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*As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.*

## CONTENTS

|  | Page |
|--|------|
| Editorial Comment .. ..                                | 661  |
| The Year's Progress .. ..                              | 662  |
| Improving the Super-regenerative Set .. ..             | 665  |
| Unbiased .. ..   | 668  |
| Further Notes on Negative Feedback Amplification .. .. | 669  |
| Current Topics .. ..                                   | 671  |
| Broadcast Brevities .. ..                              | 672  |
| New Apparatus Reviewed .. ..                           | 673  |
| Hylvoltstar "Battery-Mains" Receiver .. ..             | 674  |
| Listeners' Guide for the Week .. ..                    | 676  |
| Letters to the Editor .. ..                            | 678  |
| The Pentode Tone Corrector .. ..                       | 679  |
| Random Radiations .. ..                                | 680  |
| Resistance-Coupled Amplifiers VI .. ..                 | 682  |
| Recent Inventions .. ..                                | 684  |

## EDITORIAL COMMENT

### Service

#### Not a Synonym for Trouble

**T**HE fact that a wireless receiver is so intricate a piece of apparatus, incorporating mechanical as well as electrical components always liable to develop defects, makes it fairly certain that however well a receiver is designed and however carefully constructed and tested by the manufacturer, there must always remain a possibility, and indeed a probability, that from time to time some attention will be necessary by way of maintenance and service. If we accept, then, that a wireless set, just like a motor car, will require occasional attention after purchase, the next point for consideration is how this problem of service should be tackled in the case of wireless sets.

The subject is one which has demanded the attention of manufacturers and dealers ever since broadcasting began, and even to-day no uniform method of dealing with the matter has been adopted.

Much of the trouble seems to arise from the fact that the public has not had the question of service put to them on a satisfactory basis. The guarantee given with a new motor car normally covers the replacement of parts which, during the period of the guarantee, are found to develop defects, but ordinary wear and necessary adjustments are the responsibility of the owner, and either he attends to these himself or pays for the work to be done at a service station or garage. If the same attitude towards wireless sets were adopted, it would clear up much of the present misunderstanding.

We do not wish to make excuses for the manufacturer who sends out his receivers carelessly constructed and improperly tested, but we believe that

manufacturers whose sets give undue service trouble will not survive, so that carelessness of this kind will find its own remedy. We would, however, like to see a clear statement from manufacturers as to just what their guarantee is intended to cover, and for the guarantee to be uniform. The facts should then be made clear to the purchaser, so that where ordinary servicing to his set is required he accepts it and the charges for it with the same good grace that he would in the case of his car.

Dealers in all parts of the country should take the question of service seriously, putting it upon a business footing and equipping themselves with the necessary apparatus and staff to ensure that they are competent to carry out the work to the satisfaction of their customers. To expect a completely trouble-free wireless receiver would be to ask an impossibility. If we accept, as we must, that service is an essential part of the radio industry, let it be tackled effectively and with a proper spirit, shown both on the side of the dealer and the customer.

## New B.B.C. Governors

### A Happy Selection

**T**HE choice of Sir Ian Fraser, M.P. for St. Pancras North, and Dr. J. J. Mallon, of Toynbee Hall, as governors of the B.B.C., is a matter for very general satisfaction.

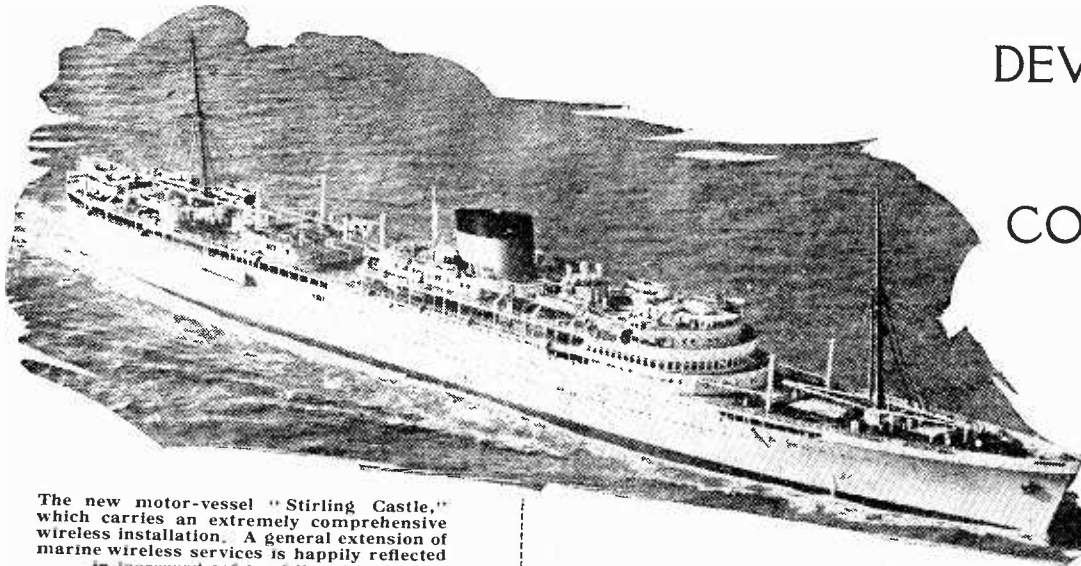
Sir Ian Fraser is particularly well known to our readers because of his long association with wireless and broadcasting interests.

His decision to retire from the House of Commons will be regretted, but the reasons which he has given for this decision are consistent with the high ideals of public service which have always characterised his actions.

# The Year's Progress

## DEVELOPMENTS IN WIRELESS COMMUNICATION

By LT.-COL. CHETWODE  
CRAWLEY, M.I.E.E.



The new motor-vessel "Stirling Castle," which carries an extremely comprehensive wireless installation. A general extension of marine wireless services is happily reflected in increased safety of life at sea.

**T**HE long-range telephone services continued to grow during the year, but at a much less hectic rate than was the case a few years ago when the field for expansion was almost clear. The reduction of rates, however, was a marked feature.

At the beginning of the year, Brazzaville, in French Equatorial Africa, was connected to the Brussels-Belgian Congo service, and San Domingo and Honduras were brought into the London-New York radio-telephone circuit. In February, there was an interesting ceremony conducted through the medium of this transatlantic circuit when Sir William Bragg, by lighting a candle at the Royal Institution in London, released electrical energy which was used for the opening ceremony of the Museum of Science and Industry in New York, the speeches in London and New York being broadcast throughout the United States. In March, a service was opened between this country and Kenya, Uganda and Tanganyika at a rate of £4 10s. for three minutes' conversation, and in July this circuit was extended to various towns in Kenya. In April, the England-Cairo service was extended by landline to Baghdad. In May, a service was opened between the Orkney and Shetland Islands, and also with Guernsey on a five-metre wavelength, this latter being the highest power ultra-short-wave commercial telephone link in the world.

In June, reduced rates for Saturdays were introduced on the Egyptian and Argentine circuits, and in July, important reductions in rates were made for the transatlantic service with the United States and Canada. In this service the rate for the three-minute call between this country and the first zone overseas (including New York and Montreal) was reduced from £6 to £4 4s., between 10 a.m. and 10 p.m., and from £4 4s. to £3 between 10 p.m. and 10 a.m., these reduced night rates being applicable throughout Sundays. Corresponding re-

*I*N this, the last issue of the old year, we follow our usual practice by publishing an authoritative article on non-broadcasting wireless developments of the past 12 months. Extensions of the long-distance radio-telephone and telegraph services are recorded, while increasing use is being made of ultra-short waves for communication at short ranges.

ductions were made for the other zones, and the rate for Cuba and Mexico was reduced from £7 16s. to £6, but with no further reduction at night. In August, the £6 rate to Japan was reduced for Saturdays to £3.

In August, too, the first zone in the telephone service with Atlantic liners was extended in a westerly direction from longitude 18 degrees west to longitude 35 degrees west. The lower rate of £1 16s. for three minutes was thus extended from 500 miles west of Land's End to about half-way across the Atlantic. Beyond this distance a double rate of £3 12s. is charged. In November, the rate for calls *via* New York, when direct calls to the ship are subject to delay, was reduced from £7 4s. to £5 8s.

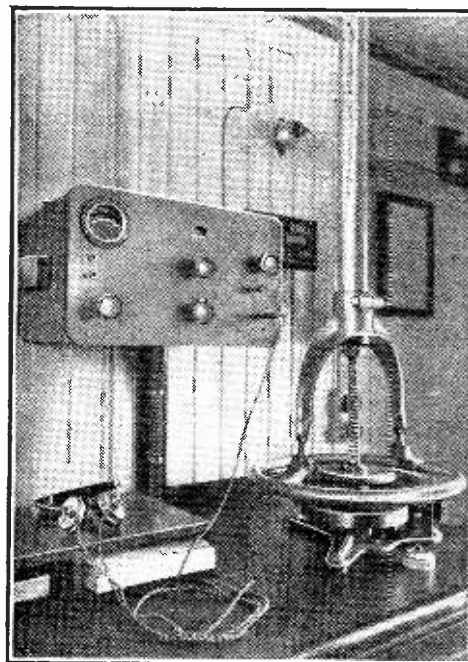
In October, a service was opened to all parts of Porto Rico at £4 16s., and at the same time substantial reductions were made in the rates to the Bahamas, Columbia, Costa Rica, Dominica, Guatemala, Hawaii, Honduras, Nicaragua and Panama.

In November, for the first time, an exchange of speeches was conducted be-

tween a ship at sea and a public gathering in London. On this occasion a luncheon was being given to honour Sir George Brown, who was retiring from the European general managership of the Canadian Pacific Railway. Speeches at the luncheon were heard in the C.P.R. liner "Empress of Britain," which was on the outward voyage, 1,200 miles from England, and speeches made aboard the

liner were heard by those assembled at the luncheon in London.

On the telegraph side no new services were established directly with this country. Abroad, duplicate circuits were established in March between New York and Rio de Janeiro, Haiti and Prague, and a new circuit opened with San Salvador. In April, services were opened between Bangkok, Sierra Leone and Vienna, on the one hand, and Saigon, Mon-



Siemens' direction-finding apparatus installed on board the M.V. "Imperial Star."

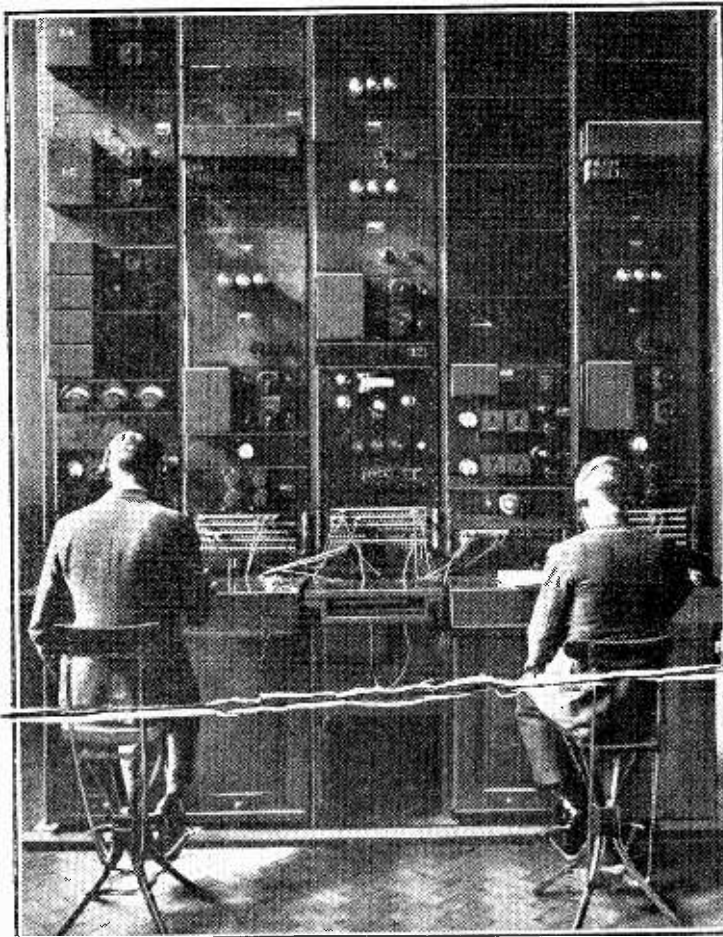
rovia and Oslo on the other. In May, Tokio and Vienna were connected with Oslo and Riga respectively, and, in June,

**The Year's Progress—**

Tokio, Rome and Aden with Tientsin, Addis Ababa and Makalla. In July, a circuit was opened between Tokio and Moscow, and in September between Beyrouth and Djibouti.

All direct wireless telegraph services with Ethiopia were closed on May 4th, and there are now only two circuits, one between Addis Ababa and Rome and the other between Addis Ababa and Asmara, both of which are conducted by the Italian Government.

In June, the Radio Corporation of America gave a very interesting demonstration of facsimile transmission on ultra-short waves of about 3 metres between New York and Philadelphia. The total distance was 90 miles, and there were two intermediate relay stations at visual distances. These intermediate stations were switched on and off automatically by a tone signal from



The Overseas Radio-telephone Exchange, Faraday House, London. This photograph shows technical operators at work on the Australian and New York circuits.

either terminal station. Six waves were used for the complete circuit, and were scrambled for secrecy. It was said that this demonstration showed such great possibilities for multiple transmission that wireless in the future might not only steal land line traffic, but might even dip into the mail bags.

The increased activity in shipping was reflected in the year's progress of the ship-to-shore wireless services. It is interesting to note that there are now about 15,000 ships fitted with wireless throughout the world as compared with about 14,000 five years ago. Of these, over 8,000 are still equipped with spark installations, the remainder having valve sets; arc transmitters have now passed away altogether.

The number of ships fitted with direction-finding apparatus has nearly doubled in the last five years, and is now well over 5,000. There is also a rapidly increasing number of small craft fitted with low-power telephone equipment suitable for communication up to a range of about 150 miles. It is interesting, too, to see how this fitting of vessels with wireless has affected the safety of the ships and the men they carry, and in this connection the

Chamber of Shipping has issued some informative figures. From these it appears that our shipping is now two and a half times safer than before the War, and foreign shipping nearly twice as safe. Of

the world's tonnage we own a third, but of the world's losses we suffer only a quarter. As regards crews, the loss for the four years before the war was 1 in 582 (or, if the "Titanic" and "Empress of India," which were exceptional losses, were omitted, 1 in 412), whereas in the period 1932-34 the losses were only 1 in 2,360, indicating that the losses are now about 4 to 6 times less than before the War. As regards passengers, for every 19 lost in the period 1910-14, only 1 was lost in the period 1929-33.

At the beginning of the year wireless was concerned in a dramatic episode of life-saving in the Antarctic. The American ex-

Receiving points at the P.O. Land's End station, which communicates with ships. The transmitting gear is seen in the background.

plorer, Mr. Ellsworth, and the Canadian airman, Mr. Kenyon, who had set out on exploration work near the South Pole, had

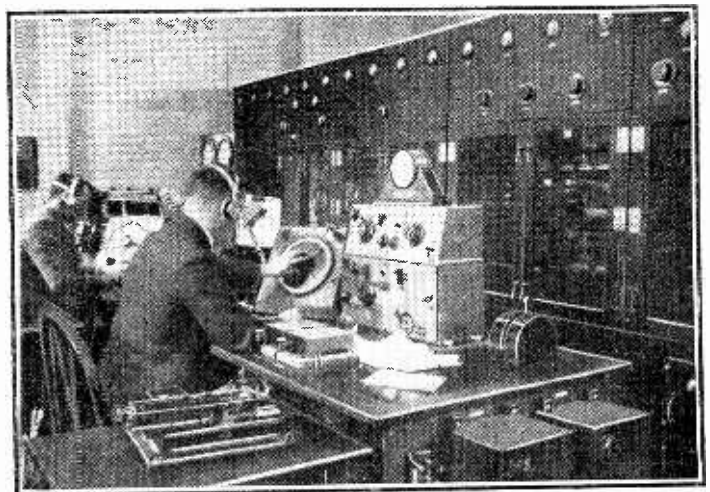
been missing since November 23rd, and on January 2nd "Discovery II" sailed from New Zealand in search of them, keeping in touch with civilisation by short-wave communication with Portishead Radio in England. The progress of the search was followed keenly throughout the world from the messages sent direct from the ship to Portishead across 10,000 miles of space, eventually culminating in the message, "Both alive and well," on January 17th.

**"Greetings" at Sea**

On April 1st the special inland telegraph service of "Greetings" telegrams was extended to radiotelegrams from ships at sea, the radios being copied on to the special greetings form at delivery offices and delivered to the addresses in the special envelope. The extra charge for this service is the cost of the indicator word, "Greeting."

On July 1st important reductions in ship-to-shore rates were introduced in this country. The old standard charge of 11d. a word for the ordinary full-rate plain language message had been in force here, and in most other countries, since the early days of ship-to-shore communications, and it had been felt for some time that, although there were lower charges for short-voyage ships, for tourist traffic and for ship letter telegrams some suitable time should be chosen for the reduction of the standard rate and the readjustment of others.

Ships' traffic, which had suffered in the slump years, was showing an encouraging upward trend, and for this, amongst other reasons, it was decided to reduce and readjust rates this year. Accordingly the standard rate was reduced from 11d. to 8d., which covers direct transmission to, or reception from, suitably equipped ships in all parts of the world, via Portishead Radio. The rate for messages sent from



the high-power station at Rugby was reduced, too, from 1s. 6d. to 1s. a word. This service meets the need of ships in distant waters which can receive Rugby's transmissions, but are not themselves fitted with short-wave equipment which would allow of communication with

**The Year's Progress—**

Portishead. The rate of 4d. a word for short-voyage ships was not altered, but was made available to all ships regularly engaged on voyages of not more than 1,000 miles from a port in the British Isles, instead of being limited to those on voyages up to 200 miles.

An interesting monthly communication was conducted during part of the year by Portishead Radio with the Oxford University Arctic Expedition in North East Land. It was a land of evil reputation, as all previous expeditions, including that of Nobile during 1928, had met with disasters of one sort or another. This Oxford Expedition, led by Mr. A. R. Glen, was the first to winter there, and obtained a mass of very useful information, including, from the wireless point of view, data on signalling conditions in the ionosphere, collected for the first time from a position north of the auroral belt.

In June, the "Queen Mary's" maiden voyage to New York produced a record in wireless traffic for the trip which will take some beating. The total telegraph traffic handled on board amounted to nearly 132,000 words, of which Portishead Radio alone dealt with about 50,000, and the telephone traffic to 149 calls, totalling 826 minutes. In addition, 40 broadcast programmes were sent from the ship to America, England, France, Denmark and Holland, occupying 647 minutes.

The equipment in the "Queen Mary" has already been fully described in this journal,\* and it will be remembered that it consists of four large transmitting plants, eight receivers and a self-contained emergency set, as well as a DF installation and equipment for two life-boats.

During the year there has been a considerable addition to the number of small ships, mostly fishing craft, fitted with wireless telegraphy and telephony, and the traffic of these vessels with the shore is increasing satisfactorily. More than half this traffic is carried out with Wick Radio in the north of Scotland, and arrangements have now been made to increase the capacity of that station by placing the receiving aerials at about a mile from the station, thus allowing of the simultaneous working of more than one channel.

All the coast stations are equipped with telephony for this communication with small craft, and for the last couple of years the telephony set in the coast station at Seaforth, near Liverpool, has been linked up experimentally to the land lines, so that communication could be carried out direct between the ships and subscribers on shore. It was considered that the same facility should be provided from an East Coast station, so a similar link service is being opened at Humber Radio.

Some interesting experiments in sending facsimile weather maps to Atlantic liners have been carried out during the year by the Radiomarine Corporation of America, in co-operation with the U.S. Weather Bureau. The weather map measures

8 inches by 10 inches, and takes 20 minutes to receive. Maps have been received from America in European waters on a frequency of 13 kc/s, 6 kc/s being used for shorter ranges.

In the case of air communications, every aircraft used for international public transport and capable of carrying ten or more persons must be equipped with wireless, and all of those of 2,000 kg. or over must be so equipped if on a day flight of more than 160 kms., or over 25 kms. across sea, or for night flying.

There are now over a dozen stations in this country for civil aviation, and it is indeed common practice for aerodromes to have short-range stations for close control. It has not yet been found necessary to arrange for commercial traffic direct between aircraft and ground stations in this country, but service traffic is rapidly increasing owing to the expansion of internal air services. The bulk of this traffic consists of route traffic and meteorological messages, and the rest of messages in connection with navigation. At the beginning of the year a modified medium-wave radio beacon was brought into service at Croydon to provide approach guidance for aircraft not equipped with the special receivers required for the ultra-short wave system, and a great deal of work has been done on blind landing systems.

These arrangements provide for guiding the aircraft to its landing place after it has been brought by ordinary DF to within about twenty miles of the aerodrome. From that distance the pilot is led in by a system of two 9-metre beams from a station in the aerodrome. One beam sends out a series of dots on one side of the true course, the other beam a series of dashes on the other side of the true course. When the aircraft is on this true course the beam signals merge together, so that the pilot hears a continuous dash in his telephones; he is provided as well with a visual indication. The distance from the aerodrome is found by means of marker beacons. The first marker beacon is about three miles from and the second one on the edge of the aerodrome. These beacons send out a vertical sheet of wireless radiation at right angles to the path of approach, and when the aircraft passes through the sheet of radiation a receiver is actuated and an indicating lamp is lit in the aircraft.

