handled them. Aileen Mills brought out much of the adorable Tess's sweet femininity—the major portion cannot be extracted from the original Hardy prose—as did Griselda Hervey in the totally different type of woman, Mrs. Alving, of "Ghosts." The Ibsen play made the better radio, as the particular Hardy qualities of illusiveness and imagery are not so essential, qualities difficult to produce over the air.

Music

Much good music has been wafted across to us: some magnificent Beecham programmes, an excellent series of Schumann recitals by that very fine and experienced Schumann player, Moiseiwitsch, and a bright and breezy production of the original Hammersmith Lyric "Beggar's Opera." What a priceless treasure house of native genius this is. Whilst the wonderful things from Edinburgh would require an article all to themselves.

Beating the Electron

A NOVEL DEMONSTRATION BY MULLARD

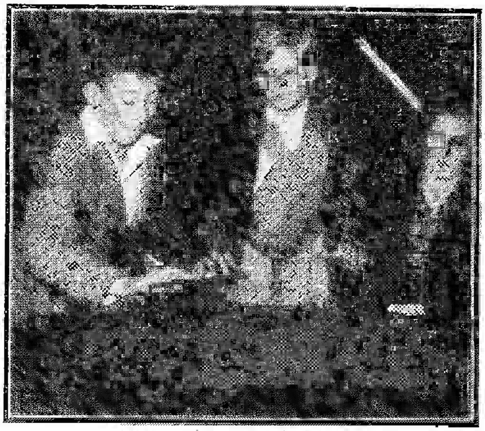
AWAY from the main stand at the National Radio Exhibition was a baize-covered table with a golden ball lying invitingly in the middle. Over the top of the table there was a message, "Can you Beat the Electron?"

Visitors approaching the table looked at the golden ball and, after overcoming their initial shyness, made a frantic grab at it. But the electron was too quick for them. Some visitors tried to capture the golden ball by means of a stick or an umbrella, but they always failed. Directly the hand or any other object approached the golden ball it very rapidly withdrew to the bottom of a deep hole let in the table top.

The "Can you Beat the Electron?" exhibit was designed by Mullard, Ltd. Although intended as a display unit, it nevertheless illustrated in a most effective way some of the possibilities that electronic techniques have in protection systems.

To explain the basic principle of operation of the protection device employed in this demonstration, it is useful to recall the first valve radio receivers which came into use immediately after the crystal sets. With these early receivers strange howls and screeches would often come from the loudspeaker whenever the hand came near the tuning knob. This form of interference was due to the electrical capacitance set up between the hand and the sensitive tuning circuit, thus causing the reaction circuit to oscillate. In recent years this effect has been "tamed" and utilised in a number of interesting electronic devices. In the display unit referred to above, the electrical capacitance between the golden ball and earth changes when the ball is approached by any person or object. By means of an electronic circuit, this capacitance change is converted into an electric current which is used to operate a relay; and the relay, in turn, is used to set in motion the necessary mechanical protection mechanism. The whole cycle of operation is so rapid that in the demonstration the golden ball disappeared from view at a speed faster than the hand can move.

The capacitance electronic detector, or the capacitance relay as it is sometimes called, besides finding many applications in protective systems, has



Two excited schoolboys, visiting the National Radio Exhibition, try to get the golden ball.

innumerable possibilities in other fields. The detecting element may take the form of any insulated metal object, but is usually in the form of a rod, a small ball or a plate. These detecting elements can be used to detect both large and small objects. For example, it is possible to detect cars or people at a distance several feet away from the detecting element even if a plate of glass or a dry plaster wall intervenes. On the other hand it is equally as easy to detect and count at rates of several hundred a second, such small objects as beans, buttons, etc.

The principle of capacitance change may also be used for such varied applications as measuring movements of the order of a few millionths of an inch; controlling the level of water in boilers; and measuring the thickness of materials, e.g., cigarette papers, plasters, and so on.

News from the Clubs

THE MIDLAND AMATEUR RADIO SOCIETY

Publicity Representative: B. H. T. Olver (G3DJQ), Cleeve Lodge, Nether Whitacre, nr. Coleshill, Warwickshire.

