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Editor:
HUGH S. POCOCK.

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DORSET HOUSE, STAMFORD STREET,
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Telephone: Waterloo 3333 (50 lines).
Telegrams: "Ethaworld, Sedist, London."

COVENTRY: Hertford Street.
Telegrams: "Autocar, Coventry." Telephone: 5210 Coventry.

BIRMINGHAM:
Guildhall Buildings, Navigation Street, 2.
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EDITORIAL COMMENT

A Questionnaire

We Invite Your Co-operation

IF readers will refer to the last page of this issue they will find an invitation to fill up answers to a Questionnaire on various matters connected with their interest in wireless.

The purpose of the Questionnaire is to assist us to be as useful as possible to our readers and to indicate to us what type of information is most welcomed.

It will be noted that the sheet on which the Questionnaire is printed carries a business reply stamp, so that the form has only to be folded and posted after being filled up.

It will also be seen that we do not ask readers to give name or address, but only age and location, as we think there are many advantages in the replies being anonymous.

What we especially ask is that EVERY READER should do *The Wireless World* the service of filling up and posting the Questionnaire, whether he lives at home or abroad, and whatever his occupation may be.

Readers of this paper may be regarded as specialists, and we think that for this reason alone we may count upon them to respond far more readily to this invitation than would be the case with a journal covering a variety of subjects in a more general way. We cannot expect 100 per cent. response, but we would at least like to see returns giving us a good majority opinion from our readership.

By devoting five minutes to this task readers will be doing us a great service and they may count upon us in return to make the best possible use, in their interests, of the information so gathered.

We know that forms of this kind are often disregarded by the ordinary reader, but this time we want *The Wireless World* to receive a truly representative response and, to ensure this, the Questionnaire must come back to us not in hundreds or in thousands, but in tens of thousands. So do not procrastinate but fill it in and send it to us *NOW*—PLEASE.

Age of Sets

How Long Do They Last?

EFFORTS have been made on several occasions to arrive at an estimate of the average number of years wireless receivers are used before their owners replace them by new ones. Recently we have seen one such estimate compiled from a large proportion of the readership of "John Bull." The census shows that some 80 per cent. of the sets in use by readers of that paper are from one to four years old, leaving 20 per cent. of sets still in use which are in excess of four years of age. The figures also show that more than 50 per cent. of sets are changed within two years.

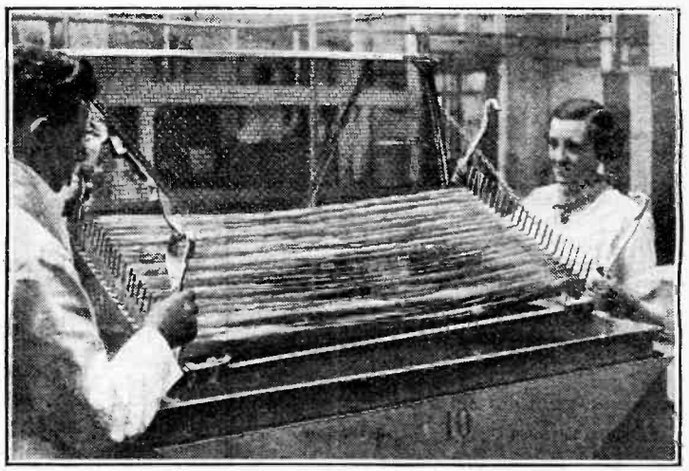
Gradually, over the past two or three years facilities have been given by many dealers to take an old set in part exchange, and probably most of the sets so bought-in have been only fit for destruction. The more modern sets, however, if of a reliable make, are still, after two or three years' service, good instruments worthy to replace much of the old rubbish which listeners who cannot afford a new set are still using. To-day the public should recognise that there are bargains available in second-hand receivers and facilities should be provided more generally for such sets to be overhauled economically before they are put into service by the new owner.

Electrolytic Condensers

PART I.—BASIC PRINCIPLES AND PRACTICAL CONSTRUCTION

By MAURICE V. PIRIE
(Manager, Ferranti Condenser Works)

THIS article and its sequel will help to dispel many misconceptions as to the functioning, applications and limitations of the electrolytic condenser. The articles are written with the object of showing readers how to employ this type of condenser to best advantage.



Lifting a rack of aluminium foil anode strips from the forming tank.

WHEN certain metals are used as anode in an electrolytic cell it is observed that the resulting current, although relatively high at first, gradually falls to a low value and that the current then attains a steady minimum.

With, for example, two electrodes of aluminium in a solution of ammonium borate, it is found that after the current has reached the steady minimum value if the cell is disconnected and the electrodes are shorted outside the cell a spark results. There is then no further discharge. On reapplying voltage the cell will accept a further charge; it is, in fact, a condenser, the capacity of which is inversely proportional to applied voltage measured when current reaches minimum value, and directly proportional to the area of the positive electrode. The area of the negative electrode does not directly affect the capacity since, as will appear later, the negative "plate" of the condenser is the electrolyte.

However, it is found that on reversing the cell approximately the original heavy current results for the same applied voltage, and on restoring original polarity the current falls again to the minimum. The cell may, therefore, be used as a rectifier.

If, reverting to the original polarity and voltage, the cell be allowed to become stabilised at the minimum current value with a resistance connected in series and then the applied voltage is suddenly increased, say, 25 per cent., it is found that the voltage at the cell terminals does not rise in proportion. The increased voltage would be found to have resulted in a relatively large increase of the steady minimum current and this current produces a voltage drop in the series resistance so that, for a time at least, the extra voltage is dropped across the resistance. In this manner the cell may be used as a voltage limiter.

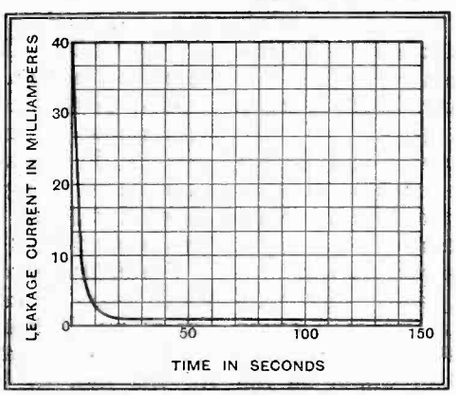


Fig. 1.—A comparatively heavy initial leakage current flows when a voltage is first applied to an electrolytic condenser.

A further voltage limiting effect is noted when such a cell is "formed" to the highest voltage normally attained, which is in the region of 500V. Any attempt to "form" well above this voltage usually merely results in the cell taking a heavy leakage current, but the voltage across it does not rise in proportion with increased applied voltage.

Aluminium is in many ways the most suitable metal for these units and these notes are confined to cells using that metal.

The capacity and voltage - limiting effects of electrolytic condensers have largely contributed to the cheapness and reliability of the modern receiver, but the rectifier effect has not been commercialised to the same extent. The behaviour of these cells was first noted in 1854 by Wheatstone. At the time there was some doubt as to whether the action was entirely due to the insulating film of aluminium oxide which is known to be formed on the anode by this process, and although great progress has been made in the study of these processes there is still some doubt on this point. The most widely accepted view compares the action of the system to a normal vacuum-tube rectifier, and the film is considered as an electron-free solid, analagous to the vacuum of a thermionic tube. According to this view, it is considered that the space charge due to electrons in transit in the film on the way from anode to electrolyte reduces the flow of current to a low value.

Forming the Dielectric Film

Connected to a source of supply with correct polarity, ions from the electrolyte cannot pass freely through the film to the anode. Such ions as do pass through help to repair the film at that point by formation of further oxide film. (This word "formation" explains the term "forming" generally applied in the trade to what is also known as the anodising process, *i.e.*, the electrolytic formation of aluminium oxide on the metal.)

On reversing polarity the electrons pass freely as in the case of a correctly connected thermionic valve. The direct leakage current is considered to be due to imperfections in the film, the leakage current falling as the film is made more nearly perfect.

During inactive periods the electrolyte attacks the film so that after periods of idleness leakage is high on first connecting in circuit. (See Fig. 1.)

The variation of film thickness, which increases with forming voltage, is probably due to film becoming complete and preventing further ions from passing from the electrolyte. If voltage is then increased there is a further passage of ions and the film thickness is increased. Since this film is the dielectric of the condenser.

Electrolytic Condensers—

this increased thickness results in reduced capacity, and the final capacity of the cell is inversely proportional to the forming voltage. This is the essential difference between, say, a 500 peak volt 8 mfd. unit and one of 500 mfd. 8 V. peak. These two units would be very nearly the same size, the graph connecting voltage and capacity deviating slightly from the straight line at low forming voltages.

Electrolytic condensers generally are made in two distinct forms, that is, with a dry or semi-dry or with a wet electrolyte, and it is the latter type which most nearly conforms to the simple cell referred to above in that the general form is an aluminium beaker containing a solution of ammonium borate, boracic acid, borax and the like substances in which is immersed a coiled or folded strip of aluminium supported on the aluminium centre piece as in Fig. 2.

The foil is often perforated in order to provide a short path for the steady

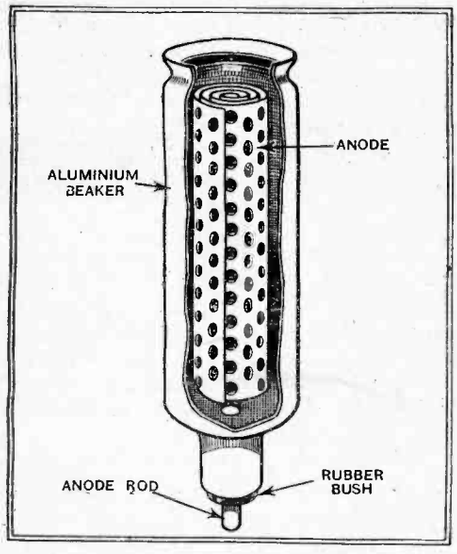


Fig. 2.—Construction of a wet electrolytic condenser.

"leakage" current previously referred to which is necessary for the maintenance of the film.

The internal resistance of the cell must be kept to as low a value as possible, and this will be referred to later in the paragraph on power factor.

Wet condensers must be mounted in an upright position, as otherwise the evolution of gas due to electrolysis might drive out the fluid and, therefore, a valve is provided which permits the escape of gas but retains the liquid. The valve in its most simple form may be merely a rubber membrane pierced with a needle, with a cavity over the needle hole into which the rubber can stretch under pressure to release the gas. The beaker becomes one connection of the condenser, and the centre post of the aluminium anode which is insulated from the beaker is the other terminal.

In the dry form the most usual type consists of two strip electrodes, separated by a textile material which is impregnated with the electrolyte. The whole is then rolled or folded to a compact form and provided with connections to the electrodes. The electrolyte may be applied as a paste, which should set hard. The dry type may be housed in a container of simple type and used in any position. As the electrodes in the dry type are only separated by a distance of .001in. to .008in., the internal series resistance of this type is much lower than in the case of wet condensers.

There is often some misconception as to what constitutes the cathode in an electrolytic condenser. Actually the cathode, as in any other electrolytic cell, is the negative electrode, but the negative "plate" of the condenser is the electrolyte itself. It is due to the fact that the two "plates" of the condenser, *i.e.*, the metal of the anode itself and the electrolyte are separated by an insulator which is only a few molecules in depth, that we are able to obtain the enormously high capacities as compared with, say, the normal paper condenser.

The materials used in both types are vitally important to quality. By far the most important feature in experiment, design and manufacture is the purity of all materials entering into the actual cell.

Electrodes and Electrolytes

The formulæ of electrolytes would be out of place in this article, but it may be noted that the liquid of the wet type is usually pure distilled water and salts and of the dry type glycerine or ethylene glycol with sorbitol or mannitol, etc., the salts being boracic acid, ammonium borate, borax, glucose, citric acid, citrates, oleates, phosphates, lactates, etc., and fillers such as starch are also used.

A large variety of compounds using these materials has been introduced in the effort to obtain the best compromise between many conflicting factors, among which may be mentioned the requirements of low power factor and high capacity, low leakage and rapid recovery after long idle periods, ability to withstand surges, etc.

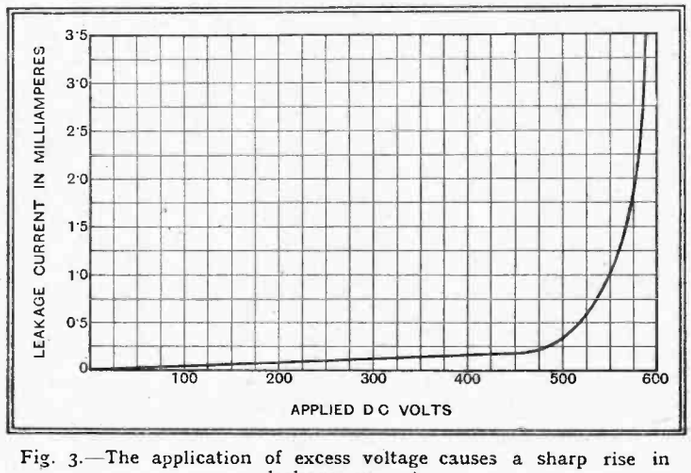


Fig. 3.—The application of excess voltage causes a sharp rise in leakage current.

All the materials must be of analytical reagent purity; water, separator materials, and all surfaces in immediate contact with the cell must be analysed for impurity.

Winding and impregnating machine used in the manufacture of dry electrolytic condensers. Prepared anode strips are stacked on the tray by the operator's elbow.

The anode aluminium must not contain more than 0.2 per cent. impurity. The cathode need not be pure aluminium; in fact, it is better impure, since if pure it would tend to "form" on reversal of polarity, and capacity would then drop as, in effect, the cell would consist of two condensers in series.

These requirements account for many of the early failures in these components, and many readers of this journal will remember the frothing and corrosion which characterised condensers of the period 1924-1928. These troubles were due to impurities.

The fact that a film can be formed on both cathode and anode is used to provide condensers which may be connected in circuit without reference to polarity—the so-called non-polarised electrolytic condensers. From the description given in the early part of this article it will be appreciated that the normal electrolytic condenser must be connected in circuit with the anode to the positive terminal of source of supply.