Much work, of course, has been carried out during the year in connection with the Empire air routes; for instance, over a score of stations have now been arranged for the England-South Africa route so that the flying boats may be in constant touch with the ground throughout the entire journey.

## International Radio Vocabulary

### Important Work in Preparation

THE International Electro-Technical Commission has issued an advance announcement regarding the forthcoming publication of the first edition of the International Electro-Technical Vocabulary, which is due to appear next year. This event marks the culmination of many years' work by delegates from all parts of the world.

Definitions are to be given in both English and French (the official languages of the I.E.C.), while a translation of the terms only will appear in German, Italian, Spanish and Esperanto.

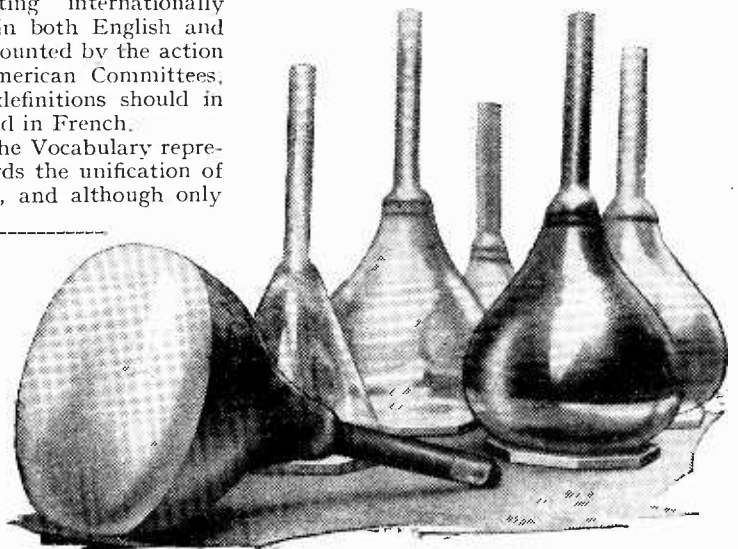
Some at least of the language difficulties encountered in drafting internationally acceptable definitions in both English and French have been surmounted by the action of the British and American Committees, who agreed that the definitions should in the first place be drafted in French.

This first edition of the Vocabulary represents an attempt towards the unification of electrical nomenclature, and although only

one of its 14 sections (that headed Radio-communication) deals exclusively with our subject, it will probably be accorded at least as warm a welcome in wireless circles as in other branches of electrical engineering.

The price of the Vocabulary has been tentatively fixed at approximately 10s., the exact price being dependent on the anticipated demand. Those interested are invited to request the British National Committee of the I.E.C. to reserve a copy or copies on publication; the address is c/o The British Standards Institution, 28, Victoria Street, London, S.W.1.

**CATHODE-RAY TUBES IN THE MAKING.**—This photograph, taken in the CR section of the Ferranti valve factory, shows different stages in the manufacture of 14-inch cathode ray tubes, which will eventually be used in Ferranti television receivers.



\* *The Wireless World*, May 29th, 1936

# Improving the Super-regenerative Set

By E. L. GARDINER, B.Sc.

**C**ONVENTIONALLY, pure sine-wave oscillations are used for quenching in super-regenerative receivers. But the author of this article advances the opinion that oscillations of saw-tooth form, giving more rapid quenching combined with a longer building-up period, confer important advantages in several directions. The practical application of the theory is described, and it is shown that the functions of quench generator and wave-form "corrector" may be carried out by a single multiple valve.

**T**HE increasing use to which wavelengths below ten metres are being put is responsible for an ever-growing demand for a simple receiver which will give good results on these wavelengths. Whilst there can be little doubt that the superheterodyne in its specialised form is the best type of receiver for this purpose, considerable skill in design and construction is necessary to obtain high sensitivity and ease of handling, whilst the cost must necessarily be quite high and may not always be considered justified for a receiver for ultra-short wavelengths alone.

The simple regenerative receiver can give quite good results in this region for the reception of telegraphic signals, but lacks sensitivity for the reception of telephony, and is unduly affected by traces of frequency modulation present in most ultra-short wave signals, which gives rise to poor quality or even complete unintelligibility. It also calls for very great care in construction, and adjustment at very high frequencies, and preferably for the use of special valves.

It is therefore not surprising that the super-regenerative receiver remains by far the most widely used type in this field, and seems likely to remain so for many purposes. It has the great advantages of high sensitivity and ease of adjustment, together with simplicity and low cost, it being possible to construct quite an efficient receiver with only a single valve, although two or three are more general; in view of these good properties any further technical improvements which can be added are likely to meet with general approval. In addition, the circuit possesses the valuable properties of a high degree of inherent AVC action and an ability to discriminate against local noise:

attributes too valuable to neglect lightly. Its drawbacks lie in poor selectivity and a tendency to bad quality when the signals received are deeply modulated; the former factor is, however, unimportant as yet, since the wavelengths below ten metres are far from congested, and there is no difficulty, for example, in separating the vision sound programmes from their neighbouring transmissions, while the question of quality has probably been overstressed. The modulation of transmissions on these wavelengths is not usually very deep, and provided that a high quenching frequency is adhered to and ample magnification provided after detection (so that the signal level can be kept low at the detector grid) the quality of reproduction will be adequate for general listening.

The efficiency of the circuit is clearly dependent basically upon that of the super-regenerative process itself. This in turn is brought about through the action of a local oscillator of relatively low frequency upon a more-or-less normal detector stage in which ample reaction is available. The various factors which determine the effectiveness of this quenching oscillation have been the subject of considerable investigation, and are comparatively well known.

Thus, for example, it is found that the amplitude of the quenching oscillation should bear a relation to that of the detec-

tor determined by the degree of regeneration applied to the latter, and this relation is arrived at in practice by controlling the regeneration of the detector or the amplitude of the quenching oscillation, or both, and by suitable circuit design. Details of this factor are outside the scope of the present article, but have an important influence upon the behaviour of the receiver, its signal-to-noise ratio and sweetness of handling.

Again, the choice of the optimum quenching frequency has been the subject of investigation, and it has been established that this should be approximately proportional to that of the incoming signals, being of the order of 0.05 to 0.005 of the signal frequency. Broadly speaking, it is found that lowering the quenching frequency results in improved sensitivity and increased selectivity, with an increased tendency to dis-

tortion if the incoming signals are heavily modulated or subject to frequency modulation; whereas raising the quenching frequency cleans up this distortion and broadens the selectivity somewhat. At some intermediate value there will be an optimum frequency for any wavelength which results in best sensitivity and cleanest reception, and which is fortunately not critical.

Little if any attention seems to have been given to the third factor which in-

## A New Method of Quenching

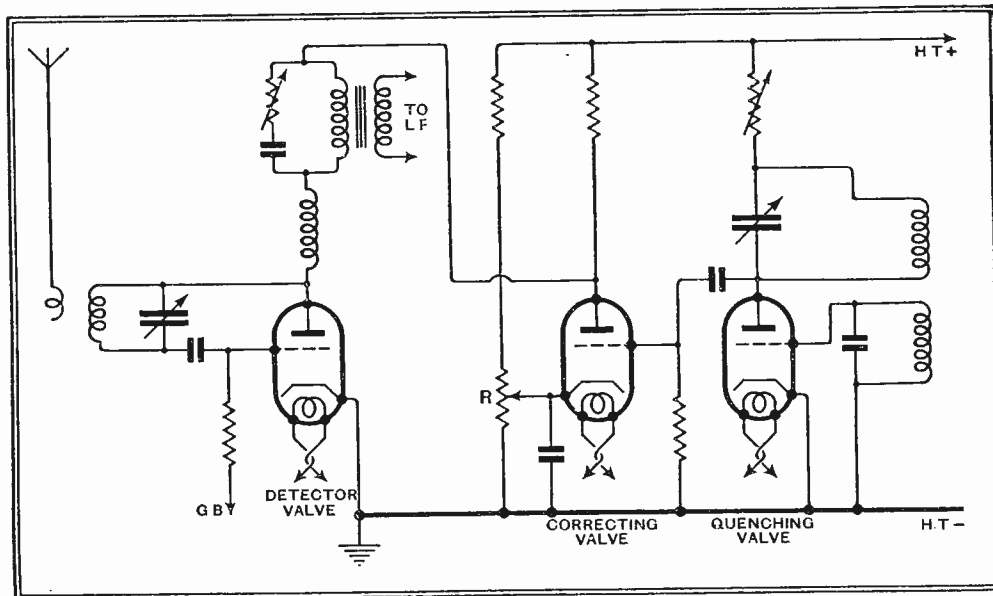


Fig. 1.—Super-regenerative receiver with an extra valve for modifying the wave-form of the quenching oscillations.

**Improving the Super-regenerative Set—**

fluences the quenching oscillation, namely, its wave-form; the general assumption having been made that this is sinusoidal and unimportant; and the writer therefore thought it desirable to make preliminary investigations into this factor, and to determine if in fact it has any appreciable effect upon the performance of the receiver.

**Saw-toothed Quenching Waves**

Considerations of the simple theory of super-regeneration would seem to suggest that a decided improvement should result from a departure from the sinusoidal quenching oscillation. The operation of the detector stage is regarded as consisting of alternate periods each of about the duration of one half-cycle of the quenching oscillation, although not exactly in phase with this. During one of these periods in which the bias of the detector is favourable for regeneration the detector builds up towards a state of self-oscillation and signals experience a considerable amplification as a result of this intensive regeneration. At about the time when a state of continuous oscillation is reached (the exact period depending upon the adjustment of the relative amplitudes) the reversal in polarity of the potential applied to the detector grid by the quenching oscillation occurs, and the bias becomes unfavourable to regeneration with a consequent damping out of the oscillations. The process is then ready to repeat itself with the next cycle of the quenching oscillation.

It can thus be seen that the most efficient operating condition might be expected to occur when the period of damping is as brief as possible and the damping bias very great, thus minimising the time spent in this inactive state during which no signal amplification occurs, whilst at the same time the regenerative periods should be as intensive as possible, and increased in frequency to compensate for the reduced duration of the damping periods. In the case of a sinusoidal quenching oscillation the two periods just referred to may be expected to be similar in duration, corresponding approximately with the half-cycles of the oscillation. Moreover, the conditions for regeneration or quenching will not be fully effective throughout each half-cycle, since the bias is only at a maximum for an instant at the peak of each of these, and is rising or falling during most of the time. Better efficiency might be expected if a complete instantaneous reversal of the quenching potential could be obtained, the wave-form being thus rectangular instead of sinusoidal; but since this is very difficult

to obtain electrically a saw-tooth wave-form of the type employed in cathode-ray time base circuits was considered the next best to adopt, the phase of this being such that the sudden sharp peak of the tooth

indicated a noticeable improvement in performance, and hence it was thought worth while to try out a more practicable arrangement, and a circuit was set up on the lines shown in Fig. 1. Here the

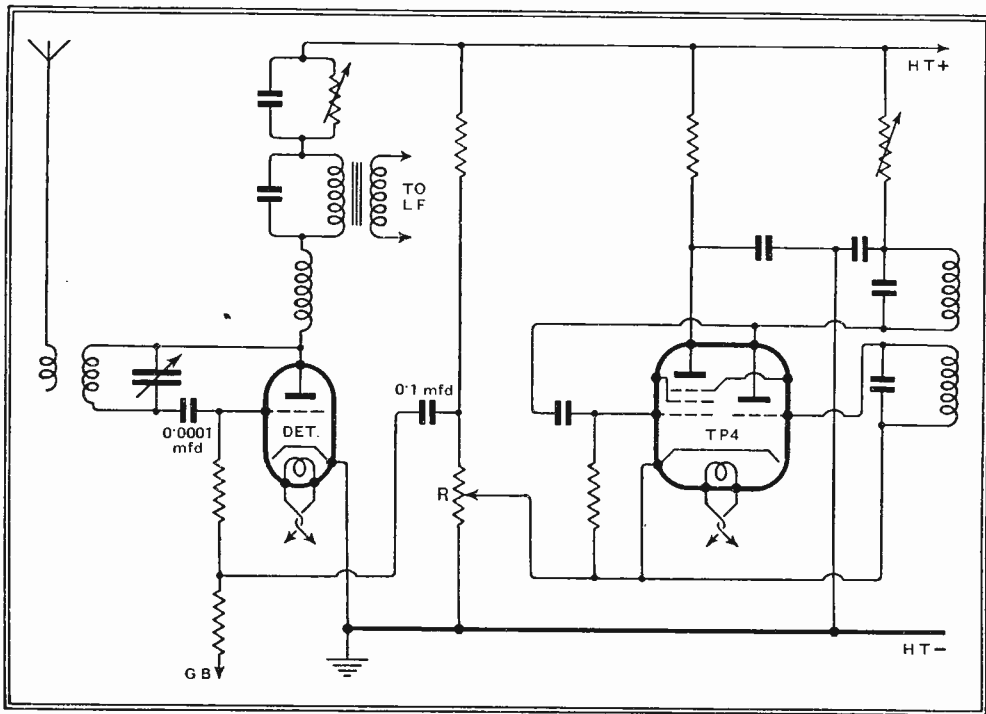


Fig. 3.—A practical version of the experimental circuit shown in Fig. 1; a triode-pentode combines the functions of quenching oscillator and wave-form corrector.

is used to give a rapid and brief but intensive quenching action, whilst the build-up period is relatively longer in duration. Combined with an increased quenching frequency to take advantage of the reduced overall period of the cycle of operations this effect has been confirmed experimentally, and is further confirmed by the fact that the optimum value of quenching frequency becomes higher when the wave-form is thus changed in accordance with the above theory.

Tests to verify this effect have been made with a normal type of super-regenerative receiver operating mainly in the five-metre amateur waveband. Normally the receiver

original quenching oscillator is employed again, but the potential from it is not applied directly to the super-regenerative detector, but to the grid of an intermediate valve V, which might be described as a wave-form corrector. This valve is over-biased to beyond anode current cut-off potential, which can be conveniently effected by a rather low resistance potentiometer across the HT supply with its slider taken to the valve cathode.

**Modifying the Wave-form**

This biasing resistance R modifies the quenching wave form and becomes quite an important control in the modified circuit. The correcting valve operates under Class "C" conditions, namely, with zero anode current, and potentials set up across its anode resistance are applied to the grid of the detector as quenching potentials. Under these conditions there will be no extra grid potential applied to the detector during build-up periods since the anode current of the corrector is zero, and hence a suitable permanent bias should be applied to the detector; this may best be obtained experimentally from a battery, and the polarity and voltage of this should be set to the value which gives the readiest and most intense oscillation of the detector. This may be found by trial for the type of valve in use by reducing reaction coupling temporarily until oscillation ceases, and finding the bias at which minimum coupling is needed.

With the corrector valve working in this manner, anode current will only flow for brief periods during the positive peaks

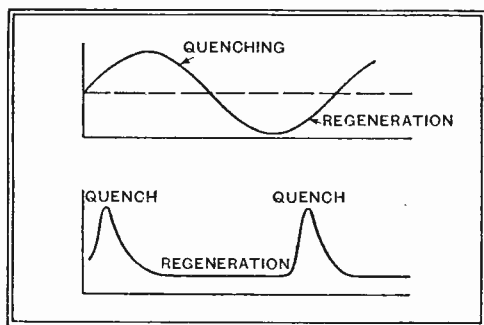


Fig. 2.—Sinusoidal quenching oscillation cycle, compared with the modified wave-form advocated by the author.

employs a low-capacity type of detector valve followed by one AF stage. A separate quenching oscillator valve having variable frequency and amplitude controls is employed, and an optional RF stage is used before the detector to improve selectivity and reduce reradiation. The set is in frequent use and its capabilities well known.

As a preliminary test the quenching valve was disconnected and replaced by a cathode-ray time base generator giving saw-tooth wave-form which could be adjusted to similar frequency and amplitude. Tests on well-known stations

**Improving the Super-regenerative Set—**

of the quenching oscillation at its grid, the duration of these brief anode pulses depending upon bias applied. Thus at these instants the detector receives a quenching pulse which can be made of high intensity but short duration, whilst at other times the bias is that selected for maximum reactive build-up. A condition of maximum efficiency is therefore more nearly obtained than if the sinusoidal quenching oscillation were applied directly to the detector. If the bias to the correcting valve be reduced to the normal value for amplification, the quenching oscillation will be merely amplified and normal super-regenerative operation obtained. As the bias is increased to the cut-off point and beyond, the wave-form becomes of the nature shown in the lower curve of Fig. 2, and improved efficiency results.

The circuit just described may be criticised on two counts. First, the quenching pulse is negative and produces suppression of the oscillations by momentarily cutting off anode current in the detector, whereas a more usual method is to damp out the oscillations by the application of a positive potential and the effects of the resulting grid current. This method results in a lower quenching amplitude and more rapid quenching. Secondly, an extra valve is necessary to give the desired wave-form distortion.

Both these points are taken care of by the circuit of Fig. 3, which is that of a practical receiver now in use. Here the load resistance across which the quenching potentials are built up is moved to the cathode circuit of the correcting valve, and functions of oscillator and corrector are combined in a dual valve. Almost any triode-hexode or similar type can be adapted to this work, that used in the circuit given was a TP4, and, although the theory of operation is somewhat different, valves of the common cathode type such as the FC4 will also operate. The conditions in the circuit of Fig. 3 are similar to those in Fig. 1, the hexode section of the valve being over-biased by the resistance R. The remainder of the circuit is self-explanatory.

It is interesting to note that, owing to the extra quenching amplitude obtainable in a circuit of this type employing an amplifying stage, it is possible to employ either positive or negative pulse quenching, and interesting comparisons become possible with slight circuit alterations. The action of the super-regenerative detector is so complicated in detail by the effect of small phase displacements and by the wide range of possible amplitude relationships between the operating conditions of detector and quench that no attempt has been made to explain the operation fully; neither is it possible to measure the improvement in performance resulting from wave-form changes with the type of equipment normally available. It is a matter of great difficulty to obtain valid performance measurements at ultra-high frequencies unless exceptional facilities are available.

Fortunately, however, the circuits described lend themselves well to experi-

mental treatment, and will operate over wide ranges of conditions, and thus provide an interesting field for the experimenter.

A further modification which has been tested with success is the use of a neon oscillator of conventional type as generator of the quenching oscillation. This circuit generates a saw-tooth wave-form which seems somewhat preferable to the conventional sine wave.

The degree of improvement obtainable by the use of a modified wave-form in the manner described is not easy to assess exactly, and has not been measured for weak radio-frequency inputs. In the case of a strong signal an increase in modulation response at 1,000 cycles has been measured in the detector anode circuit as of the order of three times, which seems to be of the magnitude to be expected from the simple theory. It is found that when all is working correctly the signal strength from a distant amateur transmission increased very noticeably as the bias upon the corrector valve was increased from the linear value towards anode cut-off, the effect being aurally similar to that of turning up the audio-frequency volume con-

trol; while it cannot be said that this is exclusively due to the change in wave-form, there is little doubt that it is largely so.

After considerable practical use the writer is satisfied that this improvement in signal strength is accompanied by an appreciable reduction in noise level on distant stations, and noticeably cleaner operation, and on account of these effects the circuit can be recommended as a helpful modification to the conventional circuits.

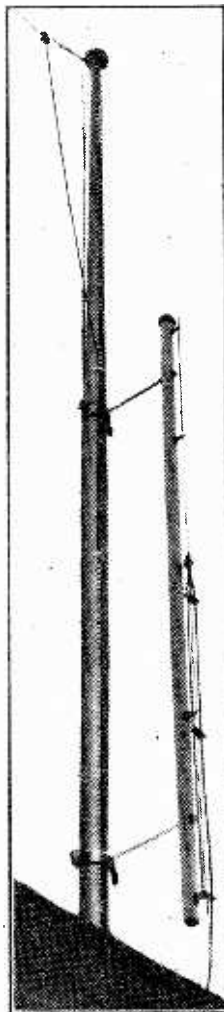
**Data on American Sets**

THE second revised edition of "Radio Field Service Data" is published in loose-leaf form, and its price includes supplements for a year. The book, which is written to meet the needs of service men, contains a mass of practical information on the characteristics of a vast number of American broadcast receivers. As an aid to the location of faults, "case histories" of many of the more popular models are given.