AT the annual general meeting held on September 18th, it was fitting that, for the forthcoming year during which the Society celebrates its 21st anniversary, Mr. C. H. Young (G2AK) should be elected president. He is a founder member of MARS and has held a licence for 25 years. The Society also honoured Messrs. Butler and Rhodes by electing them as vice-presidents in appreciation of the valuable service they have rendered over many years.

WARRINGTON AND DISTRICT RADIO SOCIETY

Press Officer: Mr. Frank E. Loxham, "Fulwood," Heath Road, Penketh, nr. Warrington, Lancashire.

THE Warrington and District Radio Society has now moved headquarters to The King's Head Hotel, Winwick Street, Warrington, and will hold meetings on the first and third Tuesdays in every month. A full programme for the winter session has been compiled, including talks on two-metre transmission and reception by G. Leigh (G2FCV), "Negative Feedback," by N. Atkins (G3EXG), "The Thermionic Valve," by Messrs. Mullard, Ltd. (with film-strips), etc.

The annual dinner and social of the Society will be held at the Fir Grove Hotel, Latchford, nr. Warrington, on Friday, November 30th, 1951, and tickets may be obtained from the hon. secretary of the Society, Mr. S. Wood (G3EZX), 51, Henshall Avenue, Latchford, Warrington, and, as the tickets are limited, early application is advisable.

DUDLEY AND DISTRICT SHORT-WAVE RADIO SOCIETY

Hon. Sec.: J. Anderson, 15, Langley Avenue, Coseley, Bilston, Staffs.

THE inaugural meeting was held Tuesday, September 18th, the proceedings being conducted by Mr. G. Pennington. As a result of an election, Mr. J. Anderson and Mr. G. Doodey were chosen as secretary and treasurer respectively.

Newcomers will be made particularly welcome.

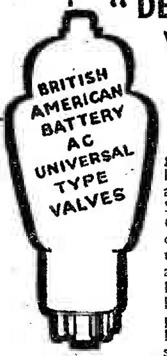
LEICESTER RADIO SOCIETY

Hon. Sec.: L. Milnthorpe (G2FMO), 3, Winster Drive, Thurmaston, nr. Leicester.

THE first meeting of the winter session was held on October 1st at the clubroom, Holly Bush Hotel, Belgrave Gate, Leicester, and it was pleasing to see the room filled to capacity. The films, "Cathode-ray Oscillograph" and "Powe 1Lines" were shown and followed, to the amazement of the members, by a short comedy film.

Full details of membership and future activities of the Society can be obtained from the Hon. Sec. (above).

"DEMOBBED VALVES" MANUAL



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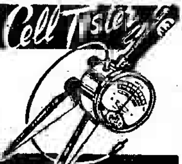

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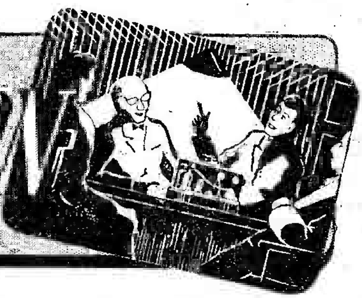


The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

High Fidelity

SIR,—I refer to the letter on the quest for high fidelity written by G. Harding, of Wembley, in the October issue of PRACTICAL WIRELESS.

When the question of high fidelity arises, it is strange how often another very important point is forgotten.

I built an outfit which was supposed to give wonderful results and was complete with twin speakers and a cross-over system. I was assured by the manufacturers that my 12in. speaker could give response up to 8,000 cycles, and that above that figure would be the responsibility of the little speaker.

It occurred to me that I might be able to demonstrate to my friends the improvement made by a cross-over system and twin speakers, and with this in mind I fitted a switch which made the outfit work on the 12in. speaker alone or could switch in the twin arrangement.

When everything was in working order, it was noticeable that little difference could be detected. Some adults said there was a slight improvement but not much, and only a small boy declared that it was a distinct improvement with the twin arrangement.

Some time later I read a book describing the functioning of the human ear. There I read that only young people could hear the squeak of a bat as it flew, because the average adult ear could hear only up to 10,000 cycles.

That being so, it is quite pointless to involve oneself in the expense of attempts to reproduce sound up to 15,000 or even 20,000 cycles when the average adult ear can hear only up to 10,000.

It is equally obvious that the average adult will believe that an instrument is reproducing faithfully if it can handle sounds within the range of his ear.