The reversible type is useful, for example, in battery or DC mains receivers in which the design is such that reversal of the DC supply across the condensers is possible. They are sometimes referred to as non-polarised electrolytic condensers. If reversed polarity be applied to a normal polarised unit for

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some minutes the excessive current which passes will damage the unit, the damage ranging from localised drying with consequent loss of capacity and increased power factor to ejection of electrolyte by the escaping gases. A momentary reversal is not likely to harm the unit, which would quickly recover on restoring to correct polarity.

In the case of low-voltage units reversal may decrease capacity by forming film on the cathode, but in high-voltage units heat is usually the deciding factor.

The features which are of greatest interest to service engineers and others are breakdown voltage, leakage current, power factor, life and the effects on these of temperature and frequency. These features and the means by which the best results are attained are to some extent interdependent, but will be treated as far as possible under separate headings.

Electrolytic condensers are rated at test voltages which are much nearer to the working voltage than is the case with paper condensers where a peak voltage rating of three times working voltage is common. The dielectric—the film—should be maintained in good condition to almost the end of life by the minute leakage current.

Electro-chemical factors set a limit to the peak voltage which is safely applied to a single-anode electrolytic condenser, the maximum offered usually being in the neighbourhood of 620 V for the dry type and 500 V for the wet type, depending on the factor of safety used by the maker.

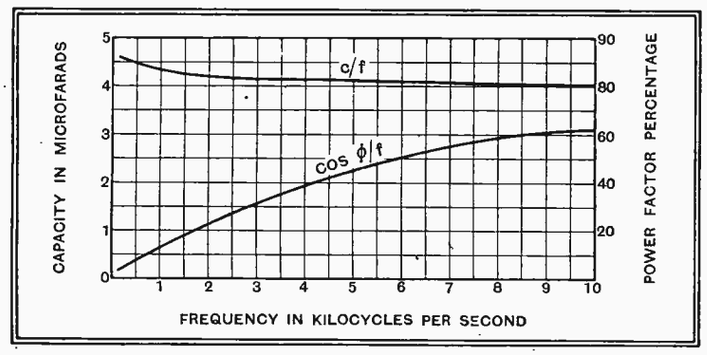


Fig. 4.—Relationships between frequency, capacity, and power factor.

There is no reason why several units should not be used in series to handle higher peaks, but care should be taken to provide for radiation of heat.

If a voltage is applied to the condenser in excess of the voltage used in forming the film, a heavy current increase will result, which may damage the unit and will certainly increase film thickness and lower capacity if allowed to continue (see Fig. 3). The extent of the damage would depend on the severity of the overload, and will range from localised patches of dryness (causing increased internal resistance, decreased effective capacity, and increased power factor) to a complete short-circuit brought about by the electrodes being welded together. Operating below peak voltage over long periods will reduce film thickness and increase capacity slightly.

Wet condensers will pass a high leakage surge current on exceeding peak voltage, and the actual shape of the applied volts—leakage current characteristic may be varied by adjusting the content of the solution so as to provide an improved measure of voltage regulation.

Ratings are given on current types as "peak volts," "working volts" or "surge." By "peak volts" is usually meant the maximum voltage to which the unit should ever be subjected, and is the total of DC surge plus AC peak.

The maximum voltage encountered in working should be usually about 90 per cent. of its peak voltage rating, and of the maximum working voltage about 6 per cent. may be AC ripple. For example, with a 500-V peak unit the maximum working voltage might be 423 V DC plus 27 V AC peak ripple, the two together making 90 per cent. of the peak rating of 500 V.

The term "peak volts" was used exclusively up to 1936 while efforts were being made to raise the maximum voltage to which the condensers might be subjected, and when these efforts resulted in an increase of some 100 V, as will be explained later, the term "surge" came to be adopted to mark this different type, although it would have been better to have retained the words "peak voltage," which means the same thing.

If a voltage greatly exceeding peak voltage rating is applied to a high-voltage unit, sparking may occur between electrodes. As hydrogen and oxygen are being liberated in explosive proportions by electrolysis, sparking may ignite the small pocket of gas which produces a larger cavity. This fills and explodes in turn, and the process may be repeated until disruption is complete.

In order to distinguish between the continuous sparking between anode and electrolyte and the larger sparks due to short-circuit or explosion of gases, the former is referred to in the art as scintillation.

If the unit is so designed as to keep the gases separate as far as possible, the actual voltage at which breakdown occurs is much higher, and in the case of dry units this condition may be obtained by replacing the usual textile separator which carries the paste by a paper-like material.

This "paper" must be of such a type that it will absorb the maximum of electrolyte, permitting the passage of ions, but preventing the passage of the gases which then come away at the ends of the unit where there is no danger of ignition. The amount of gas evolved is very small, and is not detected in any ordinary manner.

The amount of time and expense devoted to the search for suitable capillary fibres for this separator, and in design of plant for producing from it a material strong enough to take the tension of winding, is not at all evident at first glance.* The net result is a safe increase of well over 100 V on breakdown volts as compared with that obtainable with normal gauze separators.

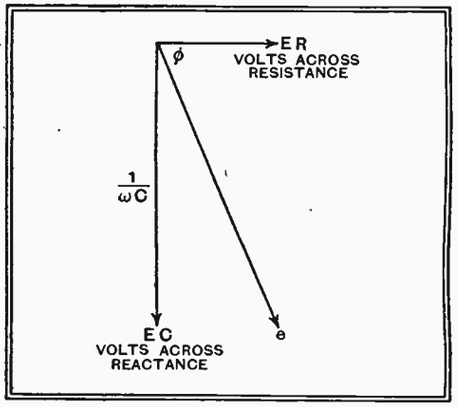


Fig. 5.—Vector diagram of equivalent circuit of an electrolytic condenser.

Engineers using these condensers are often in error as to the actual peak voltage obtaining in their circuits, and a peak voltmeter should be used to determine the actual voltage.

The steady DC leakage current is always present when voltage is applied, the current being of the order of 50 microamps per microfarad on, say, 500-V peak units and lower on low-voltage units (at peak volts). This current is necessary to the electro-chemical action of the system.

Switching Surges

If voltage is suddenly applied to the condenser after it has been idle for some time there is a high initial current surge which falls in a matter of seconds to about 2 mA in the case of an 8-mfd. 500-V unit, and then decreases to normal value in about 30 seconds (see Fig. 1). The tendency to surge when switching on is an advantage, as has been explained.

The table below indicates the normal leakage to be expected in a satisfactory condenser.

Rated Peak Volts.	Maximum Leakage in mA/mfd. approximately.
500	.08
350	.075
250	.07
100	.04
60	.03
50	.025
40	.02
30	.015
15	.01
6	.01

These leakages are for the normal type and must be nearly doubled for the rever-

* Acknowledgment is due to Messrs. Crompton and Bros., Ltd., and to Dr. A. A. Goldberg, chemist to that company, for their assistance in this phase of development.

Electrolytic Condensers—

sible types, since twice the length of winding must be used in a reversible as in a standard type. As previously explained, the reversible consists of two condensers in series and the effective capacity is halved.

Variation of DC leakage with applied volts usually follows a curve similar to Fig. 3.

Referring to Fig. 4, curve c/f, it will be seen that the effective capacity falls with increasing frequency, and in curve cos ϕ/f of the same graph is given the rate of power factor increase with frequency. It is also to be noted that PF is high compared to a paper condenser. This effect is due to the resistance of the electrolyte to such an extent that other effects can be neglected except in the incessant effort to lower the PF.

Resistance of Electrolyte

The equivalent circuit for an electrolytic condenser may be considered to be a pure capacity C farads in series with a resistance R ohms, R being the resistance of the electrolyte for the greater part, other resistance effects being almost negligible.

The following reasoning familiar to engineers is included for the help of students.

Fig. 5 is a vector diagram of the equivalent series circuit CR.

If ER is made proportional to resistance R and EC proportional to condenser reactance, then e is the resultant and ϕ the angle of lead. Condenser reactance $= \frac{1}{2\pi fC}$. When R is small, e is nearly equal to EC.

Then cos ϕ is nearly equal to $\frac{R}{\frac{1}{2\pi fC}}$.

Writing ω for $2\pi f$ we have

$$\text{Cos } \phi = \frac{R}{\frac{1}{\omega C}} = R\omega C \text{ (provided R is small).}$$

Therefore if we find series resistance R and employ the formula $PF = 2\pi fRC$ we can obtain a very near approximation to PF. The application of this reasoning to the actual test will be considered later in the section on testing. The power factor is a fraction and it has become the practice in the trade to express this as a percentage, taking unity PF as 100%.

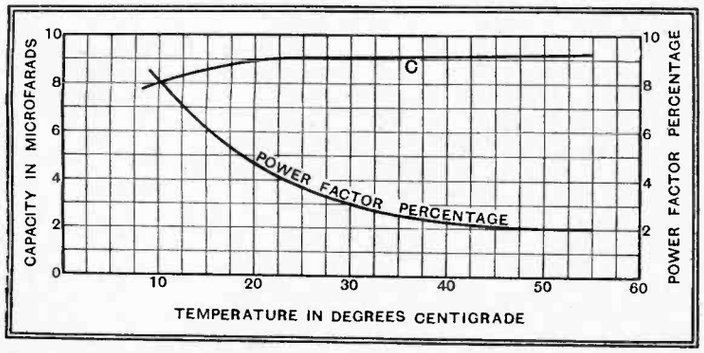


Fig. 6.—The effect of temperature on capacity and power factor.

The effect of temperature on capacity and PF is given in Fig. 6, where it will be noted that capacity is reasonably constant between 10 deg. C. and 60 deg. C., but PF varies between 2% and 8% over the same range, and varies inversely with temperature.

For use in cold climates and in aircraft the electrolyte must be modified, and the improved curve of Fig. 7 results; it is seen that PF varies between 1% and 4% over the same range of temperature.

As power factor depends on the resistance at a given frequency, constant attention is necessary to internal mechanical pressure and other features affecting resistance apart from the DC resistance of the electrolyte. One almost certain result of high power factor in the smoothing condenser of a receiver power pack is an increase in hum level.

In the early life of a condenser there is some gradual improvement of electrical characteristics as the film becomes more nearly perfect. At the same time the anode film can only be maintained by oxygen which is produced in the electrolyte by electrolysis. However slow the process may be, the oxygen must be produced from the electrolyte, and the water which is always present, if only as water of crystallisation in the salts employed, is gradually used up.

The series resistance increases, therefore effective capacity is reduced and PF increased. Fall in capacity and rise in PF are in some measure due to increasingly poor contact between foil and electrolyte.

The life of the condenser therefore depends to a large extent on the amount of electrolyte present, which in turn depends on the nature of the separator material. Many authorities in this art also insist on anode foil thickness of 0.003in. minimum. At the end of life the electrolyte is found to be dried out to a powder, and if the percentage of impurity is low there will be very little corrosion of the foil.

For use in tropical conditions the condenser should be so designed that no metal other than pure aluminium is permitted inside the unit, pure aluminium rivets or leads being brought to the terminals. This is necessary because in warm, humid conditions moisture may condense on electrical connections and either leakage current or local action will cause corrosion of the joint if another metal is touching, or near, the aluminium. These units are for this reason usually embedded in wax and for tropical use special waxes are employed.

Above all, the condenser must be so designed that electrolyte cannot possibly creep on to the joints between foil and lead or terminal if metal other than aluminium is employed. The writer has recently examined units of Continental origin in which bare copper wire was actually welded to the foil, with electrolyte in contact with the joint.

Conditions which may be expected to impose strain on normal electrolytic units and shorten their life are:—

(1) Working voltage exceeding 90 per cent. of peak voltage rating.

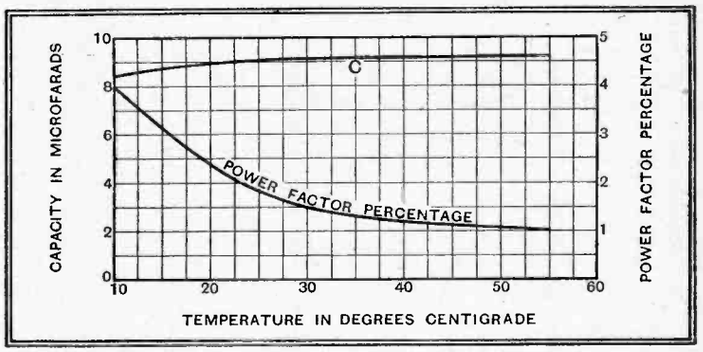


Fig. 7.—(Compare with Fig. 6.) Result of using a modified electrolyte.

(2) Ambient temperature of over 50 deg. C.

(3) Ripple voltage exceeding 10 per cent. of peak rating.

(4) Continued application of surges in excess of peak rating. (Heat dissipation is assisted by housing in a can.)

Increasing Capacity by Etching

There are other developments which cannot be discussed in such a brief article, but that of the "etched" anode deserves attention.

If the surface of the foil of the anode is roughened, as by sand-blasting or chemical etching, the area presented to the electrolyte is naturally increased. The effective capacity can be increased by etching to as much as eight times that of a plain foil.

The process has not been widely adopted, however, as past experience has taught engineers to be distrustful of drastic changes, and many are still of the opinion that etching opens up the surface to attack, and that there is some possibility at excess voltages of the dry electrolyte being forced out of the minute pits.

Sand-blasting does not produce such deep and irregular pits as etching, but is comparatively expensive and only raises capacity some 50 per cent.

The apparently simple electrolytic condenser is thus seen to provide many interesting problems for the chemist and engineer; development and enlightenment are to be expected.

Some of the more interesting details of manufacture and the special problems of testing electrolytics will be dealt with in a further article.

CURRENT TOPICS

Events of the Week in Brief Review

Switzerland Shows the Way

BY a law passed by the Swiss Government, it is now a punishable offence to leave windows open so that the sound of a loud speaker causes distress to neighbours.

Cabinet Shortage in America

THE demand for new wireless sets in the U.S.A. is said to be so heavy that a shortage of cabinets has occurred. This has had the effect of turning more attention to the production of moulded cabinets, which can be produced far more quickly than other types.