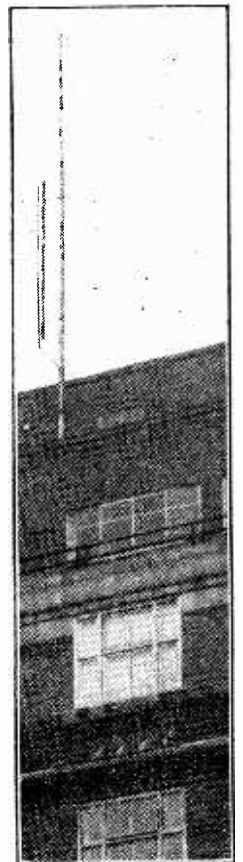
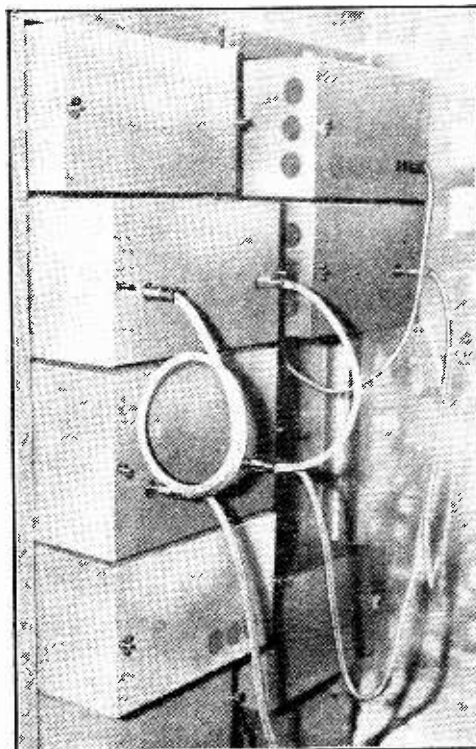
In addition to sections on such subjects as colour codes, valve characteristics, radio formulae, etc., the problems of car radio installation are described at length. The book is issued by Radio and Technical Publishing Company, 45, Astor Place, New York, U.S.A., at the price of \$2.50.

**TELEVISION  
"LAID ON"**

These photographs show an extremely ambitious installation providing both sound broadcasting and television to no fewer than 73 flats in the Law Land Company's new building, Carrington House, Hertford Street, Mayfair. The community aerials and distribution system were installed by E.M.I. Service, Ltd.



(Above) The dipole television aerial and one of the masts supporting the broadcast aerial, which is fitted with an impedance-matched screened downlead.



(Above) Both television and broadcast aerials are raised well above the field of interference.

(Left) An elaborate distributing system, with line amplifiers, ensures for each tenant a standard of reception as good as that provided by a properly installed individual aerial.

# Unbiased

## The Curse of Christmas Presents

I CANNOT express my thanks too warmly for the great kindness shown by all of you to the desperate appeal which I made to you, when in Lapland the other week, for homely remedies for colds and rheumatism. I am pleased to say that as a result of these my Christmas is likely to be a far happier one than I had anticipated, as my ailments seem to be lifting under the combined onslaught of several of these remedies. At this very moment I am writing these few notes with my feet in a mustard bath and various medicinal remedies hanging on the Christmas tree at my side, Mrs. Free Grid having faithfully arranged them there for me.

At the same time, while duly grateful for all these touching manifestations of your affection, there is, I regret to say, a fly in the ointment. I am, of course, referring to the traditional metaphorical fly and not the rather curious entomological specimens which I have found embedded in the chest salve which a kind reader has sent by Air Mail from West Africa. The trouble to which I refer is the apparent contradictions in the various remedies sent to me and the Spartan will necessary to carry some of them out.

### The Snow-bathing Cure

Mustard baths I do not object to, while my will power is sufficiently strong to swallow many of the nauseous draughts which have been sent me, but somehow or other I cannot feel that it is beneficial to rise straight from a warm bath and then go out and roll in the snow, even though I am counselled to rub myself vigorously with the wretched stuff. My difficulties are not lessened by the fact that I have to seek the kind hospitality of a nearby frozen meat repository owing to the absence of the natural article in the garden. However, I dare say that even though at the moment of writing I feel at death's door, your remedies will pull me through.

I suppose that the great majority of you on this gladsome morning are sitting gazing glumly at the various gifts which have reached you and wondering how best you may get rid of them without offending the donors. I well recollect last year being in something of a quandary myself on this point and I find myself in a somewhat similar fix this year. Things like socks and ties are not so bad, as when you wear them they cause offence to others rather than to yourself, and even bed socks have their uses. But what on earth



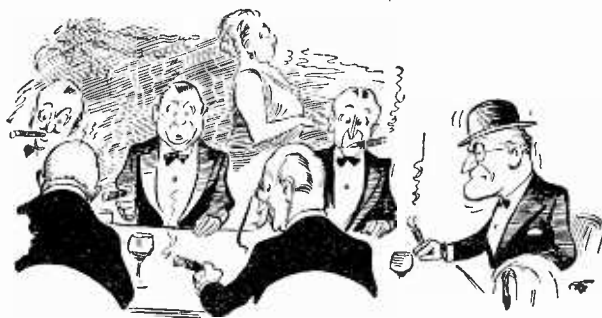
Feeling like death warmed up.

possesses women to go and buy something which they know absolutely nothing about, namely, cigars.

I remember shortly after Christmas last year, Mrs. Free Grid and myself were invited one evening to a Yuletide party given by the Vicar and the Vixen. The latter lady had sent me a box of cigars for Christmas as a small token of her esteem for my efforts in reading aloud extracts from Balzac's saucy stories to the members of the Mothers' Meeting, while they were busily engaged in making red flannel waistcoats for the unfortunate natives of the Fiji Islands, and thus unable to read for themselves.

The cigars that she sent me were really so appalling that I greatly doubted whether it could have been a case, as it usually is, of an unscrupulous tobacconist taking advantage of a woman's ignorance in these matters and deliberately palming off these compressed cabbage leaves on to her. I began, in fact, to suspect that my charitable efforts had not been appreciated at their true worth, and that the cigars were sent to me with malice aforethought.

At any rate, I filled my case with them and duly handed it round to the male members of the party at the appropriate moment. The result was, however, not



A restless feeling among those present.

quite what I had expected, for, although, as I had anticipated, a restless feeling soon began to manifest itself among those present, the prevailing bad odour was attributed to the drains, and with one or two significant remarks concerning the

disadvantages of living in old-fashioned country vicarages the guests began to totter home.

Actually, of course, as I write these words, Christmas has not yet dawned, but owing to some secret service work done by the Little Grid Leaks in return for a small fee, I am already in possession of a fairly complete list of what I am to be given this year. Fortunately, there doesn't seem to be anything particularly offensive, but I am dismayed to learn that I shall find myself the embarrassed recipient of no fewer than five television receivers, but since these are of the old 30-line type, I shall be rather at a loss to know what to do with them. It is quite obvious, of course, that some unscrupulous dealers have sold them to my ignorant womenfolk at a knock-out price as a great bargain and, as usual, I have been left to hold the baby.

## By Free Grid

It puts me in a very awkward predicament as one of them is from a wealthy aunt from whom I have expectations, and in an accompanying letter, which one of the most astute of the Little Grid Leaks has filched from the parcel, she has announced her intention of coming over to my place to see the television programmes by means of her wretched set. I cannot afford to upset her by letting her know that she has been stung, as she always prides herself on her commercial slickness. Every time I think of the amount of money which is hanging on my solving this problem in the proper manner I break out in a cold perspiration which in my present state of health is, I feel sure, not at all good for me. At the present moment the only thing I can think of is to set fire to my house on Christmas Day and burn the lot. Somehow or other I cannot help feeling that this is like using a steam hammer to crack a nut, and if any of you have helpful suggestions to make, I hope you will telegraph me immediately.

However, I dare say you have plenty of Christmas troubles of your own to occupy you without bothering about mine. I will, therefore, content myself with wishing that, at this season of good will, when even wireless manufacturers become almost human—or, at any rate, sub-human—you are able to forget all your troubles and join me in a glass of quinine.



FURTHER  
NOTES  
ON

# Negative Feed-back Amplification

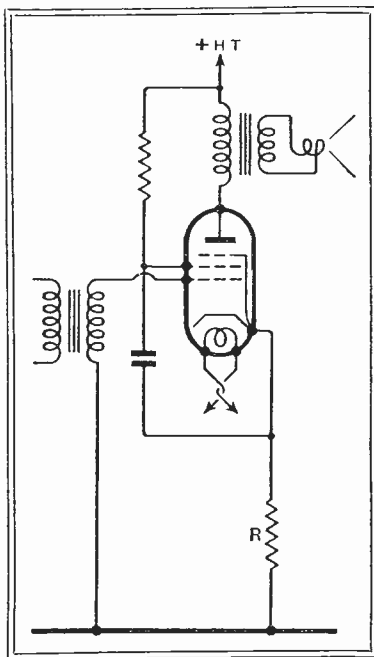
By W. T. COCKING

*SOME of the more important advantages to be derived through the use of negative feed-back have been dealt with recently in "The Wireless World." In this article the effect of the input transformer is treated, and it is also shown that the system enables a filter to be properly loaded while retaining optimum operating conditions for the valve.*

THE benefits to be derived from the use of negative feed-back in amplifiers embodying pentode-type valves were discussed in some detail in a recent article in *The Wireless World*.<sup>1</sup> It was shown that its use tends to give triode characteristics to a pentode in so far as it reduces the effective AC resistance of the valve so that the loud speaker is properly damped, it raises the signal input to the same order as that with a triode, and it reduces harmonic and frequency distortion. These advantages are very material, and are especially important in the case of DC mains apparatus where the HT voltage available is quite low. The first amplifier embodying the principle to be described constructionally was consequently of the AC/DC type, and it appeared in last week's issue of *The Wireless World*.

In this article it is not proposed to discuss this amplifier in any detail, for it has already been fully described, but rather to consider some of the practical aspects of negative feed-back. In the article already referred to, it was shown that for satisfactory

Fig. 1.—A negative feed-back circuit which gives an output resistance higher than the valve resistance.



operation the voltage fed back must be applied to the grid of the valve in series with the normal input voltage. When a low output impedance is desired this feed-back voltage must be derived from a circuit in parallel with the output, but when a high output impedance is required it must be taken from a circuit in series with the output. The two arrangements are illustrated in Figs. 1 and 2.

Normally, for an output stage we use the second circuit, giving a low output impedance, but there are undoubtedly occasions when a high output impedance is desirable. More of this anon. The point

<sup>1</sup> *The Wireless World*, Nov. 6th, 1936.

which it is now desired to raise is this: a feed-back stage will only function in the manner expected if the true voltage between grid and cathode is the difference between the input and feed-back voltages. If  $E_m$  is the voltage across the transformer secondary and  $E_f$  is the feed-back voltage (across  $R$  in Fig. 1 or across  $R_1$  in Fig. 2), then the true grid voltage should be  $E_g = E_m - E_f$ .

## Factors Which Influence Performance

This would be obtained if the input impedance of the valve were infinite. In practice it is not, for even if the Miller effect is negligible there is the grid-cathode valve capacity to consider. Even this would be relatively unimportant if the impedance of the input transformer, viewed from its

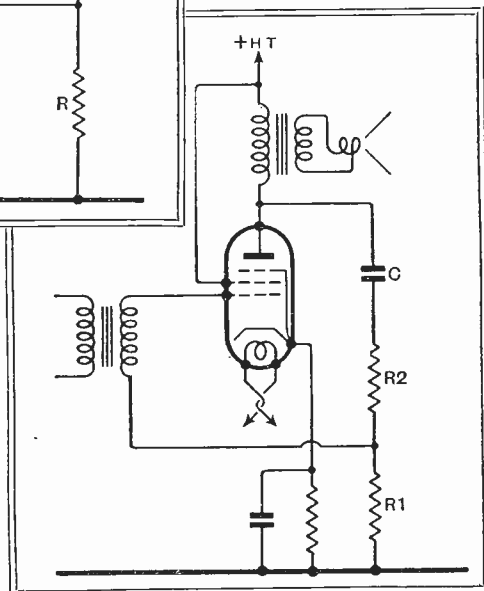
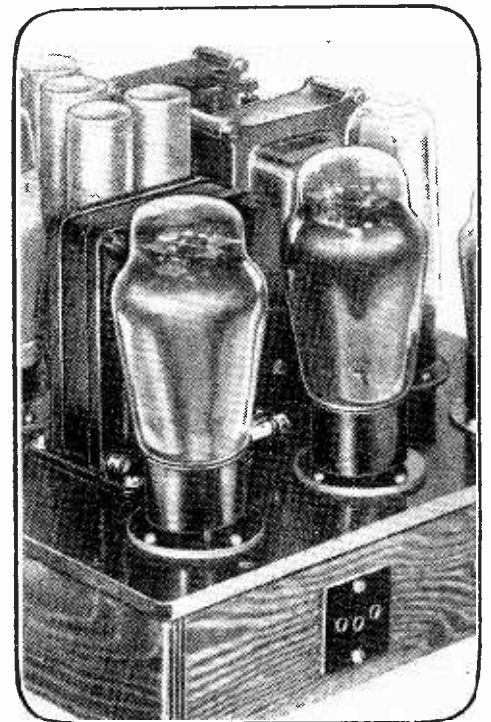


Fig. 2.—With this circuit the output resistance is lower than the valve resistance. It is consequently of wide application.



secondary terminals, were a pure resistance. The transformer impedance is complex, however: at some frequencies it is resistive, but at others it is reactive and behaves at some as a condenser and at others as an inductance. The effect of this, in conjunction with the input impedance of the valve, is to cause an alteration in the magnitude and phase of the feed-back voltage with frequency.

## Frequency Response

This naturally reacts upon the frequency-response characteristic and causes unexpected results. Large peaks in the response curve are possible, for the phase change may be such that it converts negative feed-back into positive at certain frequencies, with consequent regeneration. Experience shows that in the audio-frequency range little difficulty is found in obtaining satisfactory results. A phase-shift occurs at frequencies above about 6,000 c/s, due to a resonance effect in the transformer, and the response at higher frequencies may rise considerably. It is, however, easy to avoid the trouble by damping the transformer secondary with resistance.

This point regarding frequency-response is stressed because it is usually stated that the application of negative feed-back greatly reduces frequency-distortion. This is quite true, and the amplifier as a whole

**Negative Feed-back Amplification—**

tends to take on the frequency characteristic of the feed-back circuit. A flat over-all response curve can only be secured when the feed-back circuit gives a uniform response and a constant change of phase with frequency. With circuits such as those of Figs. 1 and 2, however, the transformer secondary and the input impedance of the valve are really in the feed-back circuit, and may consequently upset the performance. As already stated, little trouble is experienced at audio-frequencies, but serious difficulty might be experienced at higher frequencies.

The application of negative feed-back has, so far, been considered only in relation to the output stage. There is, however, another use for it, for by its aid a problem which has long caused difficulty can be solved. This is in relation to filters. It is well known that a properly designed filter requires terminating at each end with a resistance equal to its characteristic impedance. When the filter follows a valve the valve resistance is the termination at one end, and at the other end we must have a resistance equal to that of the valve.

The filter is then properly terminated, but the valve is not operating under proper conditions, for it is working into a load equal to its own resistance instead of one which is several times that value. Hitherto there has been no solution to this difficulty, but negative feed-back, with the circuit of Fig. 1, offers a solution.

The optimum load for a valve is unchanged by the use of negative feed-back, but the apparent output resistance can be

made almost anything we like. In general, for working into a filter, we want to increase the apparent AC resistance of the valve. We thus use the circuit of Fig. 1, build the filter to have a characteristic impedance which is a suitable load for the valve from the point of view of distortion, and then apply negative feed-back to increase the apparent output resistance of the valve to a figure equal to the filter impedance.

Thus, suppose we have a 10,000-ohm valve which requires a load of 20,000 ohms. We build a filter having a characteristic impedance of 20,000 ohms and terminate it at the far end by a 20,000-ohm resistance. The beginning of the filter we connect directly to the valve. Normally it would be mismatched, for the valve resistance is only 10,000 ohms, but we can bring the effective value up to 20,000 ohms by negative feed-back. In the article already referred to it was shown that the effective output resistance of this circuit is  $R_a + R(1 + \mu)$ .

In this case we wish to double  $R_a$ , so that to obtain an output resistance of 20,000 ohms  $R(1 + \mu)$  must equal 10,000. For a valve of this type  $\mu$  may be 20, and assuming this value,  $R = 477$  ohms. This is not far off the normal bias resistance for a valve of this type; if it is operated with a moderate anode voltage, however, a higher resistance may be needed to provide grid bias. The resistance can then be divided into two in series, one for feed-back and the other to make the total value that necessary for bias. This second resistance must be by-passed by a large capacity.

# On the Short Waves

## EXTRACTS FROM A LISTENER'S LOG

AS we move on into midwinter it is becoming more and more obvious that short-wave conditions are not going to drop out in the evenings this winter as they have done during the past five years, and that we are at last really in the sunspot maximum period.

At the moment of writing, 11.15 p.m., I am listening to W1XAL on 11.79 Mc/s (25.4 m.) at really excellent strength, R9+ and 100 per cent. intelligible; a few nights ago, too, W3XAL was quite good at 9 p.m., in fact even better than he had been at 6.30 p.m. Owing to cloud we have not been able to look at the sun for some days, but if present conditions (and as during the last few nights) are any guide, then sunspot activity must be high. This hangover of the daylight frequencies into the late night is quite typical of active sunspot conditions, and a fall in activity is generally shown by days such I mentioned at the conclusion of my last notes, i.e., the ultra-high frequencies good at sunset, then a rapid drop in the optimum frequency, even down to 4 Mc/s in the case of U.S.A. and Canada.

Reception on the ultra-high frequencies, however, seems to be good when there are either a lot of sunspots or none at all, and poor during the transition period.

With the increase in the sunspot activity,

too, the severity of the Dellinger fade-outs seems to be increasing. It will be remembered that these fade-outs are almost certainly connected with the ejection of hydrogen by the sun, and as the effect on radio occurs simultaneously with the solar eruption it seems certain that the agent which causes the radio disturbance travels with the speed of light.

It is more than probable that this agent is ultra-violet light, it also being remembered that only the sunlit part of the globe is affected, and the effect of this additional light is greatly to increase the ionisation and, consequently, the attenuation of the E region.

During recent fade-outs on twilight paths only the lowest of the frequencies in use has been affected, but on the bright daylight routes, such as the African, even the highest frequency in use commercially (Empire Station GSH, 21.47 Mc/s) and all lower frequencies have been rendered useless at times.

In order to escape this attenuation in an abnormally ionised E layer it is, of course, only necessary to increase the sending fre-

quency sufficiently, but if we do this we are not certain that it will be returned by the  $F_2$  layer, since at the moment we are unable to say what effect the ultra-violet light has on this region during the Dellinger fade-out periods, and whether its ionisation increases proportionately with that of the E.

A study of the reception data relevant to the reception of Alexandra Palace in Johannesburg may help us to elucidate this point.

The question is, does reception on these ultra-high frequencies improve during a hydrogen-eruption fade-out?

### Optimum Daylight Frequency

What does seem relatively certain is that the optimum frequency for midday transmission to Africa is going nearer to 28 Mc/s than to 21 Mc/s during the next few years!

Before passing from this brief propagation study one cannot help feeling that, in some ways, may not the clue to the future of short-wave communication be found in the so-called "Luxembourg Effect"? If high-power stations like Droitwich are able to affect the ionosphere to such a degree as to be able to impart their modulation to other stations, why should we not in future control the E and F layers (particularly the latter) in this manner?

These high-power low-frequency transmitters are able to affect the E region, and may not future high-power high-frequency transmitters create their own "ionisation" at the points where their beams strike the F region? This property would be particularly valuable (apart from cross-modulation effects—which might be avoided by the use of frequency-modulation) when the transmission path is from darkness into daylight.

Ultra-high frequency conditions seem to have been good from December 3rd to 6th, in particular W9XAZ and W2XEM having been outstanding signals, although many of the U.S. amateurs have also been putting in excellent signals on 28 Mc/s.

Monday, December 7th, appeared to be a typical day of "good conditions"; at 7.20 p.m. the following selection was logged: second harmonic of WSL on 25 Mc/s, R9; W3XAL, 17.78 Mc/s, good; W2XAD, 15.33 Mc/s, excellent; W2XAF, 9.53 Mc/s, good but for slight fading and heterodyne, which surely covers a very wide band of frequencies!

Barely an hour later, however, only W2XAF was left.

Conditions were similar on Tuesday, December 8th, and although W2XAF was again the best signal at 10 p.m. the higher frequencies were more in evidence.

Among the best stations in the 9 Mc/s group early on Wednesday evening were W1XK and Rome, the latter an R9+ signal at midnight.

As mentioned earlier in these notes, at 9 p.m. on December 10th W3XAL was still a good signal on 17.78 Mc/s, with W2XAF and W1XK good, too, at this time.

Ionisation levels seemed to be down a little on Friday, December 11th, but W2XAF was an excellent signal again at 8.40 p.m.; noise levels were low and the European stations weak this evening.

Saturday, December 12th, was notable for an extremely marked echo on GSH at midday, while GSG was similarly affected; on Sunday very good results were obtained from W2XE on 21.52 Mc/s (13.93 m.) until close down at 6 p.m.

ETHACOMBER.

EVENTS OF THE  
WEEK IN  
BRIEF REVIEW

**New H.Q. for European  
Wavelength Control**

NEW premises for the Brussels wavelength control authorities are said to be under consideration. The new headquarters are likely to be about a mile from the old, and will be made completely sound and vibration-proof. It is hoped that these new premises will be in use before the end of 1937.

**Relay Exchanges  
Amalgamate**

THERE has been a considerable number of complaints made concerning the unsightliness of the great number of overhead wires in Burnley. This has been largely due to the fact that, until recently, there have been no fewer than thirteen wireless relay exchanges in the district. These have now amalgamated, and the result will be a large decrease in the number of wires and also the avoidance of wasteful competition.