The "hi-fi" instruments are undoubtedly masterly instruments, but as useful as an infra-red lamp to augment a motor car's headlamps would be to the unaided human eye.—ERNEST D. PURDY (Glasgow).

SIR,—Mr. Harding's letter in the October issue is a very inviting one and he may be interested in the views of a professional musician who is very interested in high quality professionally and from the technical side as well.

The £200 speakers are just fads of a few people who will never be satisfied with anything. I have several friends possessing such units and I judge my results on what they think as much as anything. In most cases the host insists you *stand* on a certain square foot in his room with the head at an awkward angle.

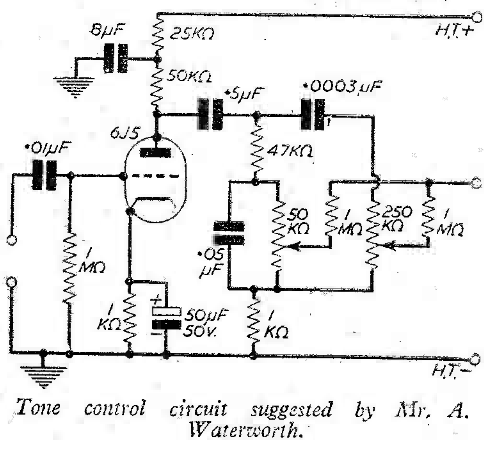
But all that is what you could call ultra high quality. There is a high quality of reproduction, very useful and not particularly expensive to attain.

The standard set by commercial manufacturers is appallingly low with their single pentodes, small iron content output transformers and speakers with minute magnets. But if you extract each one of their weaknesses and reinforce it reasonably the results, in my opinion, will justify the extra expense. The effect of replacing any one item at a time gives results any layman will applaud. Replace them all and the result is justifiably called high quality, but not by any means original quality.

Far too much money goes into the tuning side of the ordinary set to allow any quality in the L.F. side for ordinary regional listening. Redistribute the expense to cover quality and you are hardly out of pocket except for the speaker. My own set-up is a standard triode push-pull amplifier with some 10 db negative feedback, a medium quality transformer and speaker and a large baffle, the results from which have pleased many distinguished musicians.—D. BRAIN (1st French Horn BBC Welsh Orchestra, Soloist L.S.O.), (Swansea).

Tone Controls

SIR,—I very much enjoyed reading W. J. Delaney's article on tone controls, and although most of it is really useful, the circuits Fig. 5 and 6 are much too elaborate for the results obtained.



Tone control circuit suggested by Mr. A. Waterworth.

Now here is a tone control circuit which I would like you to publish, which I have been using for the past ten years with good results.—A. WATERWORTH (Burnley).

P.D. or E.M.F.

SIR,—Concerning the notes on potential difference and electro-motive force in the series "On Your Wavelength"; when a voltmeter is connected across the terminals of, say, a Daniell cell which forms part of a complete circuit whose other components are a rheostat, for varying the current, and an ammeter, all in series, it is found that the potential difference of the cell, which is the quantity measured by the voltmeter, decreases with increasing current. In other words, *the potential difference is not a constant.*

However, *the electro-motive force in question is an invariable quantity,* and is equal to the value of the potential difference when no current is flowing. A purist would assert that it is not possible to obtain a value of electro-motive force by means of a voltmeter, for, strictly speaking, any voltmeter takes *some* current.

I concede that for practical purposes the two terms can be—and in many text-books are—taken as synonymous, but that does not alter one iota the fact that there is a basic difference.—GEOFFREY PENNINGTON (Birmingham).

Battery Receivers

SIR,—Judging from what I saw at the National Radio Exhibition this year, the manufacturers seem to be under the impression that 95 per cent. of the listening public are connected to mains electricity supplies.

Most makers included a so-called A.B.C. portable in their range, but even so, who can undertake any serious listening on such devices as these, not to mention frequent and costly replacement of larger type H.T. batteries?

My own opinion is that it would pay some manufacturer to woo the 30 per cent. or so battery set users by producing something on the lines of the Ekco "Connoisseur," using perhaps lower consumption valves driven by a vibrator power supply. They might even consider supplying a small wind-driven generator to keep the battery trickle-charged!