Free Listening for the Deaf

IT is proposed to introduce a bill into the French Parliament granting free wireless licences to all soldiers disabled in the War and to all soldiers who have been pensioned for ear trouble.

New Bulgarian Station

SPECIAL precautions are being taken to protect the newly erected Bulgarian high-power station at Vakarel from damage by lightning. Thunderstorms are very prevalent in the region where the transmitter has been built, and for a long time experimental work has been going on in order to determine the most satisfactory form of lightning conductor. Transmissions from this 100-kW. station are due to commence on October 3rd.

U.S. Stations

THE National Broadcasting Co. of America now has a total of 150 stations in its network. One hundred and thirty-eight of these work on medium waves, the remainder being SW stations.

1938 Wireless Conference

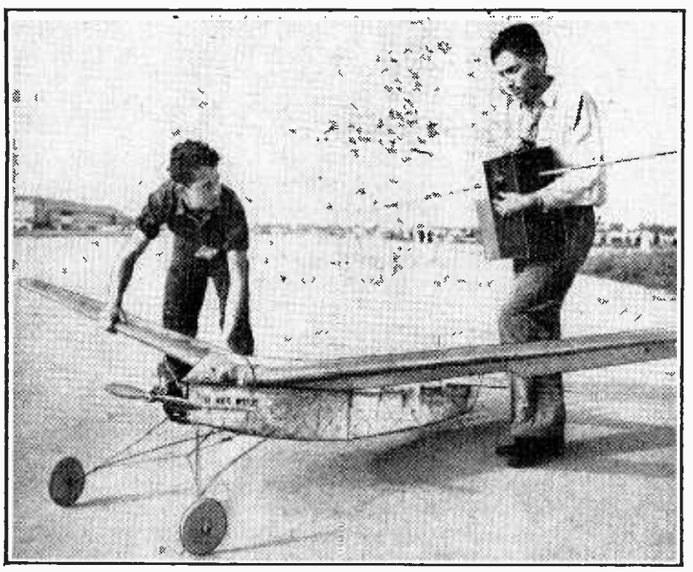
SEVERAL countries, including Great Britain, have already given formal notice of their intention to send delegates to the International Telecommunications Conference, which opens at Cairo in February. This is the fifth of these conferences to take place, the first being held in Berlin in 1903.

PA for Railway Stations

IN addition to the loud speaker systems already in use at Paddington and Birmingham stations, the Great Western Railway has now decided to provide a similar installation at Cardiff. A special type of directional loud speaker will be used in order to avoid mutual interference when different announcements are being made simultaneously on the various platforms.

Wireless Exports

IT is reported that German wireless exports are once more on the up-grade. Ten years ago Germany was the principal country exporting wireless goods, the U.S.A. and Holland coming next. After 1931 German exports rapidly declined, and by 1935 occupied third place, American and Dutch exports, curiously enough, occupying first and second place respectively. It would appear, however, from recently published figures, that Germany is commencing to make an effort to regain her former supremacy.



RADIO-CONTROLLED MODEL AEROPLANE. Successful flights were made by this miniature machine during a recent test in America. The ultra-short-wave transmitter used to send the operating signals is seen in the hands of the owner.

How Old is Radio ?

AS the result of an investigation recently carried out to find when the word "radio" was first used in connection with wireless, a French technical journal, "Machines Parlantes et Radio," has found that it is well over fifty years of age. In 1882 a book was published entitled "Radiophonie," which described a system of transmitting news without the aid of any material link, or in other words, by "wireless." In those days the transmission of messages over short distances by induction was very well known.

French Wireless Taxes

THE Government tax on sponsored programmes given by French wireless stations is to be increased from 13 per cent. to 30 per cent. of the fees charged for the use of the station. This applies only to cases where the advertising is given in French; in cases where a foreign language is used the tax will be increased from 48 per cent. to 65 per cent. Seventeen per cent. of the tax in each case will go to the French Post Office.

Lectures on Acoustics

A COURSE of five lectures on "Electro-Acoustics" will be given by Dr. Erwin Meyer at the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2, on October 12th, 13th, 15th, 18th and 20th, at 5.30 p.m. The lectures, which will be accompanied by demonstrations, have been arranged by the University of London, and admission is free. Meetings of the Wireless Section of the I.E.E. for the 1937-8 season have been arranged for the first Wednesday evening in every month, from November to May, both inclusive.

Indian Broadcasting

IT is reported that recent suggestions to hand over the control of Indian broadcasting to a semi-independent corporation modelled on the lines of the B.B.C. are not viewed with favour in official quarters in India. It is pointed out that although such a course might be adopted in the fullness of time, no deviation from the present arrangement can be contemplated at present.

The development of the station-building plans of All-India Radio is proceeding apace. The central idea is to provide a short-wave service for the whole country and to expand gradually the area served by medium-wave stations. Short-wave stations are to be located at Delhi, Bombay, Calcutta and Madras. Medium-wave stations are to be erected at Lahore, Lucknow, Trichinopoly, Dacca and Madras.

National PA

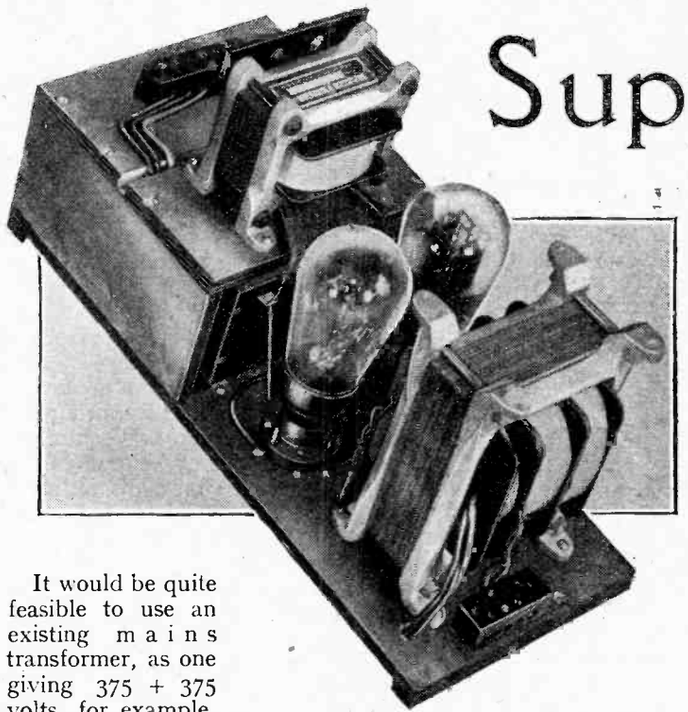
THE decision taken in Germany to install permanent public-address loud speakers at

The wireless town-crier.

crowded spots of towns and villages, is typical of German thoroughness. Hitherto, if a member of the Government wished to address the nation, certain preparations were required to provide for suitable public address in the open. In future this will become unnecessary. The new loud speaker system will be, no doubt, linked up permanently with the telephone exchanges or with suitable central receiving posts. Regional addresses will be as easily effected as nation-wide broadcasts. The existing community listening apparatus in factories and offices will remain. In times of crisis the Government will, at a moment's notice, be able to address the people independently of the broadcast transmitters.

High-Voltage Transmitter Supply Unit

A NEW APPLICATION FOR THE VOLTAGE DOUBLING CIRCUIT



By H. B. DENT

AMONG the many problems that arise in connection with amateur transmitting equipment is that of providing HT supplies of the order of 1,000 volts or so for the final RF amplifier and possibly for the modulating amplifier as well.

With the orthodox full-wave rectifying circuit the mains transformer must be wound to give 1,000 + 1,000 volts, consequently very good insulation is needed and such transformers are comparatively expensive. Added to this, special high-voltage condensers and rectifying valves are required which still further add to the cost.

The writer has for some time past been using a supply unit giving about 900 volts at 50 to 60 mA smoothed DC and using ordinary receiving-type rectifying valves. The output from the secondary winding on the mains transformer is only 425 volts RMS.

The high-voltage output is obtained by making use of a voltage doubling circuit as shown in Fig. 1. This scheme has proved very satisfactory indeed and has enabled many existing parts to be utilised. Condensers C1 and C2 are 600 volts peak working type and the only high-voltage condenser in the unit is C3, which has to stand the full peak voltage, which on light load might rise to 1,200 volts.

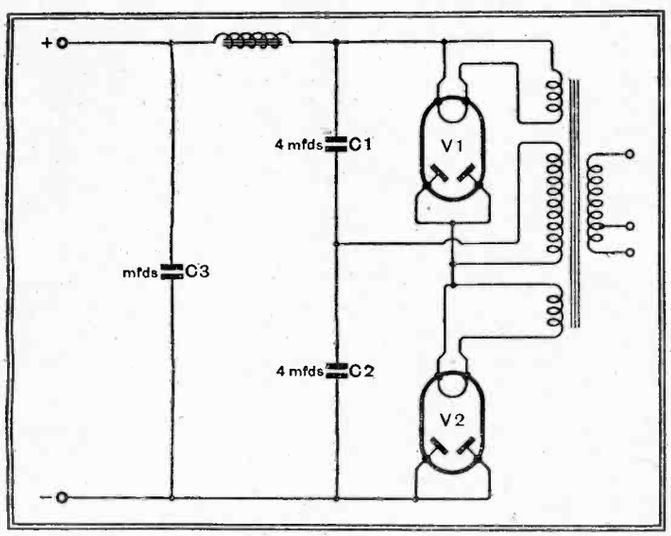


Fig. 1.—Theoretical circuit of the voltage-doubling HT supply unit.

It is also essential that the filament winding of the rectifier valve V1 be particularly well insulated, since between it and all other windings and the core is the full output potential.

It would be quite feasible to use an existing mains transformer, as one giving 375 + 375 volts, for example, will enable 750 to 800 volts at 40 to 50 mA to be obtained from ordinary receiving-type rectifying valves when using only one half of the winding. It might, however, be advisable if any doubt exists regarding the insulation of the filament windings to employ a separate filament transformer for the valve V1, but this is quite unnecessary in the case of V2, as one of the filament windings on the transformer can be used, since the difference in potential is no greater than under the usual condition of operation, i.e., in a full-wave rectifier circuit.

Another advantage of this scheme is that the transformer is comparatively easy to build, for as only about half the usual secondary voltage is required it is less tedious to wind and *extra* special precautions are not necessary to achieve satisfactory insulation.

Should this course be adopted the filament winding for the valve V1 could be wound on a separate bobbin well insulated from the core and the other windings.

The arrangement of the windings on the transformer that was built for this particular power unit is shown in Fig. 2. DSC wire was used for the primary and the HT secondary windings, and DCC wire for the two filament windings. If an additional LT winding is required, say, for the filament supply for the RF amplifier valve in the transmitter, it could be wound on the same bobbin as the primary. Though ample space will probably be available on the V1 filament bobbin the temptation to utilise it should be resisted unless considerable experience has been had in the construction of high-voltage mains transformers.

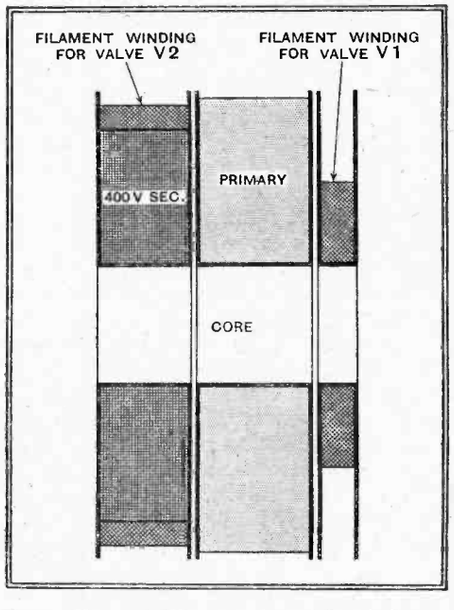


Fig. 2.—Suggested arrangement of the windings on a mains transformer for the HT unit.

UNBIASED

By FREE GRID

PA and Parsimony

THERE always seems to be a certain section, or sections, of every civilised country where the inhabitants acquire, justly or unjustly, a reputation for close-fistedness in their financial transactions. This country is, of course, no exception to the rule, although wild horses will not drag from me the names of the particular parts of it that I have in mind. No names no pack drill is my rule, and I intend to observe it. Still, my readers are not entirely bereft of intelligence in spite of what Mrs. Free Grid says, and so they should have no difficulty in understanding what I am talking about.

Curiously enough, the people who possess this parsimonious trait in their make-up, with the characteristic cleverness of their kind, never confess to it as being a dark stain on an otherwise unblemished character, but turn it into a virtue. As one of them with whom I

I at once entered into conversation.

was discussing the matter the other day put it, "the people of —— are not mean, they're careful."

All the foregoing preamble, which has undoubtedly set those of you who think the cap fits to seize your pens and write indignant letters to the Editor, is due to the fact that only the other day, while in one of the parts of the country which I have in mind, I came across a remarkable instance of this sort of parsimony in connection with a PA installation.

I happened to find myself quite unexpectedly at a seaside resort in the county of —— due to my having absentmindedly got into a long-distance train at one of the big London termini instead of a local one to a suburb at which I had an appointment. Having some little time to spare before there was a convenient return train, I wandered down to the sea front and dropped idly into a seat by the bandstand, in which some local Henry Hall was seeking to instil some of the *joie de vivre* into the dour-looking faces of the audience.

It was not long before I spotted the ubiquitous microphone dangling over the heads of the band, and I idly looked round for the loud speakers of the PA system to which it obviously belonged. I was not altogether surprised at not finding any as nowadays the people responsible for seaside bandstands are getting more and more adept at disguising loud speakers as ornamental lamps or something of that sort, but what did rather cause me to wonder was the reason for there being any PA installation at all as the seating accommodation around the stand was so restricted that even the most distant chair appeared to be well within earshot of the band.