**Japanese Wireless  
Components**

WIRELESS manufacturers in this country have for some time past been perturbed by the flood of cheap and, in many cases, poorly designed American goods, which have been coming into this country. Now we learn that the American radio manufacturers find themselves faced with somewhat similar conditions, and are seeking to have a tariff imposed on certain cheap Japanese wireless components which have been flooding the market.

**N.Z. Short-Wave Station ?**

PROPOSALS are afoot to build a short-wave wireless station in New Zealand for the purpose of putting the country "on the map" so far as the rest of the world is concerned. Considerable opposition has been experienced from various quarters however. In particular the President of the Federation of the Chambers of Commerce of the British Empire has given it as his opinion that, with her limited population and great distance from the world's centres, it is extremely doubtful whether New Zealand will be able to put out programmes of a type to hold the interest of listeners overseas.

# Current Topics

**Berlin Wireless Show**

THE opening date of the German Radio Exhibition for 1937 has been fixed for July 30th. It will remain open until August 8th.

**A Steady Increase**

FRENCH listeners continue to increase in numbers fairly steadily, and the ideal of three million, at one time considered almost unattainable, has long since been passed, the number now being 3,082,498.

**Inventor Honoured**

AUSTRIA is to issue a special postage stamp to commemorate Robert von Lieben, the Austrian inventor, who did a great deal of pioneer work in the development of the valve as an amplifier.

**Radio Foundation Day**

ON December 12th the Australian Institution of Radio Engineers commemorated the anniversary of the birth of long-distance wireless communication by a banquet at which special messages were received from the Marchese Marconi and Colonel A. S. Angwin, the Deputy-Engineer-in-Chief of the G.P.O. The day was further commemorated by means of a special message sent round the world

from Sydney via London, Bombay, Tokio, Buenos Aires, New York, Montreal and back to Sydney.

**Municipal Wireless Station**

THE City Council of Brisbane, the Queensland capital, has its own transmitting station which is used to communicate instructions and information to police cars, ambulances and service cars of the Electricity and Tramways Dept. which are radio-equipped. Other important Australian cities may possibly adopt a similar arrangement.

**A Noteworthy Conversation**

DURING the recent N.B.C. celebrations in America which were attended by the French P.M.G., the latter, while travelling in an American airship, held a short-wave conversation with the Marchese Marconi in his yacht over five thousand miles away.

**Questions in the House**

THE present number of radio beacons in use in this country is five, all these being of an experimental nature. According to the reply given by the Air Minister to a question raised in Parliament the whole subject of these beacons and the

wave-lengths they employ is to come under review at the next Tele-communications Convention which is due to be held in 1938. Another interesting fact which emerged as a result of a question in the House was that the total revenue from wireless licences issued in respect of receiving apparatus connected with wireless exchanges (i.e., loud speakers and auxiliary gear) amounts to nearly £120,000 per year. Ten per cent. of this revenue is retained by the Post Office.

**Free Aerials for All**

ALARMED at the damage done to the tiles of council houses through careless fitting of aerials, the Kirkcaldy town council is considering a proposal to erect a wireless aerial in the case of each new house built. This proposal is viewed with considerable favour by local wireless traders, who consider that the existence of an aerial already erected will encourage more people to purchase sets.

**Have You Heard It ?**

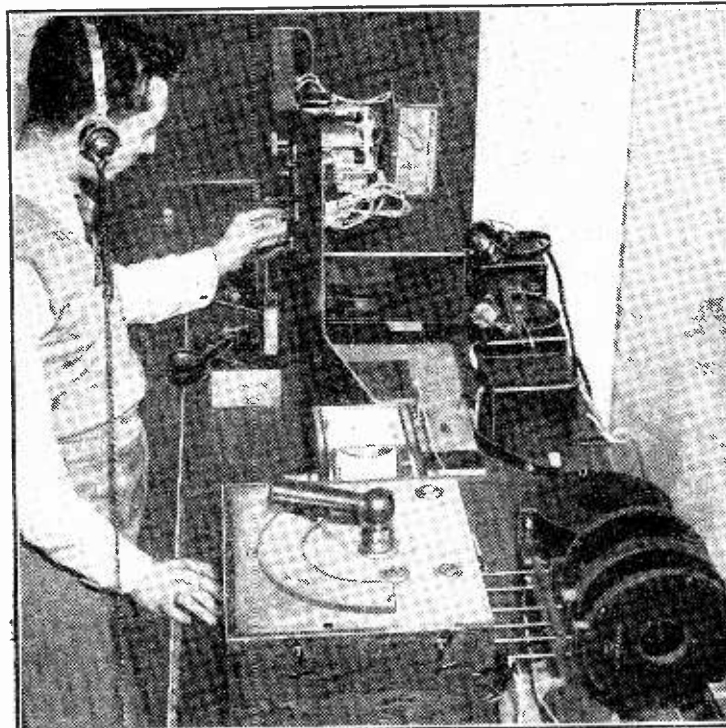
HAVANA COCD is now broadcasting programmes in English, German, French and Spanish between 10 and 11 p.m. (G.M.T.). The wavelength used is 48.92 metres (6,130 kc/s), and the power is 250 watts. In spite of the low power this station is said to be coming in at considerable strength in this part of the world, and it will be interesting to know how many of our readers have picked it up.

**Wireless-equipped Rocket**

IT is reported from Germany that a giant stratosphere rocket is being constructed to rise to a height of ten miles or so. It is to be fitted with an automatic transmitter designed to signal to receiving stations below what height it actually reaches. Special apparatus is also to be installed so that on its descent it can be guided by wireless to a suitable landing place where it will do no harm.

**Airman Praises DF**

A REMARKABLE tribute to the efficacy of wireless direction-finding has been made by M. André Japy, the hero of the recent Paris-Tokio flight. He stated that had it not been for DF he would never have been able to reach Hanoi. Meteorological conditions were so bad that ordinary navigational methods were virtually impossible, and he was compelled to rely solely on DF.



THE G.P.O.'S OFFICIAL WAVEMETER. A constant watch has to be maintained by the G.P.O. Engineering Dept. for frequency drift on the part of its wireless transmitters. The multi-vibrator wavemeter shown here undergoing tests at the Dollis Hill Laboratory is shortly to be installed in the Post Office central receiving station at Baldock for checking purposes.

# BROADCAST NEWS FROM PORTLAND PLACE BREVITIES

## More, and Yet More

IN an almost constant stream of talk and music, the B.B.C. has agitated the ether this year—from January 1st to November 30th—for 71,608 transmission hours. This beats the record of 1935 over the corresponding period by 2,813 hours.

The increase is due partly to increased loquacity and partly to the opening of North Scottish in October last.

## Bigger Breakdown Percentage

ARE the regional stations beginning to show the first signs of deterioration? A hint of this is contained in the transmission logs for 1936, which reveal a breakdown percentage of 0.031, as compared with 0.026 in the previous year.

Weather conditions, of course, play their part in mishaps due to aerial failure, and in justice to the B.B.C. it should be remembered that 1936 weather has been decidedly worse than that of 1935.

## A Seventeen-hour Day

The above figures do not take Empire broadcasting into account. During 1936 the Daventry transmitters were working at high pressure for an average of seventeen hours a day, the total transmission time to November 30 being 12,608 hours.

## Wireless in Rural Schools

JOHN BULL'S children are becoming a generation of pupils nurtured on the broadcast lesson. Figures which have recently been compiled at Broadcasting House show that some 1,300 rural schools are now upon the listening register, the children thus having the benefit of equal facilities with the pupils of schools in the big towns for education by wireless.

## Damp Squib

IS correspondence a useful guide for the programme compilers as to listeners' likes and dislikes? It is very much to be doubted, in view of recent experience at Broadcasting House. Here is a case in point. It was wrongly reported in a section of the Press that the B.B.C. was proposing to broadcast a macabre programme, and immediately a petition of protest, bearing fifty-nine signatures, was

received from a town in the Home Counties. In addition, individual letters of protest came to hand, but it was found on examination that several of them were in identical handwriting, although they bore different addresses and different signatures. It was also found that the same signatures were contained in the petition.

## Faking Correspondence

Which reminds us of a dodge practised freely in the early days of broadcasting, when some artists new to the air used to spend quite a large sum out of their fees in preparing postcards containing appreciative comments. The cards were distributed among their friends for posting back to the B.B.C. The programme correspondence section at Broadcasting House is fully alive nowadays to the need for paying attention to the opinions of bona fide correspondents only.

## Prize Fight Commentaries

THERE may be an opportunity for a new type of prize-fight commentator before the next big match is "staged"



TWO NEW GOVERNORS have been appointed to the Board of the B.B.C. They are Sir Ian Fraser, M.P., the blind Chairman of St. Dunstan's, well known to *Wireless World* readers and—

for listeners. Complaints have been received from many quarters, even as far afield as Bermuda, that as the enthusiasm of the vast crowds present at these events waxes, the interest of listeners tends to wane, for the reason that the voice of the commentator, usually cultured and smooth, cannot be heard above the frenzied din of the on-lookers.

## Wanted: A Voice of Thunder

What is wanted is, it is felt, a commentator of the calibre of a Lionel Seccombe with the stentorian roaring qualities of a circus showman. It has even been suggested that the B.B.C. has within its own walls a man who could "fill the bill" satisfactorily. He is known to his colleagues as "Sergeant," because he held that rank in the War. In his spare time he acts as M.C. at a boxing establishment. He knows the game from A to Z and has a voice like the bull of Bashan. But perhaps the simplest solution is the arrangement described on p. 549 of *The Wireless World* of June 5th, 1936. Whether technical obstacles can be overcome so as to render even a voice of thunder audible above the clamour of the masses is a matter for investigation.

## Softening the Blow

LISTENERS stand to gain, indirectly, by a benevolent gesture which the B.B.C. has just made towards its staff. The Corporation's aim is to ward off anxiety, in the belief that freedom from unnecessary apprehension will increase the efficiency of the staff and result in a better broadcasting service.

In essence it has been decided that members of the staff shall have the right to generous treatment if the Corporation terminates their service. In addition to the notice legally due, people given "the key of the street" will hereafter be entitled to a month's salary in respect of each year's service (after the first year) with the B.B.C.

Of course, even the B.B.C. must draw the line somewhere. This generous treatment does not apply in cases of resignation.

## Television Nightmare Ended

THERE was excitement in the Baird camp at Alexandra Palace last week, when a new type of spool arrived for the intermediate film apparatus. This is double the size of the spools hitherto used, and enables continuous working for forty minutes.

In the past it has not been possible to televise with this system for more than seventeen or eighteen minutes at a time, con-



—DR. J. J. MALLON, who is Warden of Toynbee Hall, the educational institution of the East End of London

sequently awkward cuts have had to be made in studio productions, notably plays, with interludes in the spotlight studio, while the "I.F." was being prepared for the next run.

Few sights are more agonising than the look on the face of producers as the seventeen-minute safety mark is passed, and, with the actors still merrily doing their stuff, the film threatens to run out. Such nightmares are now things of the past.

## Electron Camera Taking Over

Ironically enough, despite this improvement, the intermediate film gear seems to be yielding place to the electron camera, two specimens of which are now in more or less constant use in the Baird studio.

## Television: Spring Plans

TELEVISION talks, with illustrations and demonstrations, really come into their own during the next three months. Cecil Lewis, who has already made a name for himself in television as organiser of "O.B.'s," is responsible for a spring schedule which includes first-aid displays by the St. John Ambulance Brigade; cookery demonstrations by the famous chef, M. Boulestin; a feminine feature, "The World of Women," in which many distinguished women will take part; and "The Instruments of the Orchestra," a series by Philip Thornton, in which viewers will see and hear the component parts of a modern orchestra and the ancient instruments from which they originally sprang.

Other promising items in television are interviews between film stars and their directors—with excerpts from their current productions—gardening demonstrations by C. H. Middleton, and fortnightly appearance of "Friends from the Zoo," under the tutelage of David Seth-Smith.

# New Apparatus Reviewed

## RIDCO RANGER SW CONVERTER

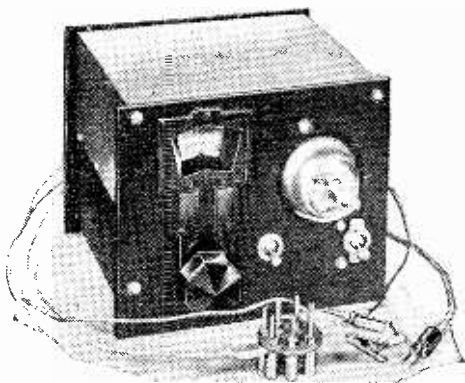
THIS converter is made by Radio Industries Development Co., Birch Street, Hanley, Staffs, for use with any AC mains broadcast set for the reception of the short waves. It has one multiple valve, a Tungram TX4, which is a triode-hexode frequency changer. There is a tuned circuit in the oscillator section, but the signal circuit is aperiodic.

HT and LT for the converter are taken from the broadcast set by means of a valve adaptor. The HT can be taken either from the auxiliary grid of an output pentode or from the screen-grid supply of an RF or IF stage in sets having triode output valves. For our tests the HT was obtained from the RF stage, since the receiver used was a straight four-valve set.

The converter has two wave-ranges covering 15 to 35 and 33 to 85 metres respectively, these wavebands being selected by a switch.

Good signals were obtained from most of the medium- and high-power short-wave stations on the Continent in daylight, while during the evening American short-wave broadcast was received at good strength when conditions were favourable.

On several occasions W2XAD on 19.57 metres and W3XAL on 16.87 metres were heard in the late afternoon.



Ranger model short-wave converter for use with AC sets.

The absence of a tuned signal circuit was responsible for some interference, but often this could be ameliorated by tuning the broadcast set to a frequency higher or lower than that recommended, which is 150 Kc/s or 2,000 metres.

Considering the simplicity of the circuit employed the unit performed very well, and will undoubtedly meet the needs of those requiring an inexpensive converter for short-wave listening. It costs 37s. 6d. complete.

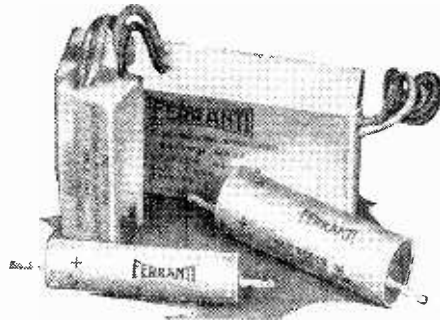
## FERRANTI DRY ELECTROLYTIC CONDENSERS

THE latest Ferranti dry electrolytic condensers are assembled in insulated cases, some taking the form of rectangular waxed cartons, while others are enclosed in tubes of bakelised material. Condensers of from one to 32 mfd. are available, the peak potentials covered by the series ranging from 6 to 500 volts.

The new series thus caters for practically

## RECENT PRODUCTS OF THE MANUFACTURERS

all requirements, be it HT smoothing or anode and grid circuit decoupling. There are some multiple types which are made in 8 + 8 and 16 + 8 mfd., and with either the negative or the positive common to both



Selection of new Ferranti dry electrolytic condensers, comprising 8+8 mfd. 500 volts, 4 mfd. 350 volts, 50 mfd. 25 volts, and 1 mfd. 500 volts types.

condensers, and they are intended for use in circuits up to 500 volts peak or 450 volts working potential. Like all electrolytics these condensers can only be used in DC circuits.

The tubular models are mostly for low voltage circuits, the majority being rated for from 6 to 50 volts peak working. Two are, however, of the high-voltage type, their capacities being 1 and 2 mfd. respectively, and the former is a 500-volt type, while the latter is rated at 350 volts.

Several samples of these new condensers have been tested and in every case the leakage current was well within the figure given by the makers. It varied from about 0.2 to 0.5 mA, according to the type and capacity. All the models tested showed their full rated capacity after polarising and every condenser functioned correctly and without fluctuation in the leakage current when subjected to the maximum peak DC potential for which it is designed.

One of the dual condensers, the CE 100A of 8 + 8 mfd. was tested for destruction, that is to say, the voltage was slowly increased until the internal insulation punctured. This model successfully withstood a voltage of 540 DC, but began to spark internally on exceeding 550 volts and eventually broke down entirely at just below 600 volts. Both condensers in the carton behaved in the same manner.

At no period of the tests on any of the condensers were signs of failure experienced with potentials up to the maximum for the type, and only when the limiting voltage was exceeded by an appreciable amount did failure occur. A satisfactory margin of safety is therefore allowed in these new Ferranti condensers.

Prices are very reasonable; a 4-mfd. 350-volt model costs 2s., one of 8 mfd. for 500 volts 3s. 6d., and an 8+8 mfd., also for 500 volts, 5s. 6d.

With but one exception, the tubular electrolytics cost 1s. 9d. each, the exception being the 50 mfd.-50 volt model, the price of which is 3s. 6d.

## OMNISECTION VALVE TESTER

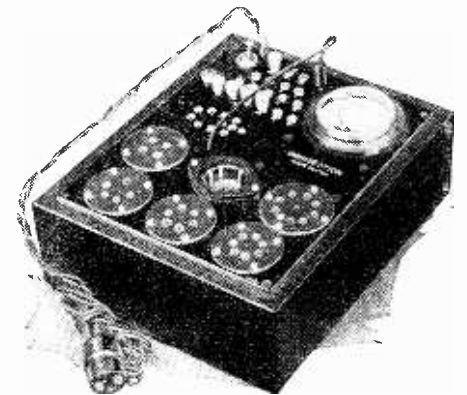
THIS valve-testing unit has been evolved for the purpose of checking the emission of any valve, but it is not solely an emission tester. Actually it achieves more than this, as it also enables an internal disconnection of any electrode to be located in a simple manner.

It does not enable quantitative measurements to be made, but the circuit is so arranged that if the valve is in good order it shows a certain reading on the meter, and all valves give approximately this same reading if sound.

On the meter scale is a small red mark, and if the pointer shows a current value less than this the valve is in most cases below standard in its performance. Provision is also made for testing the electrodes individually, a simple plug and socket arrangement serving to make the necessary changes from a "lumped" emission test to selective tests.

The tester is simple to operate, and the only adjustment necessary is that of filament voltage. A series of sockets and a wander plug enable the correct voltages to be selected for almost every type of valve in general use. Six valve-holders are fitted as well as a series of sockets on the panel; the former are for American and British nine-pin and side-contact valves, while the sockets are for standard 4-5- or 7-pin valves.

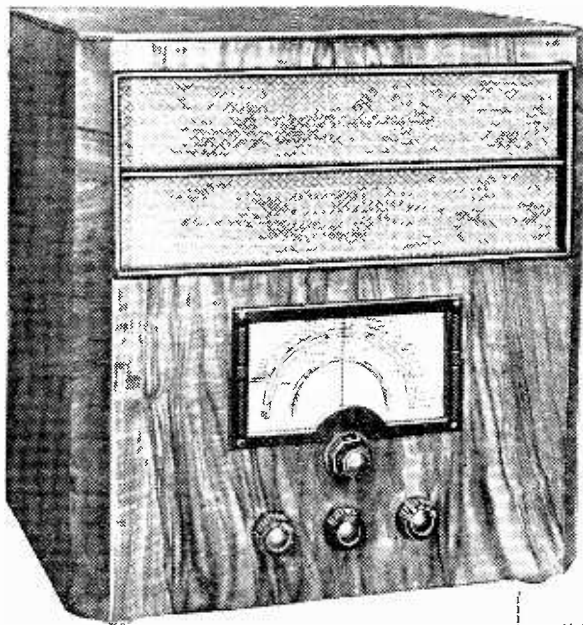
Tests made on the unit show that it does all that the makers claim and gives a reliable indication of satisfactory emission, and also enables individual electrodes to be checked for continuity with their respective pins. The indication afforded when tests were made to anode electrodes only of RF tetrodes and pentodes was inadequate.



Omnisection valve tester, a unit that not only checks the emission of any valve but also enables tests to be made on individual electrodes.

since the very high AC resistance of the anode-cathode path precludes a useful reading being obtained. With triodes, output pentodes, diodes and rectifiers the instrument functions in a perfectly satisfactory manner.

The Omnisection valve tester, which is entirely AC-mains operated, is obtainable from Norman Rose (Electrical), Ltd., 94, Tottenham Court Road, London, W.1, and the price is £4 10s.