Failing to arouse the interest of the radio industry, it may be that PRACTICAL WIRELESS might consider publishing details of an installation on the lines mentioned.—A. C. HEATH (Aldermaston).

Alternative I.F. Couplings

SIR,—With reference to Mr. D. Grant's letter in your October issue, whilst sympathising with him regarding his inability to obtain quality from a superhet or selectivity from a "hi-fi" T.R.F., may I point out that a method of reception superior to either is available?

I refer to the "Synchrodyne" invented by Dr. Tucker. This combines extreme selectivity with infinite-range quality. Should your correspondent not be familiar with this type of receiver, I will be pleased to let him have details.

Concerning Mr. G. Harding's letter re high fidelity, whilst agreeing that much of the BBC's transmitted material is of execrable quality, it must be admitted that quite a number of programmes are of first-class quality, and for these alone it is well worth while acquiring the finest quality equipment one can afford. This does not necessitate paying £200 for a loudspeaker. One of the world's finest costs £10.—HAROLD STRIPE (Surrey).

T.R.F. versus Superhet

SIR,—I note Mr. Grant's comments in the October issue, but a point which I think is often overlooked is that a T.R.F. is the amateur's receiver and the superhet is the manufacturer's receiver. How many amateurs can line-up a superhet properly? Even assuming the I.F.'s are peaked by the makers, how can you adjust padders, etc., to ensure that the oscillator gives, at the minimum, three-point tracking—unless you have a signal generator? And how many amateurs have a signal generator? On the question of quality the T.R.F. scores every time and more than one manufacturer has, on the market to-day, a tuner for use with high-quality amplifiers, in which a switch is provided so that when the "local" is received the circuit is changed-over from a superhet to a T.R.F.—H. WATTS (N.W.9).

Half-wave Rectification

SIR,—Half-wave rectification for H.T. is now much used. Even with voltages of only 200 volts or so (output), the use of a transformer is good, for reasons constructors will appreciate. But no manufacturer seems to make a transformer for such use: they all make tapped secondary transformers for full-wave rectification. One can of course use a tapped-secondary model, and waste half the secondary winding, but a simpler transformer for half-wave rectification would save space and would presumably be somewhat cheaper.—MALCOLM MACKENZIE (W.2).

A.C. Pre-set Two

SIR,—With reference to the theoretical circuit of this receiver in the November issue I note that a figure has been wrongly placed in the switch connections below the circuit. On the right-hand switch section, to which the 250 pF condenser is connected, the figure 3 against the right-hand contact point should be transferred to the centre of these three contacts.—ERIC LARNACH (Leeds).

Ex-Service Equipment

SIR,—Mr. Bradley has, apparently, discovered something which I suspected for a long time. I had, in fact, spoken to several friends about this matter and as it happened one of these had served during the war and for shortly after in the R.A.F., and he confirms that equipment is often marked for examination by coloured labels and in some cases by dabs of coloured paint, but otherwise there is nothing to distinguish them from serviceable or usable equipment. In fact, he confirms that it is even possible for equipment to be delivered by a manufacturer to a service equipment centre and to be disposed of before it has even been checked—although the factory may have checked it.—G. DAWSON (N.16).

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Review of the Latest Gramophone Records

MOZART'S essentially ensemble opera, "Cosi fan Tutte," provides many attractive duets and trios, of which His Master's Voice have recorded important excerpts from Acts 1 and 2. The latest recording, *H.M.V. DB*21120, completes the series that was recorded by the actual Glyndebourne Opera Company and Glyndebourne Orchestra under their conductor, Fritz Busch. For this record we have one of the best of the soprano solos, performed by Sena Jurinac. The aria is a rondo, and greatly enhances the delights of the second act.

"La Boutique Fantasque" (The Fantastic Toyshop) has been recorded on *Columbia DX*1785-7 by Efrem Kurtz, directing the Royal Philharmonic Orchestra. Produced as a ballet by the Diaghilev company in 1919, it is based on a collection of miniatures which Rossini wrote during his retirement.

Another recording from the ballet is Delibes' "Sylvia," which appears on *Parlophone PW*8000-1. This is the first issue of a new series of ballet music which Parlophone will release at regular intervals. Apart from the universally-known Pizzicati, there are other delightful numbers—such as the Huntresses' fanfare and the Valse lente—that make up this suite. It is played by the Royal Opera House Orchestra, Covent Garden, under the direction of Hugo Rignold.