Pursuing my policy of never neglecting any opportunity of improving my knowledge, I at once entered into a conversation on the subject with the man in the neighbouring seat, and he surprised me by saying that actually there was neither amplifier nor loud speakers, and even the microphone was only a dummy. He explained this state of affairs by saying that nowadays competition between seaside resorts was so fierce that any and every means were taken by the various town councils to improve the amenities of their particular resort.

One of the *sine quâ non* of any self-respecting seaside town nowadays apparently is a PA system associated with the local bandstand, as no visitor cares to be seen at a resort not possessing this evidence of modernity. The members of the local council of this particular town realised this, but being also "careful," did not see why they should go to unnecessary expense in the matter as the presence of a microphone would, they thought, be quite sufficient "evidence" for the average technically ignorant seaside visitor that the resort was completely up to date in this respect.

A Question of L and C

ACTING on my principle of never doing anything to-day than can possibly be put off until to-morrow, I have lately been repeatedly postponing a wireless job which I promised to do for a commercial-traveller friend of mine. I now find myself rather up against it as he is now demanding the result of my labours. It involves rather a lot of experimental work and unless some of you can help me, I am afraid that I shall have the mortification of letting him down.

The trouble is this. In the course of his business my friend naturally spends most of his life in hotels, and owing to a regrettable habit of over-sleeping he frequently misses very important appointments. Knowing, by bitter experience, the unreliability of chambermaids, he equipped himself with an alarm clock. Unfortunately, this did not create enough din to arouse him on all occasions, and he at once consulted me upon the matter.

Very important appointments.

Needless to say I built him a powerful battery-driven amplifier equipped with loud speaker and microphone, and fitted it into a suitcase. The noise created by this apparatus was more than sufficient to rouse him; in fact, it led to complaints from neighbouring hotels. But, as usual, there was the inevitable fly in the ointment. The "tick" of the clock was also amplified and was so loud that it was strongly reminiscent of a pneumatic road drill, and not only he but all the hotel was kept awake by it.

He quite naturally pointed out to me this defect in the apparatus which I had constructed for him, and I rather rashly promised to let him have a solution of the problem within a couple of months. Owing to my habit of procrastination I find that the period has well nigh expired and I have not nearly finished my experimental work, and this is where you may be able to help me.

The solution to the trouble is both obvious and simple—on paper; in actual practice I have found it far from being the case. I have made the suitcase which contains the clock, microphone and amplifier absolutely soundproof, and hoped to get rid of the pneumatic drill effect by including in the amplifier a simple LF filter-circuit tuned to the frequency of the tick.

The great question is, of course, what is the particular frequency of the wretched tick? Being neither a musician nor a mathematician, I have not attempted to work out the L and C values of my filter theoretically, but have been relying on trial and error. So far, however, I have had no luck even though I honestly believe that I have been through the whole gamut not only of musical but of unmusical frequencies also.

This is where you highbrows come in. What I want to know is, what values of L and C should I employ in the filter, or, alternatively, can you think of any other manner in which the problem can be solved?

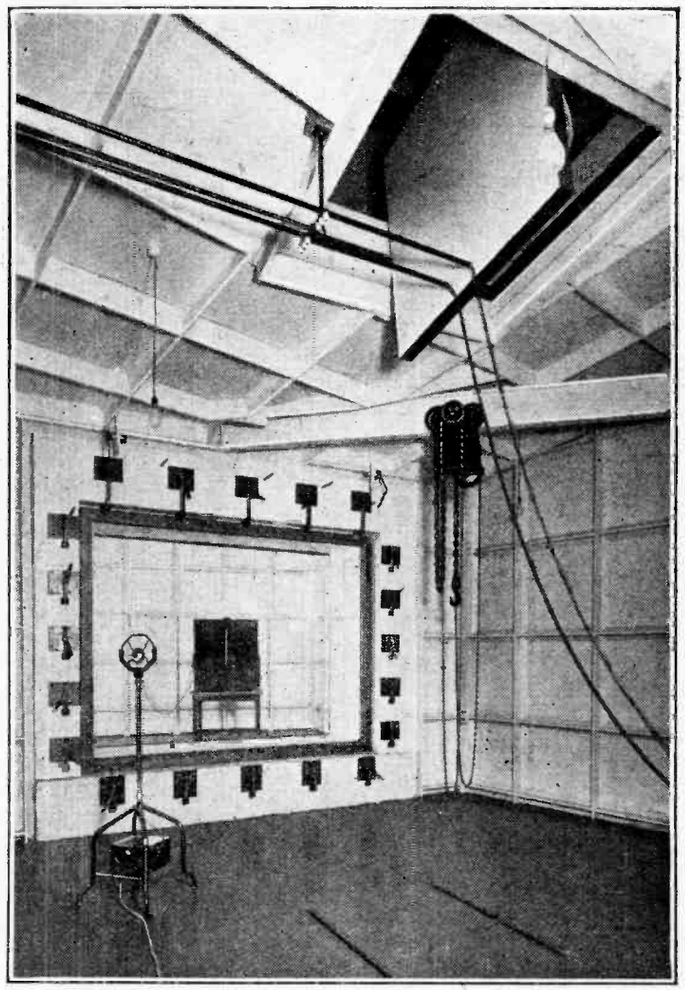
Acoustical Vibration in Buildings

RESEARCH INTO THE TRANSMISSION OF SOUND THROUGH PARTITIONS

By J. E. R. CONSTABLE, M.A., Ph.D., B.Sc.

(Physics Department National Physical Laboratory)

A GREAT deal of research in connection with the vibration of buildings has been conducted in various laboratories throughout the world. In England, the National Physical Laboratory, which comes under the Department for Scientific and Industrial Research, has been largely responsible for the research work. An important part of the work is, naturally, an investigation into the features which affect the transmission of sound through walls and partitions.



Sound transmission room in the New Acoustics Laboratory, N.P.L.

Photo. by courtesy of the Controller of H.M. Stationery Office.

THE necessity for investigating work regarding transmission of sound in buildings will be agreed to by anyone possessing a neighbour. Such transmission is only a manifestation of the fact that acoustical vibration is present in the walls and floors of the building.

For this work, the partition to be tested is sealed into an aperture connecting two otherwise sound-proof rooms, in one of which sound is emitted by a loud speaker and in the other the sound transmitted is picked up and measured by microphone. The results of many measurements upon partitions ranging from thin paper to heavy concrete show that as far as solid partitions are concerned, sound insulation is determined almost entirely by the weight of the partition per square foot, the nature of the material so long as it does not contain holes or cracks being of secondary importance.

This result is illustrated in Fig. 1. Here the sound reduction factor, i.e., the ratio of the sound falling on a partition to that transmitted through it, is given in terms of the now familiar decibel, the sound insulation being expressed as 10 times the common logarithm of the ratio of the intensity of the sound falling on a wall to that transmitted by it.[1] It will be noted that whatever the material the sound insulation falls close to the average curve. Although the sound insulation increases with weight, the curve shows that it does so quite slowly, an increase of weight of 100 per cent. being required to obtain a gain in insulation of 5 db.—a relatively small increase. This means that a wall having a sound-insulating value appreciably greater than that of the average party wall of a house (9in. brickwork) would need to be twice as thick.

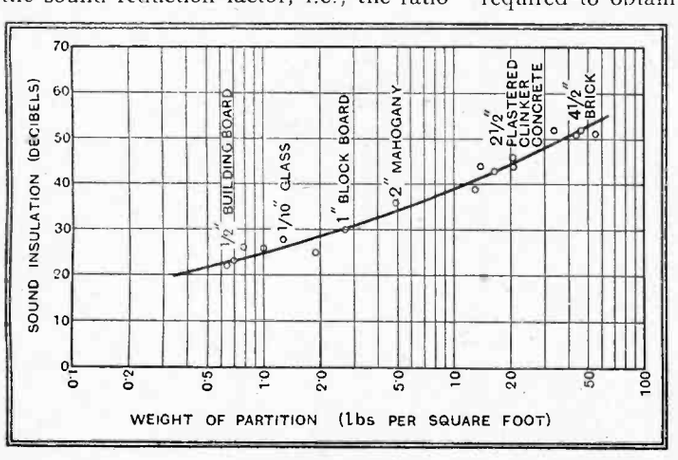


Fig. 1.—Relationship of sound insulation to weight per square foot for single partitions of various materials. Average values for frequencies of 200, 300, 500, 700, 1,000, 1,600 and 2,000 c/s are plotted as single points.

To get over the difficulty of having to use very heavy walls to obtain a high degree of sound insulation, double structures are used, for example, double windows, double doors and cavity walls. If properly constructed these afford much greater insulation than a single solid partition of the same weight. Thus the sound-insulation of a wall can be improved by converting it into a complex structure, e.g., by fixing wood battens to it and covering them with building board which is subsequently plastered.

It is of considerable interest to determine the manner in which sound passes through a wall. There is, for example, the remarkable relation between sound insulation and weight to be explained. Calculation shows that if only a wall could be regarded as having no stiffness but only weight, the dependence of sound-insulation upon weight could be easily explained. However, the calculation also shows that the insulation would then be greater than

[1] J. E. R. Constable and G. H. Aston, "Philosophical Magazine," Ser., Vol. 23, p. 161, Jan., 1937.

Acoustical Vibration in Buildings—

is measured. Accordingly, it has been supposed that the wall has a number of resonances, just as has a loud speaker diaphragm, and that their combined effect reduces the insulation. To test whether these resonances do in fact exist and to determine their effect upon a wall, two simple instruments have been used.

The purpose of these two instruments is to measure the amplitude of vibration of light and heavy partitions (for example, window glass and brick walls respectively). They are also of value when tracing the path of what is termed "structure-borne sound," for example, sounds travelling through the pipes and the framework of steel-framed buildings. The instrument[2] used for measuring the vibration of light partitions or structures, such as window glass, building board, and sheet metal partitions, was designed to avoid disturbances of the vibrating system such as would be caused by a stiff

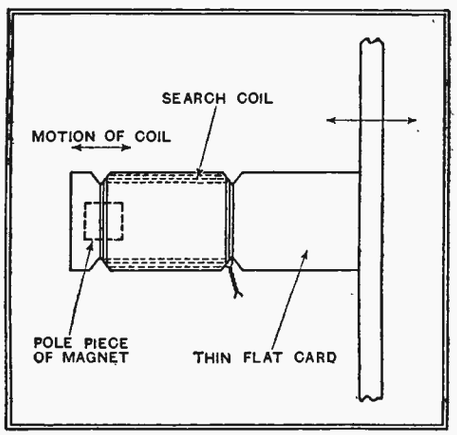


Fig. 2.—Rectangular search coil wound in thin card for exploring light partitions.

or heavy mechanical contact. It is shown in Fig. 2 and consists of a light rectangular search coil of about twenty turns of fine insulated copper wire wound as shown on a small piece of thin cardboard (size of coil about half a visiting card). The search coil is cemented to the structure to be tested and is too light to have any appreciable effect on the vibration. One side of the vibrating coil moves across the field of a small horseshoe permanent magnet, the pole pieces of which have an area of about $\frac{5}{8}$ sq. in., the opposite side of the coil being well out of the field of the magnet. The voltages induced in the coil when the partition vibrates are amplified by a suitable valve amplifier and fed to an AC meter. As the coil moves in an approximately uniform magnetic field its output is proportional to the amplitude of vibration which is thus readily obtainable.

Slight modifications of the coil have been devised for detecting motion of a partition in other directions, but the principle remains the same. The apparatus could easily be made more sensitive, but as built was sufficiently sensitive to detect the vibration due to the sound of conversation passing through window glass 0.1in. thick.

With this apparatus it was possible to show that a light partition such as a sheet of glass has many resonances spread over a wide range of frequency. The existence of these resonances can be observed sometimes when listening to music passing through a glass window; certain frequencies may be heard to come through very clearly, the glass sometimes "ringing," or rattling if loose in its frame.

The instrument used at the National Physical Laboratory for measuring the vibration of heavy walls has the advantage over that described above in that, instead of being rigidly attached, it is pressed against the surface by hand, and can, therefore, be moved from point to point. This can be done in the case of heavy walls since they are too heavy to be affected by this treatment. The instrument is a sort of gramophone pick-up except that it measures longitudinal vibrations instead of transverse such as those generated by a gramophone record. It is shown diagrammatically in Fig. 3, and it consists of an obsolete moving-coil loud speaker unit to the coil of which a brass rod is fixed. The rod is supported at one end by the loud speaker diaphragm and at the other by an additional thin bronze diaphragm soldered to the neck of the unit. Limit stops are provided, as shown, to prevent excessive movement. The free end of the rod is pressed against the surface to be examined, and the voltages induced in the coil are transformed up and fed to a high gain amplifier.

As an illustration of the instrument's

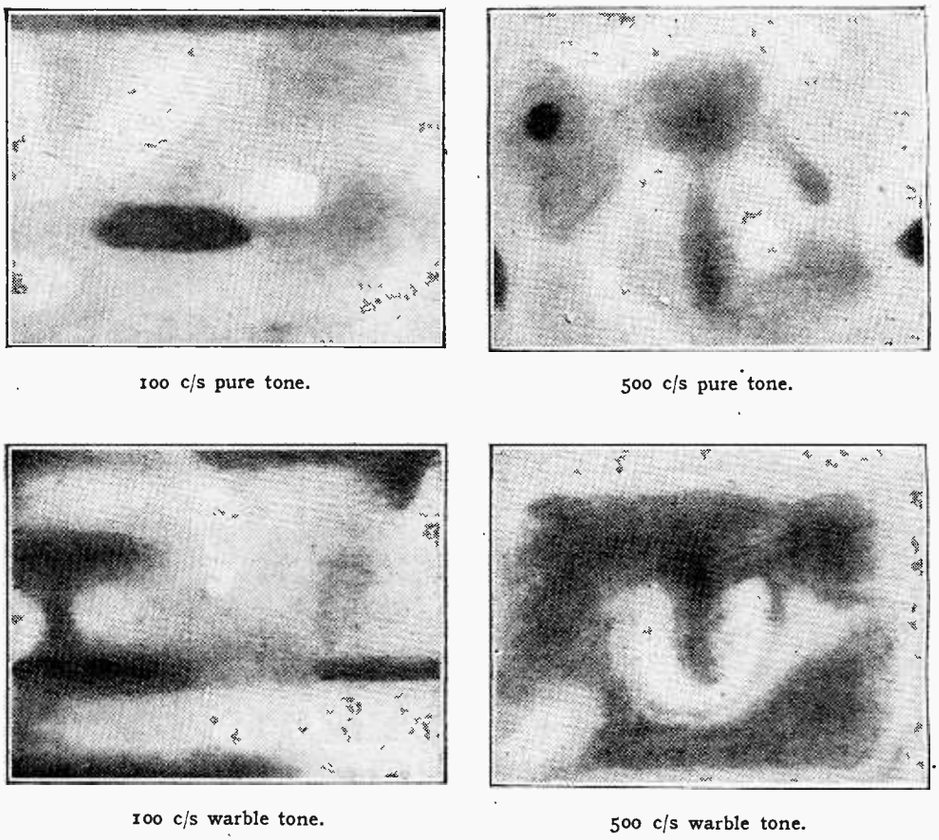


Fig. 4.—Vibration patterns of plastered 9-inch wall at various

[2] J. E. R. Constable, Proc. Phys. Soc. Lond. Vol. 48, p. 914, 1936.