# Hyvoltstar

## "Battery-Mains Receiver"

### An AC/DC Superheterodyne with Auxiliary Battery Supply

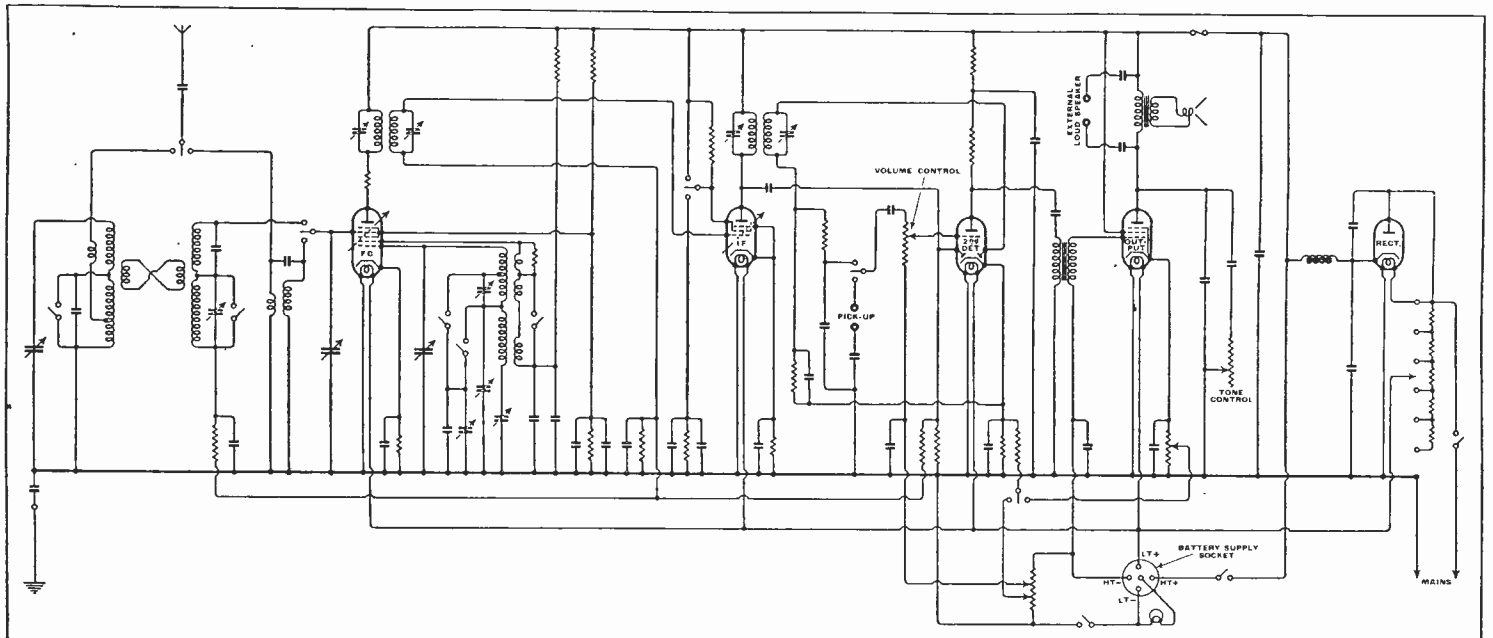
**FEATURES. Type.**—Transportable superheterodyne for operation from AC mains, DC mains or batteries. **Wave-ranges.**—(1) 16.6 to 53 metres. (2) 195 to 570 metres. (3) 900 to 2,000 metres. **Circuit.**—Heptode frequency-changer—var-mu pentode IF amplifier—double-diode-triode second detector—pentode output valve. **Half-wave valve rectifier (for mains operation).** **Controls.**—(1) Tuning. (2) Volume and on-off switch. (3) Tone. (4) Waverange. (5) Battery-mains change-over switch. **Price.**—21 guineas (including batteries). **Carrying case** 2 guineas extra. **Makers.**—Universal High Voltage Radio Ltd., 28/29, Southampton Street, Strand, London, W.C.2.

changer preceded by band-pass tuning on medium and long waves and followed by a single stage of IF amplification, a double-diode-triode providing AVC and an output pentode valve. The valves used for mains operation are taken from the Ostar-Ganz range, in which the filament heaters are of the high voltage type, and the battery valves are of Tungsum manufacture. Both sets of valves are provided with bases of the multiple side contact type, and all the subsidiary changes of circuit conditions required when changing over from mains to battery valves are made by a change-over switch at the back of the chassis. The filament and cathode connections are, of course, automatically changed when the valves are replaced, and all that the change-over switch is required to do is to substitute a direct connection for the potentiometer feed to the screen of the IF amplifier and to change over from cathode biasing arrangements to a pre-set biased potentiometer connected between -HT and -LT. The battery cable is connected to a five-pin valve socket, the centre contact of which ensures that the battery dial lamp shall not be accidentally burnt out when returning to mains operation. A half-wave rectifier valve supplies the HT current under mains operating conditions and an independent smoothing choke is provided, since the moving-coil loud speaker must of necessity be of the permanent-magnet type.

WHEN the set manufacturers or their publicity agents first applied the term "universal" to receivers which could be operated from either DC or AC mains they no doubt regarded the possibility of the development of sets with an even greater versatility in the matter of power supply as remote. In the first place, the technical difficulties of reconciling the special demands of mains and battery operation are formidable, and, secondly, the demand for a truly universal receiver of this type was no doubt regarded as limited. It would seem, however, that there is a much wider market than was at first thought, and this has encouraged Universal High Voltage Radio Ltd. to

tackle the problem of design in earnest. The set they have produced should prove invaluable to people whose business takes them into unexpected places and who cannot foretell the nature of the mains supply, if any, which may be available in their next port of call. Not the least attractive feature of this set is that they will not be deprived of wireless reception while travelling, and even for stay-at-home folk the receiver should commend itself if only for the fact that there is always a stand-by in the case of failure of mains or mains valves when a transmission of national importance is imminent. The basic circuit for both mains and battery operation is a four-valve superheterodyne consisting of a frequency-

The performance as far as range and selectivity is concerned shows no change



COMPLETE CIRCUIT DIAGRAM.—The various switches employed in changing the circuit from mains to battery operation are controlled from a single knob at the back of the chassis.

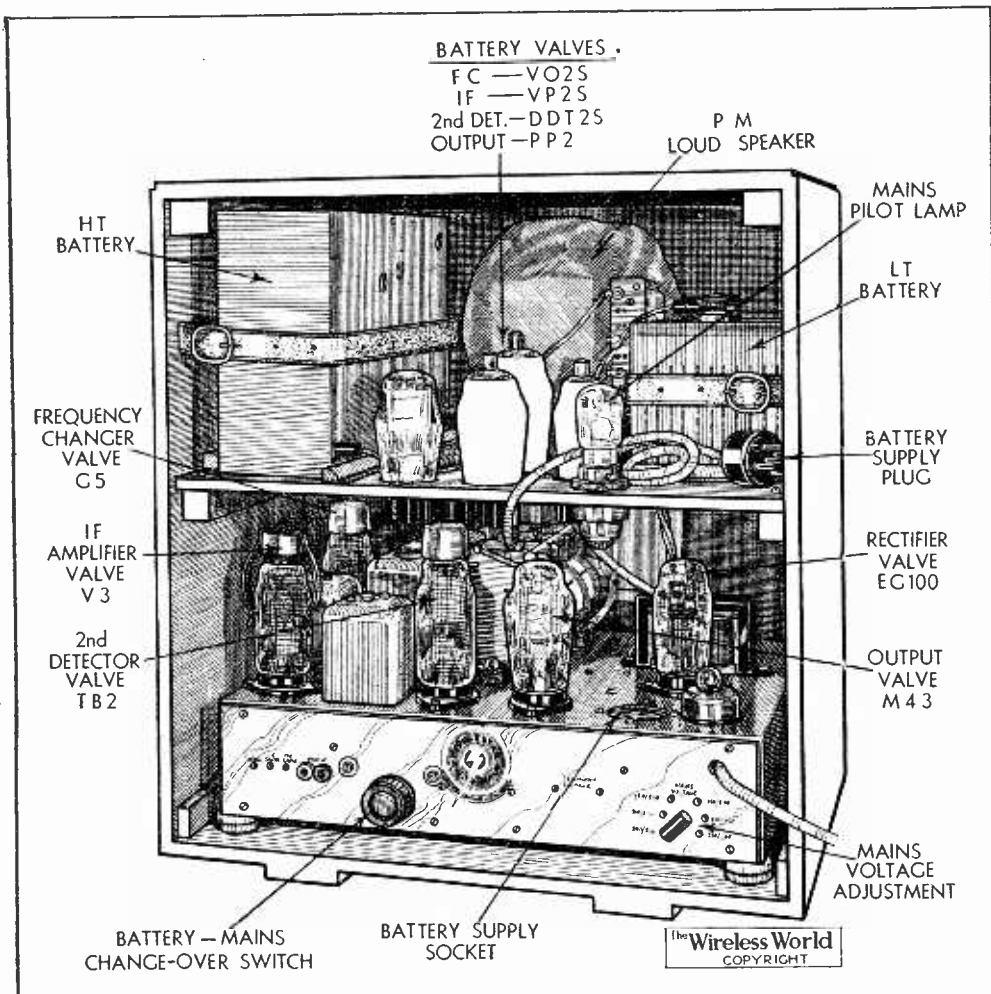
**Hylvoltstar "Battery-Mains Receiver"—**

when the receiver is switched over from mains to battery operation. There is a really sparkling performance on the medium wave-band and at least fifteen foreign stations are receivable in Central London at good programme strength

The quality of reproduction is admirably suited to the all-round usefulness of this receiver, and the loud speaker deals equally smoothly with gramophone records and all the various degrees of quality which are encountered in a long-range receiver of this type. Although the cabinet

valves near the front panel. Although the cabinet is, perhaps, in the transportable rather than portable class, its proportions are compact, and the leading dimensions are 18in. high x 16½in. wide x 12in. deep. The design is along conventional table-model lines, but a special reinforced canvas carrying case is available for its protection in transit.

The set gives an excellent account of itself on a self-contained directional aerial or a short flexible indoor aerial, either of which may be supplied with the receiver.



The receiver arranged for mains operation with the alternative valves plugged into dummy sockets on the battery shelf.

during the hours of daylight. The selectivity is good and the spread of the local stations does not amount to more than 1½ channels on either side of the normal setting. On long waves, while the sensitivity is in every way comparable with that of the medium-wave band, the selectivity is only sufficient to provide comfortable separation between Droitwich and Radio-Paris. There was also a tendency for the oscillator to cease to function at the bottom end of the long-wave scale, but this may have been a property of the particular receiver tested.

The short-wave range exhibits all the liveliness of the medium-wave band and has a remarkably quiet background between stations—almost as though QAVC had been deliberately introduced. In the absence of a preselection HF stage there are, of course, double tuning points for each station, but these are so close together that there can be no possible excuse for confusion as to the identity of a station. American broadcasting came in with ample reserve of power, and W2XAD provided a thoroughly reliable programme throughout the full period of our tests.

is deep from back to front it is well filled with components, batteries, spare valves, etc. This no doubt accounts for the complete absence of unnatural resonance in the bass. The upper middle register is also unusually clean, and the brilliant passages of music are reproduced without the slightest trace of harshness. The tone control is uniformly distributed throughout the range of the resistance, and it was found that, due to the small amount of background noise on short waves, practically the full high-frequency response of the loud speaker could be usefully employed under all conditions.

It is important in a receiver of this type that one should always be able to rely on the battery side of the circuit, and for this reason it is gratifying to find that the LT accumulator has a capacity of 24 amp. hours, which is more than adequate for the small total filament consumption of 0.4 amp. The 141-volt HT battery is also of large capacity, and the measured total current drawn from it is 15 mA.

The batteries and spare valves are mounted on a quickly removable shelf which gives access to the pilot lamps and

**Television Programmes**

The principal items only of each day's programmes are given. The system to be used each day is given below the date. Transmission times are from 3-4 and 9-10 daily.

|                    |                      |
|--------------------|----------------------|
| Vision             | Sound                |
| 6.67 m. (45 Mc/s). | 7.23 m. (41.5 Mc/s). |

FRIDAY, DECEMBER 25th.  
(Marconi-E.M.I.)

3, Demonstration of Carving a Turkey. 3.15, News Reel. 3.25, "A Lonely Christmas in the Arctic"—Edward Shackleton. 3.30, Fourteenth Picture Page.

9, The Singing Boys from St. Mary-of-the-Angels Song School. 9.10, Film: A Seasonal Tour Through the Empire. 9.22, Some Unusual Christmases—Commander A. B. Campbell. 9.27, News Reel. 9.35, Television Party—Distinguished artistes from stage and screen will be guests of the B.B.C. with Cecil Lewis as host.

SATURDAY, DECEMBER 26th.  
(Marconi-E.M.I.)

3, Bruce McLeod—Punch and Judy, and Sutherland Felce, conjurer. 3.15, News Reel. 3.25, Variety.

9, Bruce McLeod—Punch and Judy, and Russell Swan, conjurer. 9.15, News Reel. 9.25, Cabaret.

MONDAY, DECEMBER 28th.  
(Baird.)

3, The Irish Players in "The Workhouse Ward." 3.25, British Movietonews. 3.35, Variety.

9, Repetition of 3 programme. 9.25, Gaumont-British News. 9.35, Variety.

TUESDAY, DECEMBER 29th.  
(Baird.)

3, The Art of Home Washing—Mrs. Daisy Pain. 3.20, Cartoons—Bert Thomas. 3.35, Gaumont-British News. 3.45, Television Orchestra.

9, Repetition of 3 and 3.20 programmes. 9.35, British Movietonews. 9.45, Starlight—Ambrose and Evelyn Dall, with the Television Orchestra.

WEDNESDAY, DECEMBER 30th.  
(Baird.)

3, Discussion between John Hilton and Cecil Lewis—"The Pattern of 1936"—a review of trade and unemployment, etc. 3.25, British Movietonews. 3.35, Fifteenth Picture Page.

9, Joan Luxton's Children's Theatre Company. 9.30, Gaumont-British News. 9.40, Sixteenth Picture Page.

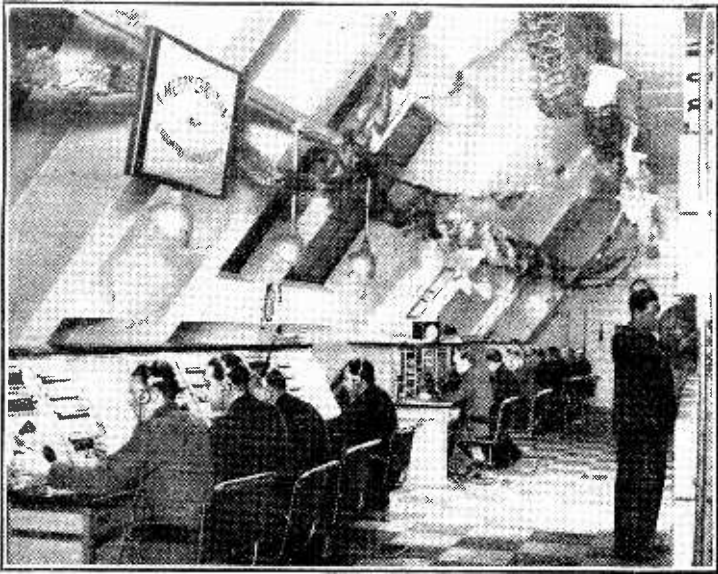
THURSDAY, DECEMBER 31st.  
(Baird.)

3, Conjurer. 3.20, Gaumont-British News, 3.30, London Characters. 3.40, Cabaret.

9, Conjurer. 9.20, British Movietonews. 9.30, London Characters. 9.40, Cabaret. 9.50, "Diary for 1936," introduced by Leslie Mitchell.

# Listeners' Gui

## Outstanding B



there. Larry Adler, who rushed over to Hollywood to appear in "The Big Broadcast of 1936," is now back in the variety theatres, and will broadcast for the first time since his return. Norman

**"THEY ALSO SERVE . . ."**  
The control room at Broadcasting House suitably decorated for those whose duties keep them at the helm of broadcasting during the holidays.

bringing these into the light of day by arranging a series of programmes introducing them. The first of these will be broadcast at 8.15 (Reg.) on Tuesday, when listeners will be asked to vote for their popularity. All the songs have been selected by a committee which include such diversity of tastes as those of a shopgirl, a postman, a policeman, a nurse and a pageboy.

Many well-known broadcasters are booked for this programme, including Elsie Carlisle, Morgan Davies, Esther Coleman and Robert Ashley.

### FROM THEATRES

DURING this week two outstanding broadcasts take place from London theatres. The first is on Boxing Day at 8.30, when Regional listeners will be taken over to the Gaiety Theatre to hear an excerpt from Leslie Henson's "Swing Along." The second is on Thursday at 8.15 (Reg.) when listeners will hear the pantomime "Cinderella" from the Coliseum. The first part will be a recorded programme showing how Cinderella was written, cast, produced and rehearsed, and then part of the actual performance will be relayed. This programme is being produced by Laurance Gilliam and John Watt.

Details of the week's Television programmes will be found on p. 675.

**H**AVING already seen so much in print relating to Christmas Day broadcasts, listeners must be wondering what exactly will be "on the air." There has, however, been little change in the arrangements since the publication of the article "Christmas Wireless Fare" in our issue of December 11th.

Only one news summary will be broadcast, and that will be at 9 on both National and Regional wavelengths.

One outstanding item which was not mentioned in our Christmas number, as arrangements were not then complete, is the concert of Christmas Music consisting of contributions from the various Regions, transmitted Nationally from 9 to 11.

It starts with the Midland Orchestra playing the first movement of Corelli's "A Christmas Concerto." Then at 9.40 the Nantyllyon Children's Choir and Welsh Orchestra will supply music of Wales. At 9.55 traditional carols of Cornwall and Dorset will be sung by local choirs followed by the choir of St. Mary Redcliffe Church, Bristol, singing a selection of carols of other countries. Music of Northern Ireland will be rendered by the Northern Ireland Orchestra at 10.10, and at 10.25 the Hallé Chorus and the Northern Orchestra will give a programme of Christmas choral music. Then on to Scotland where at 10.40 the Scottish Orchestra will play seasonable Scottish music and, as an epilogue at 10.55, the final movement of "A Christmas Concerto."

### RADIO PARTY

REFERENCE has already been made to the annual radio Christmas party which will be broadcast Nationally. No details are given except that it will include all the well-tryed and ever-popular games and amusements of the good old family party, and listeners are invited to tune in at any time between 7 and 9 and join in the fun.

### BROADCAST SERVICES

Two services are included on Christmas Day—from St. George's Chapel, Windsor, in the morning at 10.45 when the Very Rev. A. V. Baillie, Dean of Windsor, will give the Address, and in the evening at 6 from the Concert Hall, Broadcasting House, when the Rev. Leslie Weatherhead, of the City Temple, will give the sermon during the service, which will include carols.

On Sunday the B.B.C. singers, under the direction of Sir Walford Davies, will form the choir for the service from Lambeth Palace to be broadcast at 8 from both the National and Regional stations. The address will be given by His Grace the Archbishop of Canterbury.

### MUSIC HALL

BOXING DAY would not be complete without its regular Music Hall. Knowing this, the producer, John Sharman has been at great pains to rope in the best cast possible. This is a difficult day for radio Music Hall as so many of its shining lights are billed in the great variety theatres all over the country. Elsie and Doris Waters, however, will be

Long, with "a song, a smile and a piano," and Kenneth and George Western, the Two Cads, are also billed. So tune in at 9.20 (Nat.).

1936-1937

THE New Year's Eve programmes from the National transmitter include some interesting new features. At 11 we shall be given a survey of some of the old customs associated with the welcoming of the New Year and some of the ways in which people to-day will see the Old Year out and the New Year in. Following this, at 11.45, we shall be switched over to St. Michael's, Chester Square, for a short Watch-night Service conducted by the Rev. W. H. Elliott. Then at midnight listeners will hear Big Ben sound the death knell of 1936 and they will then be taken to the Chelsea Arts Ball where John Watt will describe, whilst meandering among the crowds, some of the scenes and the gaiety with which the revellers will be welcoming 1937, and then as a contrast we shall be taken to see how country folk are spending the first hours of the New Year.

To conclude, many parts of the British Isles will be visited whence New Year's greetings will be broadcast.

### "SONGS YOU MIGHT NEVER HAVE HEARD"

THERE must be on many a musician's shelves manuscripts of melodies and songs that have never reached the publisher and therefore would forever remain unknown to the public. Eric Maschwitz has hit upon the bright idea of





# e for the Week

## casts at Home and Abroad

### OPERA

CHRISTMAS DAY is rich in opera transmissions from abroad and commences with the 2 o'clock Budapest I interpretation of Humperdinck's "Hansel and Gretel"—an opera which, with its quiet charm, achieved immediate popularity and has always been regarded as the composer's masterpiece. The libretto was written by his sister and the work was intended for a children's Christmas celebration at his own fireside, but so popular has it grown that it is to be found in the permanent repertoire of every European and American Opera House. This fairy story will also be heard on Boxing Day as a studio production from Strasbourg at 8.30 and Acts 1 and 2 as a relay from Sadler's Wells by National listeners at 2.30.

On Christmas Day, also, Leipzig gives at 4 a performance of another fairy opera—Pfitzner's "Christelflein." The performance is a recorded one by the Hamburg Station Orchestra, Women's Choir and soloists, with the composer conducting. Königsberg also presents this opera at 7.30 on Sunday.

### OPERETTA

On Friday at 6.45 Vienna stages as a studio production

WINDSOR CASTLE, with St. George's Chapel right centre, seen from the Thames. This Royal Chapel will be the scene of the Christmas Morning service

Lehar's "Merry Widow" with Holzer conducting. This will be relayed by Strasbourg. Paris PTT at 8.30 on Sunday gives "Ciboulette" (Hahn)—an excellent example of the light frothy type of modern French operetta, produced in the studio. Hahn is chiefly noted for his composition of good songs, and it is this branch of his art which makes "Ciboulette," his one operetta, so very popular both in France, the country of his adoption, and abroad.

Monday brings French light opera at its best as the 9 o'clock Strasbourg programme. We are to hear Adam's "Nuremberg Doll" and Lecocq's "Le Myosotis" (in that order) as a studio production, with the station musical director, M. de Villers, conducting.