Haydn's "Toy Symphony" was specially written for children, using their own particular weapons as part of the orchestra. The toy instruments used were the cuckoo, rattle, triangle, nightingale, quail, drum and trumpet, and these have the display passages, while the strings have the *ripieno*—the parts played by the whole orchestra. All the toy instruments come out with stereoscopic clearness in this recording by George Weldon, conducting the Philharmonia Orchestra on *Columbia DX*1784.

The Hallé Orchestra, under the baton of Sir John Barbirolli, give a first-class rendering of Bizet's "L'Arlesienne" on *H.M.V. DB*9656-7. This music is part of 27 items which Bizet was commissioned to compose for a Paris production of Daudet's "The Maid of Arles."

Vocal

Discovered by H.M.V. five years ago, Boris Christoff, the Bulgarian bass, now records two items that are often heard, but which require the ability of a front rank singer to be heard at their best. They are the "Song of the Flea" and "Song of the Volga Boatman," which he sings on *H.M.V. DB*21305.

Another equally famous bass is Owen Brannigan, who sings Sterndale Bennett's famous ballad, "Leanin'" and Leslie Stuart's "Bandolero" on *Columbia C*4110. This singer is reputed to have one of the finest bass voices in Great Britain to-day.

Following Kirsten Flagstad's recent recording of Grieg's songs, she sings two more this month—"Ved Rundarne" (Return to Rundarne) and "Guten" (The Youth) on *H.M.V. DA*1992. Although this singer has announced her retirement from the operatic stage, she will still be seen in person upon the concert platform.

Variety

As a successor to the late Albert Sandler in the direction of the Palm Court Orchestra, Tom Jenkins has filled a difficult position with striking success. "Waltzing thru' Filmland," which he plays on *H.M.V. C*4116, is a medley of tunes from films arranged by Dennis Gomm.

Lester Ferguson's latest for Parlophone brings together two renderings that have made this young tenor popular in the British entertainment world. The song on the first side is an English version of the tune, "Si tu partais" (If you go), which was heard in the film "Night Without Stars." On the reverse side of *Parlophone R*3441 he sings "Love Calling Me Home."

For the first time Dinah Shore and Betty Hutton team with Tony Martin and Phil Harris to offer their version of a comedy song, "The Musicians," on *H.M.V. B*10137. The same quartette are on the reverse side with an equally amusing number from Walt Disney's "Alice In Wonderland" called "How D'ye Do and Shake Hands."

The vocal and instrumental ability of the Tanner Sisters and the Hedley Ward Trio are combined this month in a novelty number called "Jing-a-Ling, Jing-a-Ling" on *H.M.V. B*10140. The coupling is "Bon-bon Chocolate and Chewing Gum."

Dance Music

Joe Loss and his Orchestra continue with their "Dancing Time for Dancers" series with "The Valentino Tango" and a waltz, "Longing For You," on *H.M.V. BD*6108. Another record for dance tempo devotees is supplied by Victor Silvester and his Ballroom Orchestra with "Lullaby of Broadway" (quick-step) and "In a Shanty in Old Shanty Town" (waltz), on *Columbia FB*3619.

Finally, two catchy novelties from America, "Shanghai" and "Kissin' Bug Boogie," have been recorded by Sid Phillips and his Band, on *H.M.V. BD*6107.

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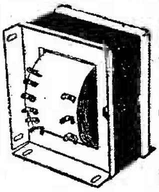

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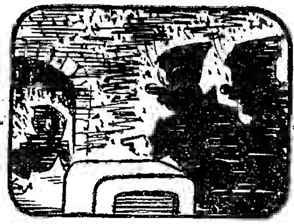

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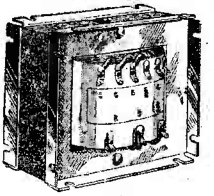

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PRACTICAL WIRELESS, DEC., 1951.

Published on the 7th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and printed in England by W. SPEAIGHT & SONS, LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A'sia), LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rate including postage, for one year: Inland and Abroad 13s. 6d. (Canada 13s.). Registered at the General Post Office for the Canadian Magazine Post.