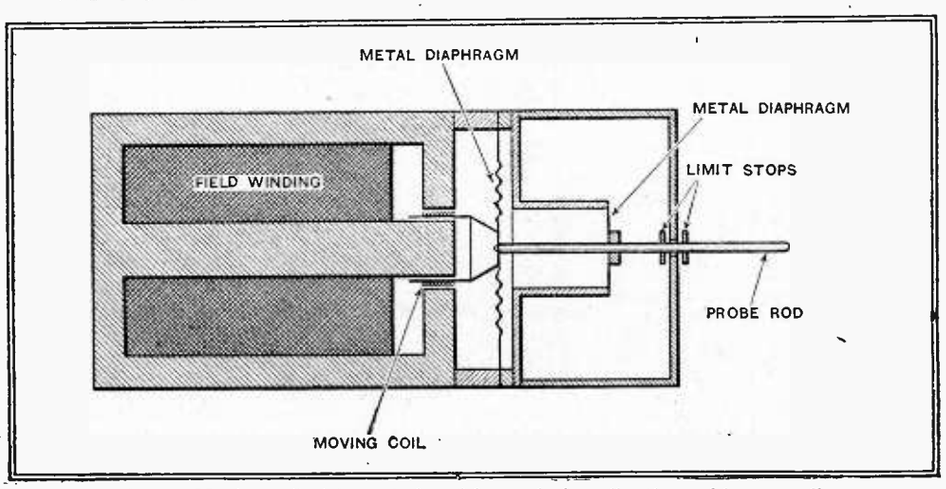
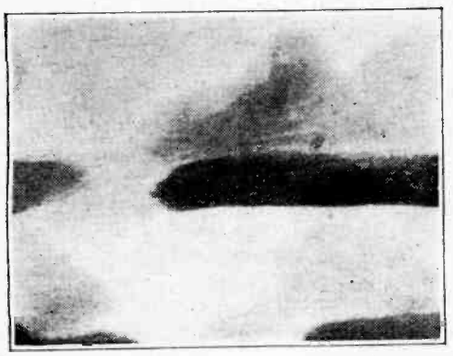


Fig. 3.—Moving coil pick-up designed for exploring vibrations of heavy walls.

1,600 c/s pure tone.

4,000 c/s pure tone.



1,600 c/s warble tone.

4,000 c/s warble tone.

frequencies. . . . The areas of greatest vibration are shown black.

use, some experiments may be mentioned in which it was used to survey the surface of a 9in. brick wall measuring about 10ft. by 8ft., which was set in vibration by sound falling on it from a loud speaker in the room on the other side.[3] This corresponds to the case of sound from the neighbour's wireless set penetrating to one's own house through the party wall. The photographs[4] shown in Fig. 4 illustrate the distribution of vibrational energy on the surface of the wall for various frequencies. The figures, in which the areas of greatest vibration are shown black, recall Chladni's figures, with which the majority of readers will no doubt be familiar. As might be expected from the non-uniform character of a brick wall the figures are not so symmetrical. The photographs show that a wall transmitting sound executes complicated flexural vibrations the amplitudes of which vary from point to point.

It will be noticed that measurements were also made using a "warble" tone that is to say, a note the frequency of which instead of remaining constant varied continually up and down about a mean value; some works syrens give a good warble tone. It will be noticed that the pattern is not as intense in this case, but does not disappear. This indicates that certain patterns correspond to resonances of the wall and that as the warble sweeps through the particular resonance the pattern is brought into being and is maintained there by the repeated action of the warble.

If any readers are anxious to pursue these phenomena in their own homes they can try the experiment of generating a pure tone in one room (the B.B.C. tuning signal would do) and tracing the vibration pattern of the wall between this room and another. This can be done well enough by listening (in the second room) to the wall vibration by placing one ear in contact with the wall.

[3] J. E. R. Constable and G. H. Aston, Proc. Physical Society, Vol. 48, p. 919, 1936.

[4] Reproduced by kind permission of the Physical Society.

The Radio Industry

THE Lexington Valve Tester has been reduced in price from 10gs. to 8gs. net. An adaptor panel for the testing of Continental valves with this instrument has been introduced.

The British Tempovox Co., Holly Road, Hampton Hill, Middx, is introducing, towards the end of the present month, a superheterodyne receiver combined with an electric clock.

The Radio Development Company has moved to Epoch House, 101-105, Goswell Road, London, E.C.1. Telephone: Clerkenwell 4865.

E. K. Cole, Ltd., have acquired the business of Thermovent, Ltd., makers of electrical convection heaters.

A leaflet describing the Cossor oscilloscope and ganging oscillator is available from A. C. Cossor, Ltd., Cossor House, Highbury Grove, London, N.5.

We are informed that a new company is to be formed for the production of "custom-built" receivers of the luxury type. The foundation will be an 18-valve chassis of the latest design and cabinets will be built to the individual requirements of each customer. A Voigt loud speaker will be included in the equipment, and each set will be supplied with a set of spare valves and a five-years' guarantee. Enquiries should be addressed to the Keates-Hacker Co., Ltd., 91-93, Bishopsgate, London, E.C.2.

Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Sound	Vision
45 Mc/s.	41.5 Mc/s.

FRIDAY, OCTOBER 1st.

3, O.B. from Pinewood Film Studios. **3.10,** Friends from the Zoo. **3.25,** Gaumont-British News. **3.35,** Cabaret including A. C. Astor (ventriloquist), The Six Clevettes (dancers) and Bil and Bil (comedy acrobats).

9, O.B. from Pinewood Film Studios. **9.10,** More Friends from the Zoo. **9.25,** British Movietonews. **9.35,** "Victorian Afternoon": a sentimental journey into the 60's.

SATURDAY, OCTOBER 2nd.

3, O.B. from Pinewood Film Studios; stars in their dressing-rooms. **3.15,** In our Garden: C. H. Middleton discusses planting plans. **3.30,** British Movietonews. **3.40,** "Keep your eye on the Ball": a sporting revue.

9, O.B. from Pinewood Film Studios: René Clair producing Maurice Chevalier and Adèle Astaire in "Break the News." **9.15,** "They're Off": a musical melodidrama. **9.45,** Gaumont-British News. **9.55,** Put your clocks back—a topical item.

MONDAY, OCTOBER 4th.

3, O.B. from Pinewood Film Studios: introducing Louis Levy and Jessie Matthews. **3.15,** Nancy Logan (songs at the piano). **3.20,** British Movietonews. **3.30,** "Peer Gynt."

9, O.B. from Pinewood Film Studios. **9.10,** Peggy Cochrane in selections from her repertoire. **9.20,** Gaumont-British News. **9.30,** "Peer Gynt."

TUESDAY, OCTOBER 5th.

3, O.B. from Pinewood Film Studios: views of the gardens. **3.15,** Physical Culture—1. **3.30** Gaumont-British News. **3.40,** "Nonsense."

9, O.B. from Pinewood Film Studios: A final glimpse. **9.15,** First time Here. **9.30,** British Movietonews. **9.40,** Cabaret.

WEDNESDAY, OCTOBER 6th.

3, "Do Help Yourselves." **3.25,** British-Movietonews. **3.35,** Eighty-third edition of Picture Page.

9, "Do Help Yourselves." **9.25,** Gaumont-British News. **9.35,** Eighty-fourth edition of Picture Page.

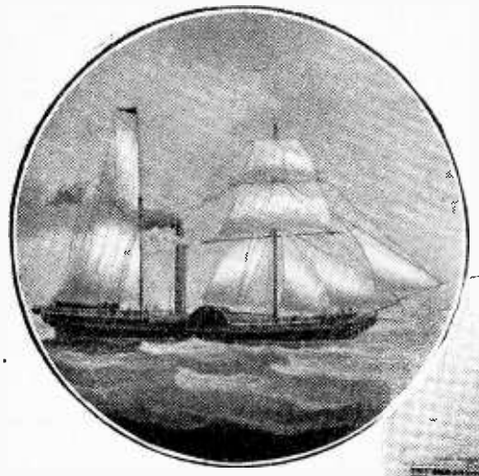
THURSDAY, OCTOBER 7th.

3, Guelda Waller and Vera Maconochie in "A Chelsea China Pastoral." **3.5,** Fashion Display. **3.20,** Gaumont-British News. **3.30,** Great Love Scene.

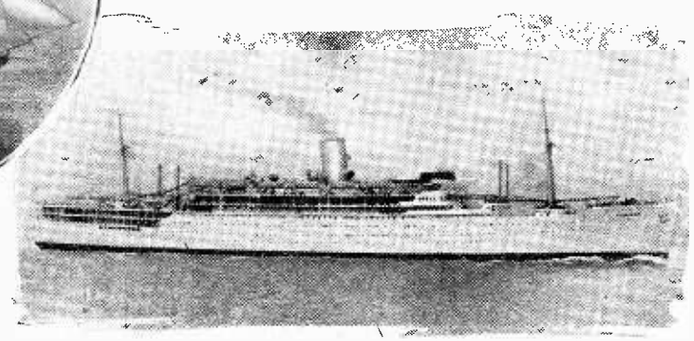
9, Fashion Display. **9.15,** Science—1. **9.30,** British Movietonews. **9.40,** "Nonsense."

Listeners' Guide fo

Outstanding Bro



1837 AND 1937. Inset is the *William Fawcett*, the first vessel chartered by the Peninsular Steam Navigation Company, of 206 tons and 60 h.p., whilst below is seen the *Strathmore*, of 23,500 tons and 24,000 h.p., the latest and largest of the "P. & O." fleet. The centenary of the "P. & O." will be celebrated in a broadcast on Wednesday.



THIS week, being the first of the autumn quarter, sees the commencement of a number of new series of programmes and the revival of one or two tried favourites.

There are two new series of talks which promise to be well worth listening to. On Mondays at 8 (Nat.) Anthony Bertram will speak on "Design in Everyday Things." For some weeks Mr. Bertram toured the country making observations, and his conclusions will be the subject of these talks. The diversity of subjects with which he will deal is apparent from the following taken from a long list: houses, furnishings, mechanical appliances, streets, public buildings, sports grounds, theatres, etc., etc.

Another series which comes at 7.30 (Nat.) on Tuesdays will be given by a well-known schoolmaster, R. W. Jepson, and will deal with "Clear Thinking." This is also the title of a book of which he is author. This will be a challenging series in that the listener will be invited to examine his own mode of thought and to ask himself whether he is thinking logically and clearly.

To-night (Friday) at 10.0 (Nat.) Sir Richard Maconachie, Director of Talks, will speak on the programme arranged for talks during the autumn.

MAFEKING

LORD BADEN-POWELL returns to the microphone within three weeks of his broadcast in the series "I Saw the Start" as the first speaker in the third "I Was There" series. On Tuesday at 9.20 (Nat.) he will deal with Mafeking which, at the outbreak of the Boer War in 1899, was cut off by the Boer forces. Lord Baden-Powell was then Colonel in command of the defence which was maintained for 217 days until relief came.

It will be good to hear from the one inseparably associated with the siege the story of this epic of the Boer War.

CENTENARY

A FEATURE programme to be broadcast from the National transmitter on Wednesday at 9.20, entitled "A Century of Steam," will celebrate the centenary of the "P. and O." The first monthly sailing of the Peninsular Steam Navigation Company, as it was then called, was in September, 1837, a month after the founders of the company had signed a contract with the Admiralty to convey Her Majesty's mails between England and the Spanish Peninsular. Three years later the service was extended to Egypt and India and the word "Oriental" was then added to the company's title. This should prove an interesting broadcast, giving as it will the story of the evolution of the steamship.

EXPERIMENTAL

As already announced, the Drama Director has been granted hourly periods for experimental broadcasts to be devoted to unusual types of programme having no pretentions to a widely popular appeal. There will be about four of these periods during this quarter. The first of these —all of which will be given in the late evening—will be heard Nationally on Thursday at 10.20. This will be "The Fall of the City," a verse play for radio by Archibald Macleish, which was written for the C.B.S. "workshop" (experimental programmes). In technique it is quite different from the conventional broadcast play.

For listeners who are not afraid of something new and frankly experimental, this play should be well worth hearing.

"ALL GOOD THINGS . . ."

THE Promenade Concerts end traditionally on Saturday evening with Sir Henry Wood's "Fantasia on British Sea Songs." The whole of the programme will be broadcast, the first part Nationally at 8, and the second at 9.40 (Reg.). The Symphony will be Schubert's "Unfinished," which will be heard during the first half, as will also the first concert performance of Arnold Bax's "London Pageant," which is dedicated to the B.B.C. Symphony Orchestra and was broadcast for the first time on May 4th during the Coronation celebrations.

AERIAL VARIETY

CHARLES BREWER, Assistant Director of Variety, has assembled another cast of ex-Air Force stage stars to take part in the third edition of "Flying High," which is to be broadcast on the National wavelength on Tuesday at 8. As guest artistes listeners will hear Ft. Lt. Tommy Rose, the well-known pilot, and Mlle.