### NORWEGIAN CHRISTMAS

AN interesting cross-country series of O.B.s will be given over the Norwegian network on Christmas Day from 6.30 to 8.50 under the heading "Christmas In Norway." The microphone will wander from a lonely lighthouse far away in Northern Norway to a wedding in the south, visiting prominent people, peasant homes and many others, thus giving a collective sound impression of the Land of the Midnight Sun.

### THE MARNE

HAMBURG, with its 7.10 programme on Monday, will make an appeal to listeners with a knowledge of German, for a war play by Edgar Maass, entitled "The Tragedy of the Marne" is announced. This will be a dramatisation of actual events of September 8th and 9th, 1914, dealt with by the playwright as a critical point in German history.

### NEW YEAR'S EVE

THE most generally interesting programmes on Thursday are those celebrating the approach of the New Year and in most cases occupy the ether from about 7 carrying on into

### HIGHLIGHTS OF THE WEEK

FRIDAY, DECEMBER 25th.

Nat., 2.15, Coventry Hippodrome Orchestra 3.45, Hastings Municipal Orchestra. 7, Radio Christmas Party 9.20, Music for Christmas.

Reg., 3.15, B.B.C. Military Band and Men's Chorus, 8.30, "The Christmas Journey"—Masque of the Nativity. 9.20, Henry Hall's Christmas Tree.

Abroad.

Radio-Normandie, 6, Carillon Recital of Christmas Carols, relayed from Rouen Cathedral.

SATURDAY, DECEMBER 26th.

Nat., 2.30, "Hansel and Gretel" from Sadler's Wells 9.20 Music Hall.

Reg., 3.15, Harlequins v. Richmond. 4.5, Pantomime, "Sinbad the Sailor." 9.20, Discussion, "Is Fleet Street what it was?"

Abroad.

Deutschlandsender, 7, "Bright Lights and Dancing"—Gala programme.

SUNDAY, DECEMBER 27th.

Nat., 6.55, "The Shadow" (Hans Andersen), 7.30 Recital—Water Widdop

Reg., 7.30, Vitya Vronsky and Victor Babin—two pianofortes. 10, Melodies of Christendom—31.

Abroad.

Leipzig, 5.30, "Der Rosenkavalier."

MONDAY, DECEMBER 28th

Nat., 7.20, Entertainment Parade—Recital—Isolde Menges and Kathleen Long.

Reg., 6, Reginald King and his Orchestra. 8.20, "The Roosters." 9, "The Nailers"—a Black-Country play

Abroad.

Hamburg, 8, A Gala Concert of Franz Schubert's works.

TUESDAY, DECEMBER 29th.

Nat., 6.25, Pianoforte Recital—Irene Kohler. 8, "The Nailers." 9.35, B.B.C. Theatre Orchestra and Raymond Newell.

Reg., 8.15 "Songs You Might Never Have Heard." 9.30 Budapest University Chorus.

Abroad.

Hamburg, 7.10, Folk Songs and Dances of the Austrian Alps

WEDNESDAY, DECEMBER 30th.

Nat., 6.40, B.B.C. Military Band and Margaret Balfour. 10.15, "Only a Shop Girl"—Musical Burlesque.

Reg., 7.30, "The World Goes By." 8, "Light Fare"—Variety

Abroad.

Hamburg, 7.45, Concert of operetta excerpts and waltz songs.

THURSDAY, DECEMBER 31st.

Nat., 7.15, Van Phillips and his Two Orchestras. 11 "New Year's Eve."

Reg., 6, Medvedeff's Balalaika Orchestra. 8.15 "Cinderella."

Abroad.

Most Continental Stations are giving special New Year's Eve programmes from 7, onwards.



Cosso photo.

the small hours of 1937. The German stations commence with the 6 o'clock relay of Dr. Goebbels' New Year's address to the nation from Berlin. Many of them give a purely local programme, with dialect sketches and relays of folk music and general jubilation.

Perhaps the most notable of these commences at 7.10 from Leipzig where the district chosen is that round the Sudetic Alps. The Munich programme timed for 9 includes a relay of the fun in a skiing hut at Bayrischzell, in the Bavarian Alps.

Stuttgart, Frankfurt and Saarbrücken will provide a joint programme of entertainment from 7 p.m. until 1 a.m. entitled "We join hands at the happy end of the year."

"A year passes by in a thousand joyous notes" is the title of the 9-11 programme from Deutschlandsender, which is a musical retrospect of 1936. At 11, which is midnight in Germany, Intendant Goetz Otto Stoffregen, Germany's most popular station director, will address listeners after which, under the title "Hinein" (In we go), three light orchestras will provide entertainment until 2 a.m. on January 1st.

### AN ANCIENT ORGAN

THE famous historic organ of the ancient Danish Royal Castle, Frederiksborg, in North Sealand, will be heard at 5 o'clock on Christmas afternoon from Copenhagen-Kalundborg. Jens Laumann will play this organ, which is thought to be the oldest of its kind in North Europe.

THE AUDITOR.

# Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

## Hill and Dale

PERMIT me to correct your correspondent S. R. Eade, "Sound Recording" (December 4th, 1936), in regard to his statement referring to Edison phonographs. These instruments were marketed up to 1926, and in their improved form were known as the Edison Diamond Disc Reproducer, employing disc records, 10in. diameter, with screw reproducer traverse, and each record with a playing duration of from 3 to 5½ minutes. A 12in. record was also available, which had a playing duration of no fewer than 20 minutes. The records were built up with cement centres and coated with a hard celluloid finish, and were practically indestructible. The diaphragm in the reproducer was built up from a number of sheets of Japanese tissue paper, and was mounted on a cork ring. The horn in my own instrument was 6ft. in length, and was exponential in shape, giving remarkably good quality of reproduction. As a matter of fact, the first moving-coil loud speakers of those days were, in my opinion, greatly inferior to the Edison Diamond Disc phonograph.

G. McAULEY.

Belfast.

I WOULD like to correct a statement of Mr. S. R. Eade in his article on sound recording in *The Wireless World* of December 4th.

The paragraph I refer to concerns the Edison phonograph, and the statement that the hill-and-dale method was discarded for various reasons, due to the difficulty of building the mechanical apparatus with sufficient precision, is incorrect.

The Thomas Edison phonograph, which was popular in the early days of recording, was a finer example of precision engineering than any popular motor to-day.

To prove my point, the machine in mind had two tracking pitches, 100 to 200 per inch, and, as the record was replayed with the lead screw in mesh, precision was the main point in manufacture.

I fully appreciate one point, however. No phonograph manufactured in England reached the quality of performance available in the genuine Thomas Edison machine, which sold, incidentally, for £4 10s.

If any of your readers care to play Edison records of thirty years ago, using a suitable pick-up and amplifier, I think they will be agreeably surprised at the quality possible with this type of record.

London, N.8. C. D. PICKERSGILL.

I HAVE been very interested to read the remarks of your two correspondents, Mr. Pickersgill and Mr. McAuley, concerning the Edison Phonograph. I must admit that I was not aware that a "hill and dale" type reproducer of this make had been marketed as late as 1926.

In the statement to which these two gentlemen take exception I was not intending to criticise the mechanics of the cylinder or disc drive. I pointed out that, in my opinion, the difficulty of building the "pick up" or "sound box" portion of the

mechanism to work by mechanico-acoustical means did not allow full use to be made of the inherent advantages of the "hill and dale" system. The electrical reproducer (usually of moving-coil form) alone made this possible.

If your correspondents can suggest any other reason for the universal adoption of the transverse track on gramophone records I will be very interested to read their comments.

S. R. EADE.

Rugby.

## Rejecting Whistles

MR. P. K. TURNER'S position in attempting to saddle me with responsibility for his inability to understand my heterodyne filter is logically untenable, and therefore I decline to bear even a part of the responsibility as he suggests.

The crucial point is that he claims to have put the system into operation and to have made it work. The exact nature of the claim is not clear, but there seem to be three possibilities: Either he set up (a) the system described in his article, (b) the system described in my article, or (c) some other system altogether. Let us take these possibilities in reverse order.

(c) Would in no way be connected with the matter, and we can dismiss it at once. If the claim is (b), it carries with it the admission that my article is sufficiently clear to allow of constructing and operating the system successfully, so that it cannot be too bad; it is certainly not my fault if Mr. Turner uses my circuit in his experiments and another one in his description of them. In case of (a) it is obvious from the reasoning in my last letter that the system described by Mr. Turner under the title of "Baggally's Retroactive Filter" cannot possibly work, so that if it were true that he claims to have made it work it would also be true that his results were so wildly in error as to cast the gravest possible doubts on his powers of observation in general. Under those circumstances it would not be surprising, and I should not be to blame, if he failed to observe and understand the points of my article.

Brighton.

W. BAGGALLY.

## Wavelength Allocation

YOUR timely leading article on wavelength allocation will give all serious students of broadcasting ample food for thought.

The time has come when the World's Broadcasting Authorities must face the obvious problem—is high-quality transmission worth while without radical alteration in wavelength allocation?

So far as I am aware, no receiver to-day can do full justice to the best of modern transmission, except under exceptionally favourable conditions.

We must either sacrifice the higher frequencies or endure sideband splash.

Undoubtedly, the best compromise at the present is the Monodial variable selectivity superheterodyne, for which we have to thank the pioneering work of the *Wireless World*.

Attention has been called to an old method of avoiding interference, viz., the frame aerial, by "Cathode Ray" and others, the great drawbacks being inefficiency and local disturbances.

Both of these could, I believe, be overcome by a large frame, for which ample room exists in the lofts of most dwelling-houses. This would have to be set and tuned once and for all for the broadcasting station which gives at the receiver the greatest entertainment value. Other stations would be received on a separate aerial.

Screening by earthed, fine-meshed wire netting might be necessary to prevent pick-up from stations approximately to 180 deg. from the wanted transmission.

Connection between such a frame and the receiver does present serious problems.

In these days of coaxial feeders and matching transformers, however, the problems should not be insoluble.

Many readers would, no doubt, be very grateful for suggestions of practicable methods of carrying out this suggestion.

J. KING.

Sutton, Surrey.

## The Hartley Turner "Duode"

WHILE we much appreciate the kindly reference to our "Duode" loud speaker in your issue of December 4th, we should like to supplement your description of the voice-coil.

You state that "the speech coil is wound on a light aluminium former . . ." etc.

Actually, the speech coil is wound on a bakelite former, and the centring washer is also attached to this former. The cone is attached to the aluminium tube, a thin tube of synthetic rubber fitted over the aluminium tube, and then the whole inserted into the speech coil former.

Thus the force on the cone is derived in part from currents induced into the aluminium tube as you describe, and in part from the currents in the speech coil; the latter force acts through the compliance of the rubber tube.

It is the balance between these two forces as frequency varies that gives the improved response.

We might also mention that improvements in manufacture since your sample was supplied have much decreased the tendency towards "belling," or "noding" as we call it, at certain low frequencies.

In justice to others, we should also like to make it clear that we make this voice-coil under licence from Messrs. Benjamin Electric, Ltd., who first introduced the principle.

HARTLEY TURNER RADIO, Ltd.  
Isleworth.

## Television Programmes

I CANNOT agree with your view that it is any business of the B.B.C. to popularise television. As a result of such popularising, the B.B.C. would hardly be expected to gain sufficient in licence fees to pay the extra expenses, and the real beneficiaries would be the television promoters and set builders and retailers. Ergo, if the B.B.C. provides the means of demonstration, surely the onus to provide the "matter" should be on those interested, and no blame can be thrown on the B.B.C., which should not act as an advertising medium.

Broadstone. G. F. FLEMMICH.

# The Pentode Tone Corrector

THERE was one thing left over from my last article ("Pentodes and Loud Speakers") that seemed to call for special attention. It is the resistance and capacity generally connected across any loud speaker driven by a pentode. When I say loud speaker I include its transformer. A tone-correction circuit *could* be connected across the secondary of the transformer, and hence across the loud speaker speech coil itself; but that would necessitate an excessively large capacity.

Another reason for connecting across the primary is that it then also helps to correct the imperfection of the transformer.

The object in wanting a tone-correction circuit at all was explained in the previous article. Briefly, it is that a pentode works according to plan only when the load (loud speaker) which it drives is of constant impedance, and preferably a pure resistance. Any inductive admixture inevitably causes the impedance to vary with frequency, with undesirable effects on the quality of reproduction. In a good loud speaker and transformer the inductance is probably not very large, but even so is hardly negligible. Pentode tone in the raw is seldom mild; it is usually strident.

The obvious thing to do to soften it down a bit is to shunt a condenser across it. Now everybody (here) knows that an inductance and a capacity together form a tuned circuit, which responds most strongly to a particular frequency. At least, that is so if the resistance in the circuit is not altogether excessive. The result is painfully marked when a high-inductance speaker is "corrected" by a simple condenser, because the combination tunes to

## HOW TO ARRIVE AT THE CORRECT CHOICE OF COMPONENTS

beyond a certain point, a circuit fails to "tune." It does not seem to be very generally known that under certain conditions a circuit with inductance and resistance in one branch and capacity and resistance in the other is as a whole equivalent to a *resistance* which is *constant at all frequencies*. This is exactly what one wants for a pentode to work into, as by making this equivalent resistance equal to "optimum" the valve works under the best conditions all the time. The requirements for this desirable state of affairs are not very complicated. If R is the AC resistance of the speaker and L its inductance, the proper corrector circuit consists of a capacity numerically equal to  $\frac{L}{R^2}$  (the units being farads and henrys) in series with a resistance R. The whole behaves at all frequencies as a resistance R, which there-

By "CATHODE RAY"

power that reaches the speaker. Whether that matters or not depends on how strongly one wants to hear such frequencies, and how efficient the speaker is in reproducing them. If the loss begins to be noticeable only when the frequency is at the top of the desired audible range it is all to the good. Generally that means a moderate inductance.

Another thing, if the inductance is too high an excessive proportion of the watts delivered by the valve will be wasted in the condenser-resistance branch.

The extent of such loss can be judged by calculating the frequency at which the inductance of the speaker and the capacity of the corrector would resonate if the resistances did not intervene. That can be done by means of one of *The Wireless World* "Abacs," or the well-known formula

$$f = \frac{1}{2\pi\sqrt{LC}}$$

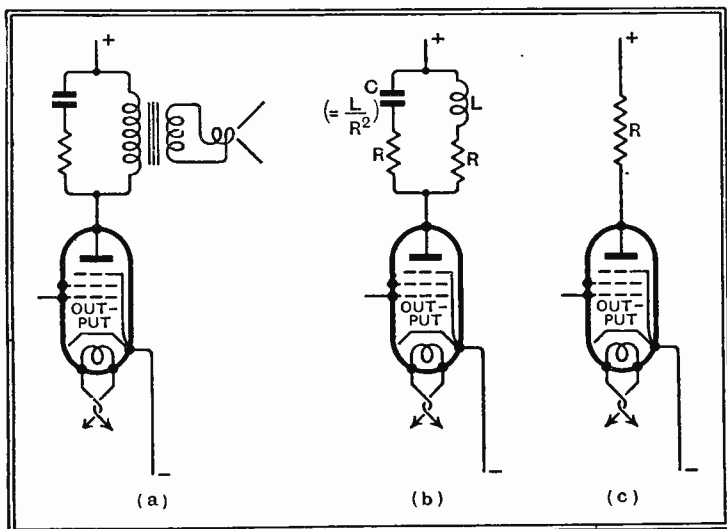
By the way, unless otherwise stated, in these formulæ L is always in *henrys* and C in *farads*. At the frequency thus calculated the loud speaker and the corrector divide the valve's output equally between them. At lower frequencies the speaker gets the bigger share; at higher frequencies the corrector absorbs more than the speaker. Obviously if the dividing line occurs low in the scale—say at a few hundred cycles per second—the proportion wasted is excessive and the efficiency is low.

### Practical Approximations

Up to the present we have been taking some things rather much for granted. In practice the resistance R of a speaker is not by any means absolutely fixed; nor, for the matter of that, is L, because certain effects, such as transformer capacity and shunt inductance, complicate the matter. But the general idea holds good, and the result of using a corrector is certainly much nearer the ideal than doing without it.

Another thing taken for granted is that R and L are known. Actually it is extremely unlikely that they are. Manufacturers give some idea of R, as a rule—they have to in order to enable the speaker to be matched to the valve—but are obviously not likely to emphasise L. And it is difficult to measure it without a laboratory bridge. In the accompanying table are given the results of some measurements I made on a few speakers that happened to be about the place. They were made at a frequency of 3,200 c/s.—high, because otherwise the error

The familiar tone corrector circuit (a) is equivalent electrically to (b), where L and R are the inductance and resistance of the loud speaker and its transformer. When C and R are correctly chosen, this in turn is equivalent to R, from the valve's standpoint, and the circuit can be represented by (c).



fore is the "optimum resistance."

While this system prevents the valve load from varying, however large the inductance may be, it is still desirable to keep it as small as

possible for several reasons. One is that although the circuit as a whole presents a constant impedance to the valve at all frequencies, that branch containing the loud speaker does not; and, if the inductive part of its impedance predominates at any frequency, there is a falling off in the

a note probably somewhere in the middle of the audible scale, and that note is emphasised above all the rest. "Fain would I change that note," as the song says, and as the listener is likely to think after a short while.

However, if the resistance is increased

**The Pentode Tone Corrector—**

due to the shunting effect of the transformer primary inductance would be large. Except for the last one (which would not be used with a pentode), and, of course, the two in parallel, the capacity is in each case not very far off 0.004 mfd.

Bearing in mind the very approximate nature of all calculations concerning loud speakers, this choice—or, at any rate, the nearest common value, 0.005 mfd.—seems likely to be about right in most cases. The correct resistance to connect in series with it is, of course, easily found, as it is the same as the “optimum load resistance,” and the same as the speaker ought to be.

To check results, the effect was tested of actually connecting a condenser of approximately 0.0041 mfd. in series with 9,900 ohms across the primary of the transformer under the conditions referred to in the third line of the table. The impedance of the whole arrangement was then found to be 9,600—a reasonably good approximation to 9,900—and was very nearly a pure resistance. If it were not for the corrector circuit the impedance at the same frequency would be 12,700 ohms, rising rapidly at higher frequencies. At 800 c/s, with corrector, the impedance was 8,800 ohms.

It often happens that an extension loud speaker is plugged in. This upsets the matching of valve to loud speaker in any case, unless there is some elaborate system for changing the transformer ratio. To keep the inductance balanced out it is necessary to increase the corrector capacity; and it is interesting to note that, although neither R nor L conforms to simple theory by falling to a half when there are two speech coils in parallel in the example given, yet the capacity is just about double, as it ought to be. If it is not thought worth while embodying arrangements for altering the transformer ratio when one or more extra speakers are in use, a scheme for increasing the capacity of the condenser is unlikely to be considered; but in such cases it is a good plan to make the capacity rather greater than would be needed for one speaker only. This is generally done; 0.01 mfd. is a usual value in manufactured sets. In any case a some-

what over-corrected system is usually favoured, more especially as there is a tendency for loud speaker effective resistance to rise with frequency.

Quite a common arrangement is a variable resistance instead of a fixed one, usually accompanied by an abnormally large capacity. This is dignified by the

name of variable tone control. It is true that with it one can vary the tone, to the extent of cutting down the “top” (and incidentally lowering the general volume at the same time); but it upsets a well-matched system and ideally it is better to have a fixed tone corrector and to do the variable tone controlling somewhere else.

# RANDOM RADIATIONS

By “DIALLIST”

## A Merry Christmas

A MERRY Christmas to you all, and may you have no wireless worries this week-end! I suppose that there's no season of the year when the wireless set is more used than Christmastide. Luckily, it's about the best time of the whole year for hearing foreign stations, since the field strength of distant transmitters is at its best and atmospherics are usually few and far between. Thousands of new sets will be put through their paces for the first time. Yet greater numbers of receivers that are old and tried friends will be used to explore Europe, or, maybe, the world in general. And I've no doubt that countless fathers will be told by their families that the job of the set at Christmas time is not to go flitting hither and thither, like a bee amidst the flowers, but to settle down to one station and provide something jolly in the way of entertainment. This is rather hard on poor father, particularly as he will have provided the set; but there it is. Queer noises from America or Australia won't be half as popular as the, to some ears, queerer noises of dance bands from stations nearer home.

## Christmas Listening

If you want cheery programmes from abroad at Christmas you're most likely to find them in the Teutonic and Scandinavian countries. They celebrate Christmas thoroughly, but the Latin countries reserve most of their energies for New Year's Eve. You'll be well advised, therefore, if the family isn't satisfied with the home programmes, to concentrate on Norway, Sweden, Germany, Denmark, and Holland in order to obtain programmes with the real Yuletide flavour. A look through the foreign programmes will show you that there's plenty of choice amongst the stations that you can count on receiving well. Carols, folk-music, orchestral concerts, Christmas

revels and operas are there for a twist of the tuning knob. And when the family is amusing itself in other ways, as no doubt it will, there'll be plenty of opportunities for letting the new or the old set show what it can do in the way of bringing in stations from here, there and everywhere.

## Radiophonographs

MY best thanks to two kind readers who have written to tell me the word used in the United States for what we call a radiogram. It appears that it is either “Combination Radio” or “Radiophonograph.” I'm rather surprised, I must say, that Americans, whose language is renowned for the brevity, crispness and neatness of its terms, can't do better than this. One possible reason is that hitherto the radiogram has not been very widely seen in the States; hence the need for a really good name for it may not have been felt. I hear that these instruments are now making big headway, largely because there is so much advertising “ballyhoo” in the broadcast programmes. Another interesting sign of the times is that many American sets are being provided with pick-up terminals this year, though previously these were seldom seen. Americans, in a word, are returning to the gramophone record and realising that electrical reproduction is the only way of bringing out all that is on a modern record.

## A Dream and Nothing More

A READER writes to ask me for a circuit diagram of the dream set whose make-up I outlined in these notes a while ago. He particularly wants details of the oscillator amplifier and so forth. I'm afraid I can't oblige, for the dream set must remain a dream, for the present, anyhow. To build it would need months of experimental work and cost goodness alone knows what. And no circuit diagram would be of very much value unless it were taken from a set that had been made up and found to work as it should. Nor is it at all certain that my dream set wouldn't be other people's nightmare! One of the peculiarities of dyed-in-the-wool radio enthusiasts is that they can never see or hear a set made by anyone else without at once beginning to devise methods of improving it. I recommend, therefore, that each and everyone in search of a diversion for spare moments should evolve in imagination his own ideal set. It may never assume concrete form—more than probably it won't—but that does not matter a bit. Castles are out of fashion nowadays, but there's a vast amount of pleasure to be derived from building wireless sets in the air.

## Shades of Marconi!

IT'S rather surprising to learn that in Italy there is virtually no interest at all in wireless construction as a hobby. Every-

| Type of Speaker.  | Type of Transformer.                                       | R in Ohms. | L in Henrys. | Calculated C in Microfarads. | Critical Frequency f in c/s. |
|---|--|------------|--------------|------------------------------|------------------------------|
| Commercial energised model. 8in. cone, lin. coil of 2½ ohms.  | Usual small commercial type. No DC in primary.             | 15,600     | 0.92         | 0.0038                       | 2,700                        |
| Ditto ... ..  | Ditto: 25 mA in primary                                    | 14,300     | 0.84         | 0.0041                       | 2,720                        |
| Commercial perm. mag. model. 7in. cone, lin. coil of 15 ohms. | Good-quality type (Ferranti ratio 25:1). No DC in primary. | 9,900      | 0.4          | 0.0041                       | 3,950                        |
| Ditto ... ..  | Ditto: 22 mA in primary                                    | 9,700      | 0.4          | 0.0043                       | 3,850                        |
| Ditto: two in parallel ...                                    | Ditto: no DC ... ..  | 5,800      | 0.31         | 0.0091                       | 3,150                        |
| Dual perm. mag. speakers for high quality.                    | Special dual type ...                                      | 2,200      | 0.046        | 0.0095                       | 7,600                        |

**Random Radiations—**

thing has been done by the authorities to encourage broadcasting on both the medium and the short waves, and few European countries are better served as regards either the stations themselves or the programmes that they transmit. Further, Italians, as a nation, are both mechanically and electrically minded; they are excellent engineers, and they have "electrified" their country rapidly and extensively. They were amongst the first to develop the transmission of power at high voltages over lengthy cable lines. And one *does* seem to have heard the name Marconi. These things being so, one would have thought that Italians, in the towns and cities anyhow, would have taken to wireless experimenting as ducks take to water. But it isn't so. A reader living for the time being in Italy tells me that obtaining any kind of component—even such a simple thing as a resistor—is a grim business. You try dealer after dealer without success, and, when you do discover one who is willing to order what you want (you won't find it in stock), you're lucky if you get it in less than a month.

**Some Service!**

AN American contemporary, *Radio News*, is engaged in investigating the shady side of radio service work in New York, and very shady some of it seems to be. A particularly straightforward five-valve set was first of all given a thorough test in the laboratory to ensure that every part, including valves, was in tip-top working order. Each component was then marked so that it could be identified. One of the speech-coil leads to the loud speaker was unsoldered at the output transformer end, the set was installed in a private flat, and service concerns (unaware, of course, with whom they were dealing) were summoned one after another to locate and rectify the fault. The first man who came spotted it at once, set matters right, and made a moderate charge. The lead was again unsoldered and No. 2 came to try his hand. He diagnosed a broken-down condenser, quoted 4 dollars (16s.) for the job, and was allowed to take the set away. It was returned three days later in working order, with the assurance that a condenser had been replaced. Examination showed that the original condensers and no others were still in the set. No. 3 took the set away and a report was telephoned to the effect that a coupling condenser had broken down and the output transformer burnt out. Cost of job, 28s. Again no renewals whatever were made.

**Curiouser and Curiouser**

On the fourth occasion the set was left with a service company, which reported a defective speech-coil. They charged 10s. and again put in no new part. Like the others they did nothing but resolder the lead that was adrift—except that they removed a brand new valve and inserted an old one in its place. The fifth concern took refuge once more in the broken-down condenser diagnosis, and gave an estimate of £1. As the set wasn't ready at the end of 9 days, it was taken away, and it was found that the service (!) people had never even undone the packing in which it was delivered.

Well, I think that our service work is a bit better than that. I've come across several cases of inefficiency, but never, so far, one of deliberate swindling by charging for the replacement of parts that were not replaced. The worst in our land of the service man who doesn't know his job is that

he may have a set that won't work returned quite unnecessarily to the makers, thus landing you into the costs of carriage both ways as well as those of the work. Service work in this country is improving notably, and much credit is due to the larger manufacturers, especially the E.M.I. Service, Ltd., for educating the dealer and making him look upon service in a proper business-like spirit.



**Service Insurance**

SOME time ago I suggested that it would pay retailers to work out service and maintenance schemes, whereby the purchaser of a set could put down a fixed sum of so much a week, a month or a quarter for regular inspection and complete maintenance of his apparatus, with full service and including every necessary renewal of parts and valves. A good many firms now have such arrangements, and I am glad to see that the movement is spreading. After all, it shouldn't be too difficult to work out a figure that is fair to the set owner and will pay the dealer, so long as the latter remembers that he is likely to be dealing with scores, and possibly hundreds, of people, and not just with one isolated case. The dealer must have been in business for a good few years now, and he should have a pretty shrewd idea of what the average set owner spends on repairs and renewals. With that as a working basis he can arrive at a figure that should be satisfactory to all concerned. If he does start an "insured maintenance" scheme on a sound footing, I'm sure he'll find it a paying business, for this kind of thing may well turn the casual customer into a permanent one.



**Aerials Again**

A LONDON reader raises an interesting and important point with regard to outdoor aerials. "Many of us," he writes, "who are sufficiently interested in wireless to read *The Wireless World*, are also interested in modern houses, decoration, furniture and gardening, and we will not have any of the present outdoor aerial systems at any price for what we consider good aesthetic reasons. To add a forest of poles and wires to a residential district is obviously anti-social and, in the long run, inimical to all radio interests."

**THE RADIO INDUSTRY**

NEW leaflets issued by Marconi-Ekco Instruments, Ltd., describe a Distortion Factor Meter for measuring total harmonic content and a Beat Frequency Oscillator covering the range 10-10,000 c/s.

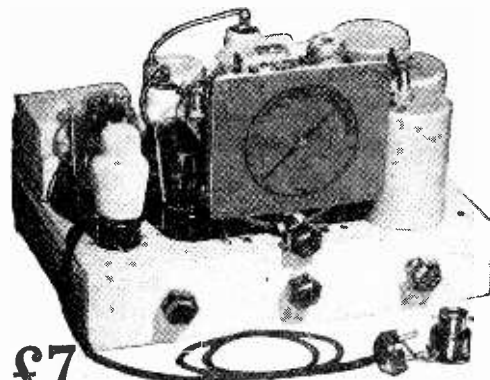
Many new productions are described in the latest edition of the Eddystone catalogue of short-wave components, issued by Stratton and Co., Ltd., Bromsgrove Street, Birmingham, 5. Prices of certain components have been reduced.

The G.E.C. has received an order from the Crown Agents for the Colonies for a radio relay equipment to be installed on the Gold Coast.

Change of address: Harries Thermionics, Ltd., to Britannia House, 233, Shaftesbury Avenue, London, W.C.2. Telephone: Temple Bar 8327.

A statement from the London office of the *Foire de Paris* (17, Tothill Street, S.W.1) lays emphasis on the international character of the Fair and the greater opportunities that it now offers to British manufacturers.

**MCCARTHY**  
*for the finest value in*  
**All-Wave Receivers!**



**£7**  
**6 VALVE ALL-WAVE SUPERHETERODYNE**

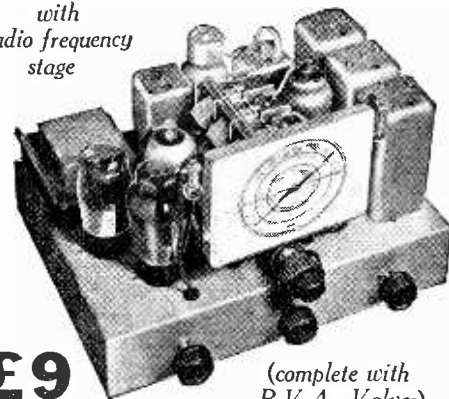
(complete with B.V.A. Valves)

Improved edition of this popular receiver (praised "Wireless World" test reports). Heavier gauge cadmium-plated steel chassis. Iron-cored I.F. transformers give even better performance. No increase in price.

Brief Specification: 8-stage, all-wave band-pass superheterodyne, 7 tuned circuits. D.A.V.C. with "squelch" circuit valve for noise suppression. Illuminated "Airplane" dial. Octode frequency changer. 3-5 watts pentode. Switching for gramophone pick-up. Wave ranges: 16.5-50, 200-550, 800-2 000 metres.

**"De Luxe" Model**  
**MCCARTHY ALL-WAVE SIX**

with  
radio frequency  
stage



**£9** (complete with B.V.A. Valves)

"De Luxe" 6 valve receiver with 8 valve performance (specially recommended for tropical and foreign reception conditions). Built on special cadmium-plated 16 gauge steel chassis. Varley iron-cored I.F. coils. Litz-wound tuning coils. 3 wave-ranges—16.5-2000 metres. Illuminated "Airplane" dial with principal station names. Micro-vernier 2-speed drive.

Circuit comprises: Pre-selector radio frequency amplifier (operative on all wavebands), triode-hexode frequency amplifier, double band-pass coupled I.F. amplifier, double diode-triode detector, D.A.V.C. applied to 3 preceding valves. I.F. amplifier and pentode output. Variable tone control and volume control operate on radio and gramophone.

All McCarthy receivers supplied complete with valves, knobs, pilot lamps, leads, mains cable and plug. 12 months' guarantee.

Deferred terms on application, or through London Radio Supply Co., 11, Oat Lane, E.C.2.

Cash with order on 7 days' approval. Also write for illustrated catalogue of complete range of all McCarthy receivers.

**MCCARTHY RADIO LTD.**  
44a, Westbourne Grove, London, W.2

Telephone: Bayswater 3201/2.

# Resistance-Coupled Amplifiers

## PART VI.—THE GRID BIAS CIRCUIT

THE details already given cover the more important points in the design of resistance-coupled amplifiers, but in the case of mains-driven equipment the bias circuit will well repay attention. It is the usual practice to employ cathode biasing wherever possible, for this makes each valve independent of the others and some degree of automatic compensation for variations in the characteristics of different specimens of valves of the same type is obtained.

When cathode biasing is used grid circuit decoupling serves no useful purpose in a resistance-coupled amplifier. Referring to Fig. 15, AC potentials are set up across the bias resistance  $R_5$  in the cathode circuit of  $V_2$ , and these must be prevented from reaching the grid of this same valve. Accordingly,  $R_4$  and  $C_4$  are often interposed in the grid return lead to act as a decoupling circuit, the idea being that as the voltage applied through  $R_2$  to the grid is that de-

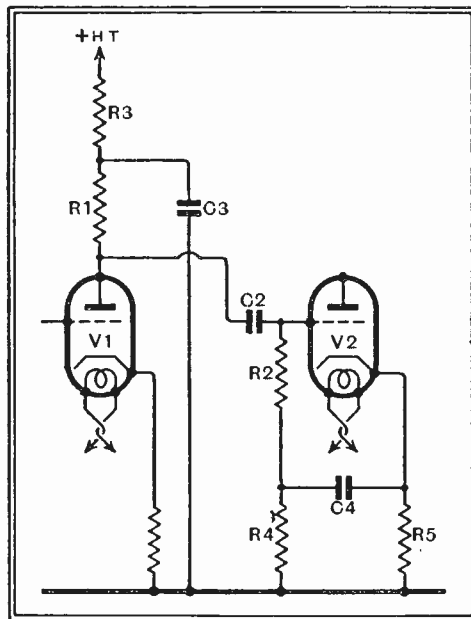


Fig. 15.—As explained in the text, grid-circuit decoupling is ineffective with resistance-capacity coupling.

veloped across  $C_4$  it will be negligible if the reactance of  $C_4$  at the lowest important frequency is very small compared with the resistance of  $R_4$ . This is quite true, but, unfortunately, there is an alternative path by which voltages developed across  $R_5$  can reach the grid—this path being through  $C_3$ ,  $R_1$  and  $R_2$ —and the decoupling circuit is consequently of no practical utility. Where the circuit is such that this alternative path does not exist, as may sometimes happen in the case of the coupling from a diode detector, then it is quite satisfactory to employ decoupling.

### The Bias Resistance and Feed-Back

Because of these facts, it is the general practice to employ the circuit of Fig. 16, which is the same as Fig. 14 of Part V, in which a condenser  $C_4$  is connected across the bias resistance  $R_4$ . If the reactance

of the condenser is very small at the lowest frequency compared with the resistance of  $R_4$ , then the voltage developed across the combination, and

*In this concluding article of the series, automatic grid bias and anode circuit decoupling are treated. The bias circuit can cause a loss of amplification or frequency-distortion if it is not properly arranged and in certain circumstances the decoupling condenser can lead to a rising bass characteristic.*

hence the feed-back to the grid circuit, will be negligible. If we assume that the reactances of  $C_2$  and  $C_3$  are negligible compared with their associated resistances, the effect of any impedance in the cathode circuit is easily dealt with and the amplification of the stage becomes

$$A = g r \times \frac{\sqrt{1 + I/\omega^2 C_4^2 R_4^2}}{\sqrt{1 + \left\{ I + \frac{R_4(I + \mu)}{R + R_a} \right\}^2 / \omega^2 C_4^2 R_4^2}}$$

where  $R = R_1 R_2 / (R_1 + R_2)$ .

It is easy to see that the amplification tends to fall off at low frequencies. It must not be forgotten that the loss introduced by this circuit is that found with perfect transmission by the intervalve coupling proper, and that if the coupling causes a loss of bass the action of the bias circuit may be somewhat modified. This is not very important, however.

First of all, let us suppose that we use no condenser  $C_4$  at all. The amplification then becomes

$$A = g r \times \frac{R + R_a}{R + R_a + R_4(I + \mu)}$$

There is no frequency distortion, for the gain is reduced equally at all frequencies. The amount of reduction is best realised from a typical case, and taking the amplifier stage considered earlier, we have  $R = 22,750$  ohms,  $R_a = 10,000$  ohms,  $R_4 = 1,000$  ohms, and  $\mu = 20$ . Consequently  $A = 0.61$  gr. The amplification is

only 61 per cent. of that obtained with perfect by-passing.

If a by-pass condenser is used which is not large enough, the resistance will be adequately by-passed only at high frequencies, and the full gain will be realised only at those frequencies. At low frequencies feed-back will occur and reduce the amplification. In the particular case cited above, the maximum loss of bass which can occur is 4.36 db. If we decide that the loss at the lowest frequency required can be 1 db., then the necessary value of  $C_4$  can be calculated from

$$C_4 = \frac{\sqrt{\left\{ 1 + \frac{R_4(I + \mu)}{R + R_a} \right\}^2 - 1.26}}{3.2 f R_4}$$

Inserting the values given above and taking the lowest frequency as 20 c/s, we find  $C_4 = 18.65 \mu F.$  The nearest standard value is  $25 \mu F.$ , and this would give a loss of rather less than 1 db. at this frequency. In the case of an output valve, such as the PX4, the by-pass capacity should be  $67.5 \mu F.$ , assuming a resistive load.

### The Bias Resistance

To obtain such large capacities at reasonable cost and with reasonable dimensions, it is, of course, necessary to use electrolytic condensers, and these are now readily obtainable. It is important to note that if for any reason it is impossible to use a large enough condenser, it is better to dispense with it entirely. Only the gain will then suffer, not the frequency response. Difficulty in obtaining adequate by-passing rarely occurs with triodes, but is common with tetrodes and pentodes.

Before concluding this section a useful

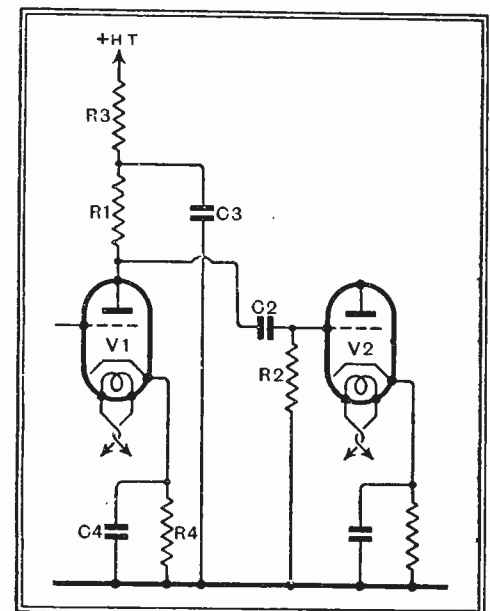


Fig. 16.—The reactance of the decoupling condenser  $C_3$  can, under suitable conditions, cause a rise in the bass response.

### Resistance-Coupled Amplifiers—

rule for the choice of the bias resistance is worth noting. Although it can only be accurately determined by the methods described in Part V, it so happens that with triodes the optimum value is roughly equal to the load resistance divided by the amplification factor of the valve, or  $R_4 = R/\mu$ . Also, roughly, the capacity of  $C_4$  in microfarads is equal to 10,000 divided by  $R_4$ , for a loss of 1 db, at 20 c/s.

The amount of anode circuit decoupling which is needed is not a matter which can readily be settled on theoretical considerations, for it depends upon the amount of amplification following the stage under consideration and upon the impedance of the HT supply. The larger the values of the resistance  $R_3$  and condenser  $C_3$ , the greater the decoupling efficiency. The ratio of the voltage applied to the grid of  $V_2$  (Fig. 16) to a voltage in the HT supply is given by

Ratio of voltages =

$$\frac{R_a}{R_a + R_1} \times \frac{I}{\sqrt{1 + 1/\omega^2 C_3^2 R_2^2}} \times \frac{1}{\sqrt{\omega^2 C_3^2 R_3^2 + \left(1 + \frac{R_3}{R_a + R_1}\right)^2}}$$

It can be seen that making  $R_1$  higher than  $R_a$  tends to improve the decoupling, as also does a small value of  $C_2 R_2$ . The value of  $C_2 R_2$  is fixed by the bass response required, however, and so cannot be varied to reduce feed-back effects without adversely affecting the frequency response. The decoupling proper is governed by the third factor in the above equation, and it will be seen that it depends chiefly upon the product  $C_3 R_3$ . It is clear, however, that while an increase in the value of either  $C_3$  or  $R_3$  will increase the decoupling, the use of a larger value of  $R_3$  will have a greater effect than a similar increase in  $C_3$ . In other words, for a given product  $C_3 R_3$ , greater decoupling is secured with a high value of resistance and small condenser than with a low resistance and large capacity. This effect is only present to any marked degree when  $R_3$  is of the same order as, or greater than,  $R_a + R_1$ .

### Decoupling

In general, it is convenient and inexpensive to use 8  $\mu$ F. electrolytic condensers for decoupling in LF circuits, and to vary the value of the various decoupling resistances to obtain the requisite decoupling. In the case of the penultimate stage, experience shows that a decoupling resistance of the order of 10,000 ohms provides adequate decoupling and does not drop the anode voltage excessively. Much more decoupling is needed in the preceding stage, however, and with the same value condenser something like 50,000 ohms is usually required. Fortunately, it is quite possible to employ such a value without reducing the anode voltage excessively, for the undistorted output required is much smaller than in a later stage, and the valve can safely be operated at a comparatively low voltage.

Before leaving the decoupling circuit it may be mentioned that under suitable conditions it is capable of giving a rising characteristic in the bass! If the reactance of  $C_3$  is comparable to the resistance of  $R_1$  at low frequencies, but is yet low compared to the resistance of  $R_3$ , the load impedance will rise at low frequencies and hence the amplification. When  $R_3$  is very large it is possible so to choose the values of  $R_1$  and  $C_3$  that the loss in  $R_2$  and  $C_2$  is compensated exactly. In general, the effect is not marked with triodes, but when screen-grid or pentode valves are employed it is quite easy to secure a rising bass characteristic. The effect is most marked when, in addition to the conditions mentioned above,  $R_1$  is less than  $R_a$ .