ATMOSPHERE. Some of the cast of the last "Flying High" programme with Charles Brewer at an aerodrome to get local colour for their broadcast. They are, left to right, Alan Russell, Roy Royston, Sir Alan Cobham, Charles Brewer, Hugh Wakefield, and Sonny Day. Of these, all but Sir Alan Cobham will be heard in Tuesday's broadcast.

the Week

The times of programmes from Sunday onwards are given in G.M.T.

sts at Home and Abroad

Simone Deretz, the original Mademoiselle from Armentières.

"Flying High" will, as usual, consist of popular songs of 1917-18 vintage, and once more the audience will be drawn from the Comrades of the R.A.F. Association and Old Comrades of the W.R.A.F.

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"PALACE OF VARIETIES"

THE tenth visit to the imaginary "Palace of Varieties" will be heard by listeners to-night (Friday) at 8 o'clock (Nat.) Miriam Ferris and Joan Young in the guise of two matey housewives will convey to listeners from their seats in the "pit" what is happening. The bill is an attractive one, and will be opened by John Rorke singing some cheery songs in his inimitable way. It includes two acts which have not previously been heard by listeners; these are Winsor and Wilton, a bright double patter act; and the Gerard Singers, a quartet which includes two very well-known singers.

A famous music-hall act which has not previously been heard from a studio is included in this performance. This is Elsie Bower and Billy Rutherford, who have been entertaining theatre audiences for many years. Listeners to the September edition of Radio Rodeo will remember hearing this popular turn from the Union Cinema, Kingston-on-Thames.

A high spot in the bill is a musical show entitled "Good Pull-up for Cyclists," which has been written, composed, arranged and orchestrated by Ernest Longstaffe, the producer of "Palace of Varieties."

SWEDISH MUSIC will be played by the Gothenburg Wireless Orchestra, which is here seen conducted by Tor Mann, during a concert from Gothenburg to be relayed by all Scandinavian stations on Tuesday at 7. This concert is the outcome of an arrangement to provide inter-Scandinavian music and educational broadcasts.

◈ ◈ ◈

LOSSIEMOUTH

REGIONAL listeners on Saturday at 9 will hear a repetition of one of the most successful of recent actuality broadcasts, "Landings at Lossiemouth." It is a programme of the fishing industry and the microphone will visit the homes of some of the fisher folk, will be on the quay for the arrival of one of the fishing boats, and will then go to the auction room for the sale of the catch.

◈ ◈ ◈

SONG HUNT

LISTENERS will again have the opportunity of taking part in a big "song hunt" during the reintroduction of the popular feature of last winter, "Songs You Might Never Have Heard," the first of which will be heard at 9 (Reg.) on Wednesday. Bruce Sievier, who originated the programmes which he is again arranging, has collected from the shelves of music publishers about two hundred all-British songs which, though published prior to 1937, have not been performed. As during the last series, listeners will be invited to vote for the song which they like best.

MEET "THE PLUMS"

AT 7.45 every Monday evening National listeners will spend fifteen minutes with "The Plums," a Lancashire "family" of newcomers to broadcasting. They are the creation of Sonny Miller, who is well known to listeners for his popular broadcasts, "Paradise Isle."

There will be Gus Plum, his wife Aggie, and their children, Mary and Willy, whose daily life will form a basis of each broadcast. A typical, though mythical, North Country family of the type which cheerfully endures the struggle to keep its head above water, the Plum family should make entertaining listening.

◈ ◈ ◈

OPERA

THERE is a scarcity of opera broadcasts from the Continent this week. On Saturday Brussels II is relaying Wagner's "Lohengrin" from the Royal Flemish Opera House, Antwerp, at 8. Paris PTT is giving excerpts from the Salle Gaveau performance of Debussy's only opera, "Pelléas et Mélisande," on the same evening at 8.30. As mentioned last week, this will be the seventy-fifth birthday of Maeterlinck, whose drama it is that Debussy has used for this opera.

Although there is a dearth of straight opera, there are a few good comic opera broadcasts. From the State-controlled French station, Toulouse-Pyrenees, at 8.30, on Sunday, will be heard a gala performance of Ibert's "Angélique." On Monday Kalundborg relays from the Casino, Aarhus, at 7.50, the second and third acts of Raymond's three-act "Spring in Heidelberg."

For the anniversary of Offenbach's death Strasbourg is giving a programme of music from his operettas on Monday at 8.30. THE AUDITOR.

HIGHLIGHTS OF THE WEEK

FRIDAY, OCTOBER 1st.

Nat., 7.30, Six Hours Back. 8, Palace of Varieties.
Reg., 6, Medvedeff's Balalaika Orchestra. 8.20, Beethoven Prom. 9.35, Star Gazing: Huntley Wright.
Abroad.
Leipzig, 8, Symphony Concert from the National Theatre, Weiman.

SATURDAY, OCTOBER 2nd.

Nat., 3.40, Band of 2nd Batt. The Buffs from Eastbourne. 8, Promenade Concert.
Reg., 6, "Melody out of the Sky," presented by Jay Wilbur. 8, Music Hall. 9, Landings at Lossiemouth.
Abroad.
Königsberg, 8, Hindenburg Anniversary Programme.

SUNDAY, OCTOBER 3rd.

Nat., 5, Recital by the Choir of the Russian Orthodox Theological Academy, Paris. 6, Great Occasions in the House of Commons; the eve of the Great War.
Reg., 6.30, South Place Sunday Concert Society. 9.5, "To Catch a Thief"; a new radio play. 9.50, Troise and his Mandoliers.
Abroad.
Vienna, 6.10, Rosenthal (piano) and the Vienna Symphony Orchestra.

MONDAY, OCTOBER 4th.

Nat., 7, Monday at Seven. 8, Design in everyday things: Anthony Bertram. 9.35, Yiddish Chauve Souris.
Reg., 6.25, The International String Quartet from the Wigmore Hall. 8, Dancing Through: Geraldo and his orchestra. 9, Franz Schubert, a musical biography.—I
Abroad.
Radio Paris, 8.30, Three-act opéra-comique "Richard Coeur de Lion" (Grétry), from Nice.

TUESDAY, OCTOBER 5th.

Nat., 7.30, Clear Thinking: talk by R. W. Jepson. 8, Flying High—3. 9.20, I Was There: Lord Baden-Powell on Mafeking.
Reg., 7.30, The Leeds Triennial Musical Festival. 8.35, Conversation in the Train: Are Lawyers Necessary? 9, Billy Thorburn and his music.
Abroad.
All German stations, 7, Opening concert of the Winter Relief Fund Campaign, relayed from Deutschlandhalle.

WEDNESDAY, OCTOBER 6th.

Nat., 7.30, Musical Comedy "Princess Flavia." 9.20, "P. and O." Centenary Programme.
Reg., 6.20, The Serge Krish Septet. 9, Songs you Might Never Have Heard.
Abroad.
Königsberg, 7, Variety concert from the Stadthalle.

THURSDAY, OCTOBER 7th.

Nat., 7, Death at Newtownstewart: a reconstruction of a famous Ulster crime in the 70's. 10.20, "The Fall of the City": a verse play for radio.
Reg., 6.30, Recital: Clarinet Ensemble. 8.30, Musical comedy: "Princess Flavia."
Abroad.
Warsaw, 7, Symphony concert for the "Festival of Polish Art."

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Frequency and Wavelength

(This list is included in the first issue of each month. Stations with an Aerial Power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Ankara (Turkey)	152		1973.5	5
Kaunas (Lithuania)	153		1961	7
Radio Romania (Brasov) Romania	160		1875	150
Hilversum, No. 1 (Holland) (10 *kW.* till 2040)	160		1875	150
Lahti (Finland)	166		1807	150
Moscow, No. 1, RW1 (Komintern) (U.S.S.R.)	172		1744	500
Paris (Radio Paris) (France)	182		1648	80
Istanbul (Turkey)	185		1622	5
Irkutsk (U.S.S.R.)	187.5		1600	20
Deutschlandsender (Germany)	191		1571	60
National (Droitwich)	200		1500	150
Minsk, RW10 (U.S.S.R.)	208		1442	35
Reykjavik (Iceland)	208		1442	16
Motala (Sweden)	216		1389	150
Novosibirsk, RW76 (U.S.S.R.)	217.5		1379	100
Warsaw, No. 1 (Poland)	224		1339	120
Luxembourg	232		1293	150
Moscow, No. 2, RW49 (Stchelkovo) (U.S.S.R.)	232		1293	100
Kalundborg (Denmark)	240		1250	60
Vienna, No. 2 (Austria)	240		1250	0.5
Kiev, No. 1 (U.S.S.R.)	248		1209.6	100
Vigra (Aalesund) (Norway)	253		1186	10
Tashkent, RW11 (U.S.S.R.)	256.4		1170	25
Oslo (Norway)	260		1153.8	60
Leningrad, No. 1 RW53 (Kolpino) (U.S.S.R.)	271		1107	100
Tromsö (Norway)	282		1065	10
Tiflis, RW7 (U.S.S.R.)	283		1060	35
Saratov (U.S.S.R.)	340		882.3	20
Finmark (Norway)	347		864	10
Archangel (U.S.S.R.)	350		857.1	10
Rostov-on-Don, RW12 (U.S.S.R.)	355		845.1	20
Budapest, No. 2 (Hungary)	359.5		834.5	18
Sverdlovsk, RW5 (U.S.S.R.)	375		800	40
Voroneje, RW25 (U.S.S.R.)	390		769	10
Boden (Sweden)	392		765	0.6
Banska-Bystrica (Czechoslovakia) (15 *kW.* after 1800)	392		765	30
Geneva (Switzerland)	401		748	1.3
Moscow, No. 3 (RCZ) (U.S.S.R.)	413.5		726	100
Ostersund (Sweden)	413.5		726	0.6
Oulu (Finland)	431		696	10
Tartu (Estonia)	511		587.1	0.5
Hamar (Norway)	519		578	0.7
Innsbruck (Austria)	519		578	1
Ljubljana (Yugoslavia)	527		569.3	6.3
Viipuri (Finland)	527		569.3	10
Bolzano (Italy)	536		559.7	10
Wilno (Poland)	536		559.7	50
Budapest, No. 1 (Hungary)	546		549.5	120
Beromünster (Switzerland)	556		539.6	100
Athlone (Irish Free State)	565		531	100
Klaipeda (Lithuania)	565		531	10
Palermo (Italy)	565		531	3
Stuttgart (Germany)	574		522.6	100
Alpes-Grenoble, P.T.T. (France)	583		514.6	20
Madona (Latvia)	583		514.6	50
Vienna, No. 1 (Austria)	592		506.8	100
Rábat (Morocco)	601		499.2	25
Sundsvall (Sweden)	601		499.2	10
Florence (Italy)	610		491.8	20
Cairo, No. 1 (Egypt)	620		483.9	20
Brussels, No. 1 (Belgium)	620		483.9	15
Lisbon (Portugal)	629		476.9	15
Tröndelag (Norway)	629		476.9	20
Christiansand (Norway)	629		476.9	20
Prague, No. 1 (Czechoslovakia)	638		470.2	120
Lyons, P.T.T. (France)	648		463	100
Petrozavodsk (U.S.S.R.)	648		463	10
Cologne (Germany)	658		455.9	100
North Regional (Slaithwaite)	668		449.1	70
Jerusalem (Palestine)	668		449.1	20
Sottens (Switzerland)	677		443.1	100
Belgrade (Yugoslavia)	686		437.3	20
Paris. P.T.T. (France)	695		431.7	120
Stockholm (Sweden)	704		426.1	55
Rome, No. 1 (Italy)	713		420.8	50
Kharkov, No. 1, RW20 (U.S.S.R.)	722		415.4	10
Fredrikstad (Norway)	722		415.4	1
Tallinn (Estonia)	731		410.4	20
Madrid, EAJ2 (Spain)	731		410.4	3
Seville (Spain)	731		410.4	5.5
Munich (Germany)	740		405.4	100
Marseilles, P.T.T. (France)	749		400.5	100
Pori (Finland)	749		400.5	1
Katowice (Poland)	758		395.8	12
Scottish Regional (Westerglen)	767		391.1	70
North Scottish Regional (Burghead)	767		391.1	60
Stalino (U.S.S.R.)	776		386.6	10
Toulouse, P.T.T. (France)	776		386.6	120
Leipzig (Germany)	785		382.2	120
Barcelona, EAJ1 (Spain)	795		377.4	7.5
Lwow (Poland)	795		377.4	50
Welsh Regional (Penmon) (Anglesey)	804		373.1	5
Welsh Regional (Washford)	804		373.1	70
Milan, No. 1 (Italy)	814		368.6	50
Bucharest (Romania)	823		364.5	12
Kiev, No. 2, RW9 (U.S.S.R.)	832		360.6	35
Agen (France)	832		360.6	1.5
Berlin (Germany)	841		356.7	100
Sofia (Bulgaria)	850		352.9	100
Norwegian Relay Stations	850		352.9	—
Valencia (Spain)	850		352.9	3
Simferopol, RW52 (U.S.S.R.)	859		349.2	10
Strasbourg (France)	859		349.2	100
Poznan (Poland)	868		345.6	16
London Regional (Brookmans Park)	877		342.1	70
Linz (Austria)	886		338.6	15
Graz (Austria)	886		338.6	15
Helsinki (Finland)	895		335.2	10
Limoges, P.T.T. (France)	895		335.2	1.5
Hamburg (Germany)	904		331.9	100
Dniepropetrovsk (U.S.S.R.)	913		328.6	10
Toulouse (Radio Toulouse) (France)	913		328.6	60
Brno (Czechoslovakia)	922		325.4	32
Brussels, No. 2 (Belgium)	932		321.9	15
Algiers (Algeria)	941		318.8	12
Göteborg (Sweden)	941		318.8	10
Breslau (Germany)	950		315.8	100
Paris (Poste Parisien) (France)	959		312.8	60
Bordeaux-Sud-Ouest (France)	968		309.9	30
Odessa (U.S.S.R.)	968		309.9	10
Northern Ireland Regional (Lisnagarvey)	977		307.1	100
Bologna (Radio Marconi) (Italy)	9 6		304.3	50
Torun (Poland)	986		304.3	24
Hilversum No. 2 (Holland) (15 *kW.* till 2040)	995		301.5	60
Bratislava (Czechoslovakia)	1004		298.8	13.5
Midland Regional (Droitwich)	1013		296.2	70
Chernigov (U.S.S.R.)	1013		296.2	4
Barcelona, EAJ15 (Spain)	1022		293.5	3
Cracow (Poland)	1022		293.5	2
Oviedo (Spain)	1022		293.5	0.7
Königsberg, No. 1 (Heilsberg) (Germany)	1031		291	100
Parede (Portugal)	1031		291	5
Leningrad, No. 2, RW70 (U.S.S.R.)	1040		288.5	10
Rennes-Bretagne (France)	1040		288.5	120
West of England Regional (Washford)	1050		285.7	50
Bari No. 1 (Italy)	1059		283.3	20
Paris (Radio Cité) (France)	1068		280.9	0.8
Tiraspol, RW57 (U.S.S.R.)	1068		280.9	10
Bordeaux-Lafayette (France)	1077		278.6	35
Zagreb (Yugoslavia)	1086		276.2	0.7
Falun (Sweden)	1086		276.2	2
Madrid, EAJ7 (Spain)	1095		274	5
Vinnitsa (U.S.S.R.)	1095		274	10
Kuldiga (Latvia)	1104		271.7	10
Naples (Italy)	1104		271.7	10
Moravska-Ostrava (Czechoslovakia)	1113		269.5	11.2
Radio Normandie (Fécamp) (France)	1113		269.5	15
Alexandria, No. 1 (Egypt)	1122		267.4	0.5
Newcastle	1122		267.4	1
Nyiregyhaza (Hungary)	1122		267.4	6.25
Hörby (Sweden)	1131		265.3	10
Turin, No. 1 (Italy)	1140		263.2	7
Genoa (Italy)	1140		263.2	10
Trieste (Italy)	1140		263.2	10
London National (Brookmans Park)	1149		261.1	20
North National (Slaithwaite)	1149		261.1	20
Scottish National (Westerglen)	1149		261.1	50
Kosice (Czechoslovakia)	1158		259.1	10
Monte Ceneri (Switzerland)	1167		257.1	15
Copenhagen (Denmark)	1176		255.1	10
Nice-Corse (France)	1185		253.2	60
Frankfurt (*and Relays*) (Germany)	1195		251	25
Prague, No. 2 (Czechoslovakia)	1204		249.2	5
Lille, P.T.T. (France)	1213		247.3	60
Gleiwitz (Germany)	1231		243.7	5
Cork (Irish Free State)	1235		242.9	1
Saarbrücken (Germany)	1249		240.2	17
Riga (Latvia)	1258		238.5	15
Rome, No. 3 (Italy)	1258		238.5	1
Bilbao, EAJ8 (Spain)	1258		238.5	1
Nürnberg (Germany)	1267		236.8	2
Radio Mediterranée (Juan-les-Pins) (France)	1276		235.1	27
Dresden (Germany)	1285		233.5	0.25
Aberdeen	1285		233.5	1
Klagenfurt (Austria)	1294		231.8	5
Vorarlberg (Austria)	1294		231.8	5
Danzig	1303		230.2	0.5

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Swedish Relay Stations	1312	.....	228.7	—
Magyarovar (Hungary)	1321	.....	227.1	1.25
German Relay Stations	1330	.....	225.6	—
Montpellier, P.T.T. (France)	1339	.....	224	1.5
Lodz (Poland)	1339	.....	224	2
Dublin (Irish Free State)	1348	.....	222.6	0.5
Rjukan (Norway)	1348	.....	222.6	0.15
Salzburg (Austria)	1348	.....	222.6	2
Tampere (Finland)	1348	.....	222.6	0.7
Cairo No. 2 (Egypt)	1348	.....	222.6	0.5
Königsberg (Germany)	1348	.....	222.6	2
Nottoden (Norway)	1357	.....	221.1	0.15
Italian Relay Stations	1357	.....	221.1	—
L'Ile de France (France)	1366	.....	219.6	2
Basle (Switzerland)	1375	.....	218.2	0.5
Berne (Switzerland)	1375	.....	218.2	0.5
Warsaw, No. 2 (Poland)	1384	.....	216.8	7
Lyons (Radio Lyons) (France)	1393	.....	215.4	25
Stara-Zagora (Bulgaria)	1402	.....	214	2
Vaasa-Vasa (Finland)	1420	.....	211.3	10
Alexandria, No. 2 (Egypt)	1429	.....	209.9	0.5
Turku (Finland)	1429	.....	209.9	0.5
Miskolc (Hungary)	1438	.....	208.6	1.25
Paris (Eiffel Tower) (France)	1456	.....	206	7
Pecs (Hungary)	1465	.....	204.8	1.25
Belgian Relay Stations	1465	.....	204.8	0.1
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
Binche (Belgium)	1487	.....	201.7	0.1
Belgian Relay Stations	1492	.....	201.1	0.1
Nimes (France)	1492	.....	201.1	0.7
Albacete (Spain)	1492	.....	201.1	0.2
Santiago (Spain)	1492	.....	201.1	0.5
Belgian Relay Stations	1500	.....	200	0.1
Pietarsaari (Finland)	1500	.....	200	0.25
Radio Alcalá (Spain)	1500	.....	200	0.2
Karlskrona (Sweden)	1530	.....	196	0.2
Liepàja (Latvia)	1734	.....	173	0.1

SHORT-WAVE STATIONS OF THE WORLD

Station.	Call Sign.	kc/s.	Tuning Positions.	Metres.	kW.
Batavia (Java)	YDA	3,040	.....	98.68	10
Vancouver (Canada)	VE9BK	4,750	.....	62.63	—
Kharbarovsk (U.S.S.R.)	RV15	4.273	.....	70.20	12
Caracas (Venezuela)	YV5RC	5,800	.....	51.72	1
San Jose (Costa Rica)	TIGPH	5.820	.....	51.52	0.5
Vatican City (Vatican State)	HVJ	5,970	.....	50.26	10
Mexico City (Mexico)	XEBT	6,000	.....	50.00	1
Montreal (Canada)	CFCX	6,005	.....	49.96	—
Havana (Cuba)	COCO	6,010	.....	49.92	2.5
Prague (Podebrady) (Czechoslovakia)	OLR2A	6,010	.....	49.92	30
Bogota (Colombia)	HJ3ABH	6,018	.....	49.90	1
Zeesen (Germany)	DJC	6,020	.....	49.83	50
Boston (U.S.A.)	W1XAL	6,040	.....	49.67	20
Miami (U.S.A.)	W4XB	6,040	.....	49.67	2.5
Daventry (Gt. Britain)	GSA	6.050	.....	49.59	10-50
Cincinnati (U.S.A.)	W8XAL	6,060	.....	49.50	10
Philadelphia (U.S.A.)	W3XAU	6,060	.....	49.50	10
Skamlebaek (Denmark)	OXY	6,060	.....	49.50	0.5
Motala (Sweden)	SBG	6,060	.....	49.50	1
Chicago (U.S.A.)	W9XAA	6,080	.....	49.34	0.5
Lima (Peru)	OAX4Z	6.080	.....	49.34	15
Nairobi (Kenya)	VQ7LO	6,083	.....	49.31	0.5
Toronto (Bowmanville) (Canada)	CRCX	6,090	.....	49.26	0.5
Hong Kong (China)	ZBW2	6,090	.....	49.26	2
Johannesburg (South Africa)	ZTJ	6,100	.....	49.20	5
Bound Brook (U.S.A.)	W3XAL	6,100	.....	49.18	35
Chicago (U.S.A.)	W9XF	6,100	.....	49.18	10
Belgrade (Yugoslavia)	YUA	6,100	.....	49.18	1
Manizales (Colombia)	HJ4ABB	6,105	.....	49.12	1
Daventry (Gt. Britain)	GSL	6,110	.....	49.10	10-50
Calcutta (India)	VUC	6,110	.....	49.10	0.5
Pittsburgh (U.S.A.)	W8XK	6,140	.....	48.86	40
Winnipeg (Canada)	CJRO	6,150	.....	48.78	2
Lisbon (Portugal)	CSL	6,150	.....	48.78	0.5
Parede (Portugal)	CT1GO	6,200	.....	48.40	5
San Jose (Costa Rica)	TIPG	6,410	.....	46.80	0.5
Valencia (Colombia)	YV4RV	6,520	.....	46.00	0.5
Riobamba (Ecuador)	PRADO	6,620	.....	45.31	2
Amateurs		7,000 to 7,300	.....	42.86 to 41.10	0.01
Prangins (Radio-Nations) (Switz'l'd)	HBP	7,780	.....	38.48	20
Budapest (Hungary)	HAT4	9,125	.....	32.88	5
Bangkok (Siam)	HS8PJ	9,350	.....	32.09	20
Madrid (Spain)	EAQ2	9,480	.....	31.65	20
Rio de Janeiro (Brazil)	PRF5	9,500	.....	31.58	12
Daventry (Gt. Britain)	GSB	9,510	.....	31.55	10-50
Melbourne (Australia)	VK3ME	9,510	.....	31.55	1.5
Hongkong (China)	ZBW3	9,520	.....	31.49	2
Jelöy (Norway)	LKJ1	9,520	.....	31.49	1
Schenectady (U.S.A.)	W2XAF	9,530	.....	31.48	25
Zeesen (Germany)	DJN	9,540	.....	31.45	50
Suva (Fiji)	VPD2	9,540	.....	31.45	3
Prague (Podebrady) (Czechoslovakia)	OLR3A	9,550	.....	31.41	30
Zeesen (Germany)	DJA	9.560	.....	31.38	5-50
Lima (Peru)	OAX4T	9,560	.....	31.38	10
Bombay (India)	VUB	9,565	.....	31.36	4.5
Millis (U.S.A.)	W1XK	9,570	.....	31.35	10
Daventry (Gt. Britain)	GSC	9,580	.....	31.32	10-50
Lyndhurst (Australia)	VK3LR	9,580	.....	31.32	1
Philadelphia (U.S.A.)	W3XAU	9,590	.....	31.28	10
Sydney (Australia)	VK2ME	9,590	.....	31.28	20
Huizen (Holland)	PCJ	9,590	.....	31.28	20
Prangins (Radio-Nations) (Switz'l'd)	HBL	9,595	.....	31.27	20
Moscow (U.S.S.R.)	RW96	9,600	.....	31.25	20
Rome (Italy)	I2RO3	9,635	.....	31.13	25
Sourabaya (Java)	YDB	9,640	.....	31.11	1
Lisbon (Portugal)	CT1AA	9,655	.....	31.09	2
Buenos Aires (Argentina)	LRX	9,660	.....	31.06	5
Lisbon (Portugal)	CT1CT	9,680	.....	31.00	0.5
Madrid (Spain)	EAQ	9,860	.....	30.43	20
Lisbon (Portugal)	CSW	9,940	.....	30.18	5
Bandoeng (Java)	PMN	10,260	.....	29.24	5
Ruysselede (Belgium)	ORK	10,330	.....	29.04	9
Buenos Aires (Argentina)	LSX	10,350	.....	28.99	12
Teneriffe (Canary Isles)	EAJ43	10,360	.....	28.94	4
Bandoeng (Java)	PLP	11,010	.....	27.25	3
Lisbon (Portugal)	CSW	11,040	.....	27.17	5
Motala (Sweden)	SBG	11,700	.....	25.63	1
Winnipeg (Canada)	CJRX	11,720	.....	25.60	2
Paris (Radio-Colonial) (France)	TPA4	11,720	.....	25.60	12
Daventry (Gt. Britain)	GSD	11,750	.....	25.53	10-50
Zeesen (Germany)	DJD	11,770	.....	25.49	50
Boston (U.S.A.)	W1XAL	11,790	.....	25.45	20
Tokio (Japan)	JZJ	11,800	.....	25.42	20
Vienna (Austria)	OER2	11,800	.....	25.42	1.5
Rome (Italy)	I2RO4	11,810	.....	25.40	25
Daventry (Gt. Britain)	GSN	11,820	.....	25.38	10-50
Wayne (U.S.A.)	W2XE	11,830	.....	25.36	10
Lisbon (Portugal)	CT1AA	11,830	.....	25.36	2
Prague (Podebrady) (Czechoslovakia)	OLR	11.840	.....	25.34	30
Zeesen (Germany)	DJP	11,850	.....	25.31	50
Daventry (Gt. Britain)	GSE	11,860	.....	25.29	10-50
Pittsburgh (U.S.A.)	W8XK	11,870	.....	25.27	40
Paris (Radio-Colonial) (France)	TPA3	11,880	.....	25.23	12
Moscow (U.S.S.R.)	RNE	12,000	.....	25.00	20
Lisbon (Portugal)	CT1CT	12.082	.....	24.83	0.5
Reykjavik (Iceland)	TFJ	12,235	.....	24.52	7.5
Parede (Portugal)	CT1GO	12,400	.....	24.20	0.35
Warsaw (Poland)	SPW	13,635	.....	22.00	10
Amateurs		14,000 to 14,400	.....	21.42 to 20.84	0.01
Sofia (Bulgaria)	LZA	14,970	.....	20.04	1.5
Moscow (U.S.S.R.)	RKI	15 010	.....	19.95	25
Zeesen (Germany)	DJL	15,111	.....	19.85	50
Vatican City (Vatican State)	HVJ	15.123	.....	19.84	10
Daventry (Gt. Britain)	GSF	15,140	.....	19.82	10-50
Bandoeng (Java)	YDC	15,160	.....	19.80	3
Tokio (Japan)	JZK	15,160	.....	19.80	20
Daventry (Gt. Britain)	GSO	15,180	.....	19.76	10
Hongkong (China)	ZBW4	15.190	.....	19.75	2
Zeesen (Germany)	DJB	15,200	.....	19.74	50
Pittsburgh (U.S.A.)	W8XK	15,210	.....	19.72	40
Huizen (Holland)	PCJ	15,220	.....	19.71	20
Prague (Podebrady) (Czechoslovakia)	OLR5A	15.230	.....	19.70	30
Paris (Radio-Colonial) (France)	TPA2	15,243	.....	19.63	12
Boston (U.S.A.)	W1XAL	15,250	.....	19.67	20
Daventry (Gt. Britain)	GSI	15,260	.....	19.66	10-50
Wayne (U.S.A.)	W2XE	15,270	.....	19.65	10
Zeesen (Germany)	DJQ	15.280	.....	19.63	50
Buenos Aires (Argentina)	LRU	15,290	.....	19.62	5
Daventry (Gt. Britain)	GSP	15,310	.....	19.60	10-50
Schenectady (U.S.A.)	W2XAD	15,330	.....	19.57	18
Zeesen (Germany)	DJR	15,340	.....	19.56	50
Budapest (Szekesfehervar) (Hungary)	HAS3	15,370	.....	19.52	20
Hongkong (China)	ZBW5	17,750	.....	16.90	2
Zeesen (Germany)	DJE	17,760	.....	16.89	50
Wayne (U.S.A.)	W2XE	17,760	.....	16.89	10
Huizen (Holland)	PHI	17,770	.....	16.88	23
Bound Brook (U.S.A.)	W3XAL	17,780	.....	16.87	40
Daventry (Gt. Britain)	GSG	17,790	.....	16.86	10-50
Bandoeng (Java)	PLE	18,830	.....	15.93	60
Bangkok (Siam)	HS8PJ	19,020	.....	15.77	20
Bandoeng (Java)	PMA	19,350	.....	15.50	60
Daventry (Gt. Britain)	GSH	21,470	.....	13.97	10-50
Wayne (U.S.A.)	W2XE	21,520	.....	13.94	10
Daventry (Gt. Britain)	GSJ	21,530	.....	13.93	10-50
Pittsburgh (U.S.A.)	W8XK	21,540	.....	13.93	40
Daventry (Gt. Britain)	GST	21,550	.....	13.92	10-50