*Earlier instalments of this series describing the characteristics and design of resistance-coupled amplifiers were included in the following issues:—*

- Part I.—The Fundamental Operating Conditions, Oct. 30th.
- II.—The Coupling Condenser and Grid Leak, Nov. 6th.
- III.—Calculating the Performance, Nov. 13th.
- IV.—Valve Capacities, Nov. 27th.
- V.—Valve Operating Conditions., Dec. 18th.

## Club News

### The Exeter and District Wireless Society

Some very interesting lectures have recently been given to members of the above society including one on the di-pole aerial by Mr. F. Thorn, who very ably demonstrated the difference between this and the ordinary receiving aerial. A lantern lecture given by Mr. Marne, M.I.E.E., on "Electronics and Cathode-Ray Tubes" proved very popular. After explaining the methods of making these devices the lecturer dealt with their use, more especially in the case of the cathode-ray tubes which television has brought so much to the fore. Meetings of the society are held at 3, Dix's Field, Exeter, on Mondays, at 8 p.m., and those interested are invited to get into touch with Mr. W. J. Ching 9, Sivell Place, Exeter.

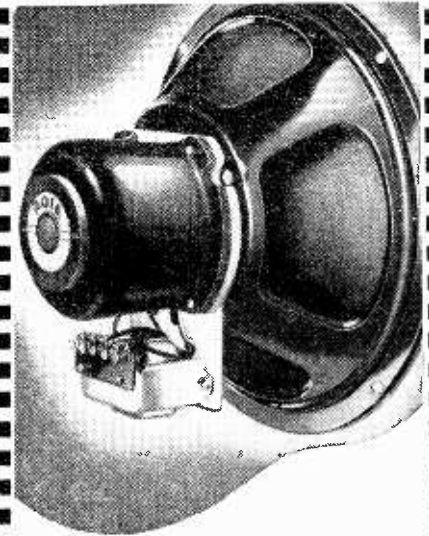
### The Golders Green and Hendon Radio Scientific Society

The most satisfactory method of receiving the sound accompaniment to the B.B.C. television programmes is engaging the attention of most real enthusiasts at the present, and a lecture on this subject by Mr. D. N. Corfield, D.L.C., proved extremely interesting. The lecturer pointed out that, owing to a better signal-to-noise ratio, an anode bend detector was preferable to a diode. A triode hexode seemed to be the best frequency-changer, said the lecturer, who also strongly advised a stage of signal-frequency amplification, and the provision of a separate control for the oscillator circuit. Full details of the society can be obtained from the Hon. Secretary, at 60, Pattinson Road, Hendon, N.W.2.

### The Croydon Radio Society

The special loud-speaker night held recently, at which members were invited to bring their instruments for comparative tests, proved an extremely popular feature. Members decided that no one loud speaker could be adjudged superior to the others on all counts. A lecture by Mr. H. G. Menage on piezo-crystals proved very instructive. Great interest was aroused by a new piezo-electric pick-up working on the tortion principle. The members of the society ask us to convey their best wishes for Christmas to readers and invite those interested in their activities to communicate with Mr. E. L. Cumbers, 14, Campden Road, S. Croydon.

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**Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.**

# Recent Inventions

## SIGNALLING SYSTEMS

IN short-wave signalling valves are used which are constructed with a closed "resonator" space between the electrodes. This is stated to avoid "leakage" radiation, and to increase efficiency both in transmission and reception.

Because of the higher level of energy available, a large number of intermediate frequencies can be superposed on a single short-wave carrier, thus allowing greater scope than usual for multiplex working.

Also the intermediate-frequency signals can be graduated in strength, so that certain of the transmitted signals can be received on a simple and comparatively cheap type of receiver, whilst other broadcast items are only available to a more limited circle of subscribers possessing more sensitive and expensive sets.

*N. V. Machinerieën En Apparaten Fabrieken "Meaf." Convention date (Germany) October 27th, 1934. No. 453733.*

## SOUND AND PICTURE RECEIVERS

THE dipole aerial A receives sound and picture signals radiated on ultra-short-waves, both sets of signals being fed through an amplifier V, where they are separated. The picture signals are fed through a further ampli-

The amplifier V is a superhet. circuit, the separation of the sound and picture signals being effected by a series-tuned circuit in one of the IF stages.

*A. C. Cossor, Ltd., L. H. Bedford, and O. S. Puckle. Application date March 7th, 1935. No. 453184.*

## MOTOR CAR RADIO

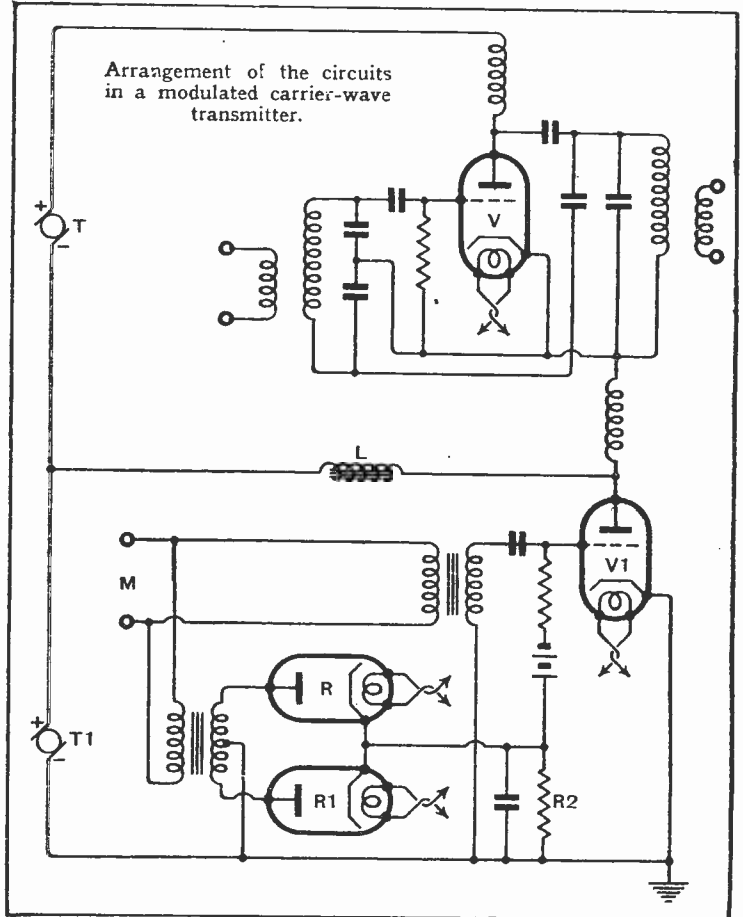
THE screening action of the metal roof of a motor car has forced designers to look for a more suitable place in which to locate the aerial. Somewhere underneath the chassis is a possible alternative, though it brings the aerial closer to the local interference from the ignition, and therefore necessitates expensive screening.

According to the invention a folded dipole aerial is used, made of a U-shaped rod or tube, and of such dimensions that it is broadly resonant to a frequency of about 7 metres, which is usually the wavelength of the interference radiated from the ignition system. Owing to the standing-wave formation set up, such interference is neutralised in the aerial itself and will not be fed into the receiver, if the latter is connected at points equidistant from the free ends of the U-shaped dipole. The lead-in to the receiver consists of a screened transmission line, which serves as a fixed filter against interference and, in combination with the tuned input circuit, presents a band-pass characteristic to the desired signals.

*Marconi's Wireless Telegraph Co., Ltd. (assignees of R. M. Smith). Convention date (U.S.A.) December 29th, 1934, and May 31st, 1935. No. 453736.*

The valve V<sub>1</sub> is, in effect, a "floating" modulator, since the rectified grid-bias varies in accordance with the instantaneous value of the applied signals. The power taken by the valve V<sub>1</sub> is accordingly regulated by the changing levels of modulation input,

According to the invention, the rapid-acting switch is located in the grid circuit of one of the low-frequency amplifiers, and is operated through a branch circuit which is coupled to one of the high-frequency stages. This branch circuit includes an amplifier and a rectifier. When an abnormally strong impulse is received, the branch circuit passes a corresponding pulse of rectified current, which "opens" the grid circuit of the LF amplifier and so cuts out the loud speaker. Since the switch is



although the mean amplitude of the carrier-wave output developed by the valve B remains substantially constant.

*Marconi's Wireless Telegraph Co., Ltd., and W. T. Ditcham. Application date March 11th, 1935. No. 453501.*

## SUPPRESSING STATIC

THE invention relates to the type of static-suppressor in which the interfering impulse is made to open a rapid-acting switch, or to otherwise break a part of the receiving circuit, so that both the disturbance and the signal are momentarily cut out. Since the duration of a static impulse is usually very brief, the break is so short that the apparent continuity of the signal is not affected, although the interfering impulse is completely suppressed.

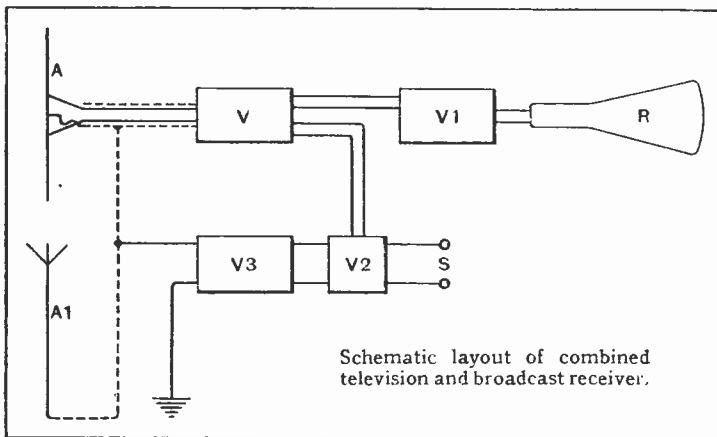
placed at a point in the receiver at which no direct current or voltages are present, the "break" does not give rise to any "click" or similar undesirable noise in the loud speaker.

*N. V. Philips Gloeilampenfabrieken. Convention date (Germany) April 13th, 1935. No. 453261.*

## TELEVISION RECEIVERS

IN place of an ordinary lamp, a cathode-ray tube is used to produce X-rays, the intensity of which is then controlled by the incoming television signals. The resulting X-rays after passing through a scanning disc are projected on to a large fluorescent screen for viewing.

*D. Applebaum. No. 2043094 (U.S.A.).*



Schematic layout of combined television and broadcast receiver.

fy stage V<sub>1</sub> to a cathode-ray reproducer R, while the audible signals pass through a low-frequency amplifier V<sub>2</sub> to the loud speaker S.

For receiving medium- or long-wave broadcast programmes the dipole aerial A is earthed by a down-lead, which is coupled as indicated in dotted lines to a separate input amplifier V<sub>3</sub>. Alternatively, a second aerial A<sub>1</sub> may be used for normal broadcast working, either alone or in combination with the dipole A.

## MODULATING CIRCUITS

A CARRIER-WAVE amplifier V is arranged, in series with a modulating-valve V<sub>1</sub>, across a divided source of high-tension T, T<sub>1</sub>, and a low-frequency choke L is inserted across the junction between the two valves and the two HT sources. Modulating signals are applied to the grid of the Valve V<sub>1</sub> from M, part of the signal voltage being passed through a full-wave rectifier R, R<sub>1</sub> so as to develop a grid-bias across the load resistance R<sub>2</sub>.

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**ALL-WAVE** Receivers, suitable for use on ships, as supplied to officers of many shipping lines.

**OUR 8 and 10 Metal Valve All-wave Receivers**; 15-2,000 metres, acknowledged by the trade as the best for range, tone, and general performance.

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**HEAVY DUTY** Mains Transformer, worth 35/-, 350-350, 150 m.a., 4 v., 2.5 ACT, 4 v., 6 ACT., 12/6.

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**CLEARANCE** List (Trade Only).—Write Leonard Heys, 36, Henry St., Blackpool. [0527]

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**HEAVY** Duty Model, as fitted to cinemas and dance halls; £15.

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Chassis with

### ROLA F.6 SPEAKER

**THIS** new chassis is designed to give a good all round performance with 31 watts output on both radio and gramophone. Short wave-band is arranged to cover both the English and American amateur bands as well as the usual short wave broadcast. All the best English components are used throughout and the circuit incorporates the latest improvements such as three wavebands with band-pass input, full range volume and tone controls working on both radio and gramophone, large full vision scale with station names marked on all wavebands, etc.

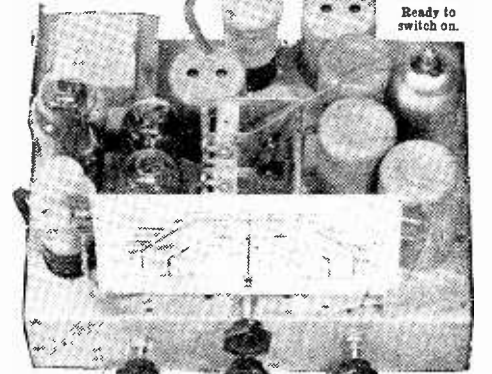
The price includes radiogram chassis complete with 6 British valves and 8' Rola moving coil speaker, matched to the chassis, mains leads, pilot lamps and everything ready for immediate use. Packing and carriage free.

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**FERRANTI** 6-valve Battery Superhet.; £6.-91 Flat, Mantell St., N.1. [3480]

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**EXCEPTIONAL** Reconditioned Bargains.—Kilodyne Four, with valves and coils, assembled with power pack, £7/17/6; Kilodyne Four, with valves, coils 13-550 metres, assembled for battery operation, £6/6; Kilodyne Four, valves, coils from 7-550 metres, specially converted for 180 degrees bandspread, £6/6; G.E.C. High Fidelity Eight Superhet, all wave, with special laboratory cabinet, finished Admiralty grey, with milliammeter, £17/10; R.C.A.-Victor Fidelity Eight, 13-550 metres, complete, £14/10.—A.C.S. Ltd., 52, Widmore Rd., Bromley, Ravensbourne 1926. [3464]

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**425** 0-425v., 120-160 m.a., 4v. 5-10a., 4v. 2.5, 4v. 1-2, 4v. 1-2, supershrouded model, 2½% regulation; 26/-.

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**CHOKES**, 30h. 60 m.a., 5/6; 7-13h., 10/6; 30h., 150 m.a., 12/6; regulation, 7/6.

**OUTPUT** Transformers, 4-10 watt, W.W. Q.A., 17/6; 20-watt super shrouded, 30/-.

**SPECIAL** Wide Frequency Range Model; £3/10.

**AUTO** Transformers, 100-120 to 200-240v., 60 watt, 9/-; 120 watt, 12/6; 200 watt, 16/6; 500 watt, 30/-.

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**TRANSFORMERS**, Ltd.—Transformers and chokes embodying all the best in design; no better value at any price; Radiolympia models; tapped and screened primaries, filaments, centre tapped.

**250** 0-250v. 60 m.a., 4v. 1-2a., 4v. 2-4a., 12/6, post 7d.; extra filament, 4v. 1a., 12/6.

**350** 0-350v. 60 m.a., 4v. 2-3a., 4v. 2-4a., 15/-, post 8d.; extra filament, 4v. 1a., 16/-.

**350** 0-350v. 120 m.a., 4v. 2-3a., 4v. 4-6a., 4v. 1-2a., 19/-, post 1/-; extra filament, 20/-.

**500** 0-500v. 140 m.a., 4v. 2-4a., 4v. 4-6a., 4v. 2a., 4v. 2a., 29/6, post 1/-.

**L.T.** Charger, charging rate 1a. 2, 6 or 12-volt, employing metal rectifier L.T.5; 57/6, post 1/-.

**WRITE** for List; special quotations by return.

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**PARAMOUNT** Mains Transformers.

**PARAMOUNT** in Quality, lowest in price; example, 250v. 60 m.a., 4v. 1a., 4v. 4a., open type 9/-, shrouded 11/-, post 9d.; 350v. 75 m.a., 4v. 2-5a., 4v. 4a., open type 12/-, shrouded 14/-, post 9d.

**WRITE** for List, "Paramount Mains Transformers."—R. H. Salter, 66, Hartfield Rd., Wimbledon, S.W.19. Phone: Liberty 3226. [2303]

**TANTALUM** for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [2729]

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**HIGH** Class Radio Cabinets Made to Order; competitive prices.—C. Mostyn, Ltd., Cabinet Manufacturers, 8-9, French Place, London, E.1. (Bishopsgate 8784.) [3306]

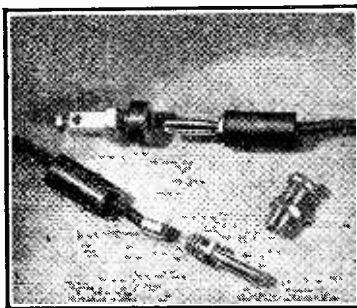
No. 18

*Notes*

**Terminals versus Plugs and Sockets**

For years terminals held a supreme position, for the following reasons:—

1. They were cheaper than plugs and sockets.
2. In the best terminals there is no loose part to be lost.
3. A screw connection must necessarily have lower and more constant contact resistance than the average friction connection.
4. With a terminal there is one less link in chain of contacts.
5. Any odd piece of wire can be rapidly screwed down with a terminal.



To-day, with the exception of (1) above, all these points still hold good, but with the advent of cheaper and still cheaper socket assemblies, the plug and socket is now cheaper than a decent terminal, so they are fitted by most manufacturers of domestic radio receivers; even though with a plug and socket it is necessary for someone to dismantle the plug, carefully to insert the wire, reassemble, and then plug in—a tedious initial process.

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With a good plug and socket no damage will occur if some clumsy fool trips over the lead; the plug will be withdrawn. A resilient socket is often distorted by other than a straight pull at the plug, then there is trouble. A plug can be straightened, but it almost needs a tin opener to get at a socket on a modern set, and it becomes a service job. Hence we advise rigid, robust sockets and resilient plugs rather than the solid plugs and resilient sockets.

Plugs and sockets are certainly more convenient if it is desired to connect and disconnect a permanent wire, because the wire is loaded once and for all into the plug. Plugs and sockets should have both fixed and movable parts lettered to correspond.

*The illustration above is one of 150 illustrations, including 75 blue prints of curves, diagrams, circuits and constructional details and specification of all our standard products in the accessory or component class. Of particular value to Radio Engineers, Designers and those engaged in any section of the radio industry, as well as to every amateur constructor of radio or television apparatus. Send 8d. for copy, post free.*



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**MANUFACTURER'S** Clearance.

**HALCYON** Radiogram Cabinets, rich, dark, figured walnut, 33 x 23 x 19½, 45/-; many others, 30/- upwards; photos for selection sent on request.

**TABLE** Radio Cabinets (undrilled); 6/6 upwards.

**SPEAKER** Cabinets; 4/6 upwards.

**SEND** Particulars of Your Requirements (giving size of set, etc.), or call and make your choice from our stocks of over 100 different types; from 3/6 to £4/10.

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**DYNAMOS, MOTORS, ETC.**

**1-10** h.p. A.C. Induction Motors, 2,750 revs., self-starting, all voltages; 35/-—Easco, 18, Brixton Rd., S.W.9. [0455]

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**WARD**, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518]

**NEW LOUD-SPEAKERS**

**HULBERT** for Quality Surplus Speakers.

**THE** Following Genuine Bargains are Made by One of the Best-known Manufacturers of high-grade moving coil speakers. All are brand new and offered at considerably under half list prices. The Auditorium models are fitted with latest dual curved cones, giving remarkably wide and even frequency response, resulting in quality reproduction of both speech and music.

**37/6** Only, usual price £5; Auditorium permanent magnet speaker, with Alni magnet and die cast frame, large 12in. dual cone, comprising latest curved cone with auxiliary bakelite cone; complete with large 25 ratio transformer.

**59/6** Only, usual price £6; Auditorium electro-magnet speaker, 1,000, 1,250, 2,000, or 2,500 ohms field; exceptionally large magnet of high permeability steel, giving enormous flux density; 2in. moving coil; large dual cone, comprising latest curved cone with auxiliary bakelite cone, giving wide frequency response; complete with universal transformer; the ideal speaker for use with "Wireless World" and other quality amplifiers.

**75/-** Only, usual price £9; as above, but for use on A.C. mains; complete with Westinghouse rectifier and full smoothing equipment.

**24/-** Only; permanent magnet speaker, Alni magnet, die cast frame, 10in. cone, Universal transformer.

**15/6** Only; permanent magnet speaker, Alni magnet, 8in. cone Universal transformer.

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**2/9** Only; brand new cabinets.

**8/6** Only; electro-magnet speakers, with 8in. cone, 6,500 ohms field, Universal transformer.

**IF** You are Requiring Quality Reproduction at Low Cost Order Now from:—

**HULBERT**, 6, Conduit St., W.1. Cash or c.o.d. [2895]

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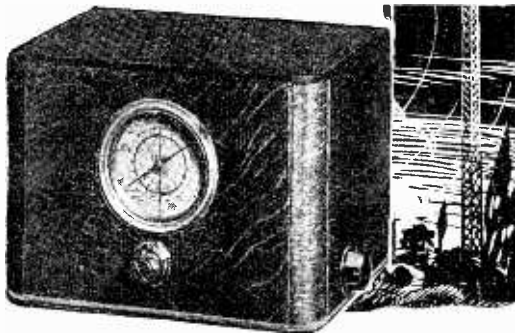
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