BROADCAST BREVITIES

NEWS FROM PORTLAND PLACE

Stagshaw Reverts to Type

HISTORY repeats itself at Stagshaw, for the new station to be opened on October 19th at this unknown hamlet six miles from Hexham will employ high power modulation. This is a reversion to the good old days before 5GB, Daventry, startled the broadcasting world by modulating first and amplifying afterwards.

A Transformer Question

The reason for that step, by the way, was economic rather than technical. High power modulation transformers were not easy to come by in those days at a figure that suited the B.B.C. purse. But transformer design has now progressed so far that the economic objection has been ruled out.

Stagshaw will be the only home station modulating at high power, though the new Empire transmitters are similarly equipped.

Adjustable Mast

At last the North Country should get really good signal strength, for, in addition to a 60 kW output, Stagshaw uses an anti-fading aerial of the mast-radiator type, 470 feet high.

The mast itself is adjustable for different wavelengths, but it is likely to stay put at 267.4 metres for a long time to come.

Healthy Complexion

The station building follows the traditional "regional" pattern and tones remarkably well with its surroundings, being finished in a kind of rosy buff which matches the healthy complexions of the Stagshavians.

Flashes at Falkirk

TWELVE men on the books of Falkirk Labour Exchange hooched with delight when a braw bricht streak of lichtnin' carried awa' the Westerglen aerials last week and gave them a good day's work clearing up the debris.

September 19th was the most exciting night that B.B.C. engineers have spent since Moorside Edge was snowed up five years ago.

Quick Repairs

It was the first occasion on which lightning had completely wrecked a B.B.C. antenna system, yet within forty minutes of the disaster the National transmitter's emergency aerial was brought into action; less than half an hour later the Regional was also putting out a strong signal.

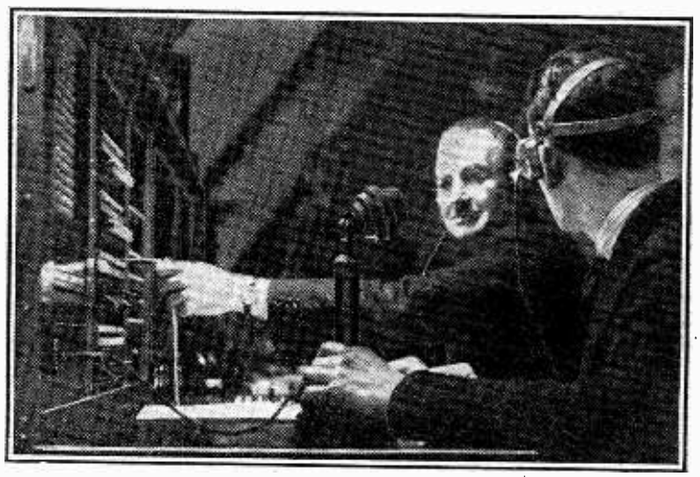
By 4.0 p.m. next day the station was back to normal working conditions.

Thanks to the elaborate system of fuses, no serious damage was done to the transmitters themselves. The great voltmeter fuse perished nobly.

Unrehearsed

HOW nearly television rehearsals approximate to the real thing was amusingly demonstrated on Friday last when D. H. Munro, Productions Manager, found himself almost stymied by the late arrival of two ballet dancers.

There was no time for rehearsal, and the show went on the air just as it had been planned on paper, fortunately without a hitch. At the end a member of the orchestra walked up to Hyam Greenbaum, the conductor, and said: "When does the transmission take place?" Said Greenbaum: "That *was* the transmission." The musician is now out of danger.



"THE NEXT PART OF THE PROGRAMME will follow almost immediately." Resembling the switchboard of a small telephone exchange, the simultaneous broadcast control panel at Broadcasting House is the scene of continuous activity. Whenever it is necessary to link up two or more transmitters for broadcasting the same programme the switchboard comes into action. All the B.B.C. stations are linked up with Broadcasting House by means of underground telephone lines.

Foreign Artistes and the B.B.C.

THE British Broadcasting Corporation is living up to its name by tightening up the regulations regarding the employment of foreign artistes. In this it has the blessing of the Home Office, which is anxious that foreigners shall not be employed in work that can be equally well performed by Britishers.

Virtuosity Breaks Down Barriers

Signor Toscanini is untouched by the new rules, for it is laid down as an axiom that foreigners with special virtuosity or qualifications for a particular task shall be welcomed at Portland Place.

Nor do the new rules apply to foreign works of art, musical or otherwise. Bach and Brahms need no Home Office permits.

Televising the Cenotaph Ceremony

THE Home Secretary has given permission for the televising of the Cenotaph service on Armistice Day.

Three cameras will be used. Two will be placed at first-floor level on a building overlooking the Cenotaph, and one of them will probably be fitted with a telephoto lens to give close-ups of the King and members of the Cabinet.

The Sun May Intervene

It was hoped to use the third camera to give a distant view of Big Ben as the minute hand approached the hour, but unless the day is dull the sun would probably interfere with the arrangement as it will be directly over the clock tower as seen from Whitehall.

In the Small Hours

SNAPPY work in the London and Edinburgh control rooms will be necessary in the small hours of Sunday next, when the B.B.C. broadcasts D. G. Bridson's "The March of the 'Forty-five'" to the American National Broadcasting Company's Blue network.

The time-table is complicated by the fact that the play begins at the moment of change in this country from Summer Time to Greenwich Mean Time.

Transatlantic Complication

Production will be shared by Gordon Gildard, in the Edinburgh studios, and Val Gielgud sitting up late in London. The drama will be picked up in New York at 8 p.m. (E.S.T.), which means that the British production must begin five hours later.

The Transatlantic Beam system has been booked for an hour's broadcast.

Listeners in this country will have the unique opportunity of hearing the broadcast for an hour from 2 a.m. and still retiring when the clock tells the same time.

Broadcasting Billiards

PEOPLE with visual imagination get much more out of broadcasting than those who have no "mind's eye." Take a billiards commentary, for example, of the kind which Willie Smith is to give us from Thurston's on October 28th. Listeners who have developed the sort of sixth sense which enables them to see through the commentary will get a lot of fun from the sealed handicap match which Davis and Newman will be fighting out on the green baize.

The game will be broadcast Nationally at 8 p.m. for twenty minutes.

Listeners as Jurymen

THE "Listener Research" campaign is being carried into Wales. On October 23rd, look you, the Swansea Guildhall will entertain 300 picked listeners who will be asked to vote on the popularity of all the different features presented in the Welsh Regional programmes.

The B.B.C., anxious to avoid suggestions of "hanky panky" in the choice of this select committee, invites all Welsh listeners to write for tickets of admission. If the number exceeds the accommodation of the hall, the letters will be put in a sack or drum to be drawn with full Druidical rites.

Could anything be fairer?

Wired-Wireless in Germany

ALTERNATIVE PROGRAMMES TRANSMITTED ALONG ORDINARY TELEPHONE LINES

TELEPHONE wires and private lines were used for relaying entertainment matter long before wireless gave broadcasting the popularity it enjoys to-day. In the form of an audio system it later supplemented direct radio reception, and now a new system using wired-wireless, and of which a brief description is given here, has been introduced in Germany.

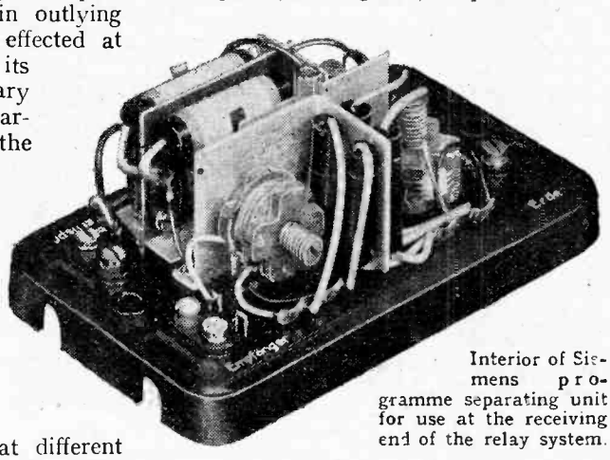
Broadcast receiver with small rejector unit for wired-wireless use.

SOON after the introduction of wireless broadcasting the Bavarian section of the German Post Office decided to use the existing telephone system, supplemented where necessary by extension lines, for relaying the programmes to listeners living in outlying districts. These relays were effected at audio frequency, and one of its disadvantages was that ordinary telephone work could not be carried on without interrupting the broadcasts.

Despite its limitations, and there were others in addition to that mentioned, the idea enjoyed a measure of popularity on the Continent, and some districts in Switzerland adopted it also.

The system of land-line relays to individual listeners has come once again to the fore, but now in a somewhat different guise. The latest system takes the form of wired-wireless. Of course, wired-wireless is in itself not a new idea, but applying it to existing telephone systems may perhaps be heralded as an innovation. Experimental services have been in operation for some time in Rostock and in Eastern Prussia, where it is proving so successful that an extension to other districts is contemplated.

Known as the Gladenbeck system, it utilises RF carrier frequencies of 155, 220 and 250 kc/s. A 30-kc/s separation has been found adequate for most purposes, even though the main idea is that existing broadcast sets shall be used where available and rejectors added if required.



Interior of Siemens programme separating unit for use at the receiving end of the relay system.

Within the band of frequencies mentioned it would be possible to accommodate four separate channels of 30 kc/s separation, but only three have been chosen as it was deemed advisable to leave the 190 kc/s channel clear owing to its proximity to that used by the Deutschlandsender, which might cause some interference when the programmes were transmitted over land lines.

In this wired-wireless relay system the distributing centre for each area is to be the telephone trunk exchange where will be installed low-power RF transmitters. They will be modulated by linking up with the audio systems of the main broadcast stations.

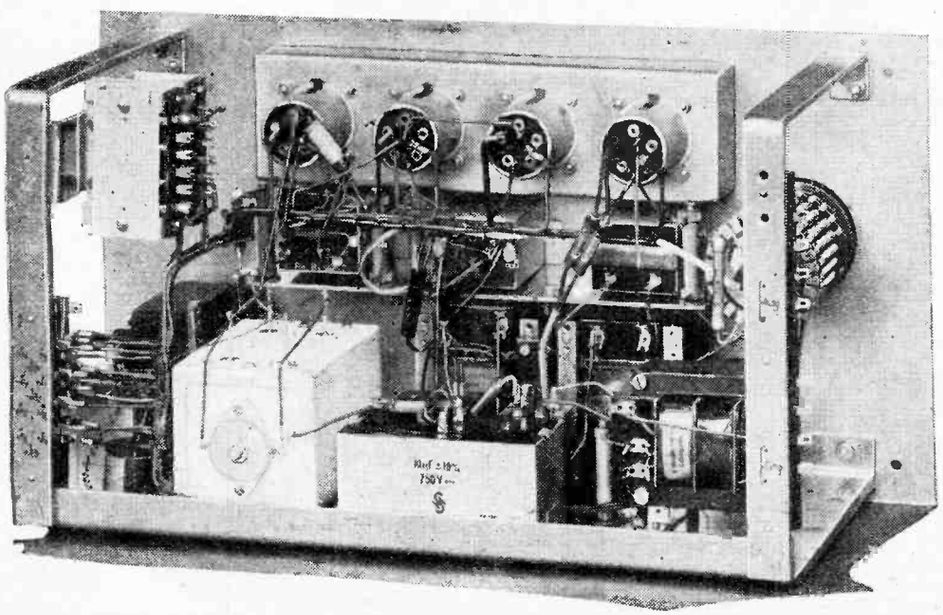
From the data compiled with the experimental system it has been found that an input of 25 millivolts is necessary at the receiving end to ensure good quality reproduction and with freedom from interference from other services using the telephone lines. At the distributing centre between one and two kilowatts of modulated RF is required to satisfy these conditions.

The modulated output from the central transmitter is fed through a system of filters to the subscriber's line, while further filters, and where required rejectors, are installed at each receiving point. The functions of the filters are to confine the output from each transmitter to the bandwidth of the appropriate channel and, it is assumed, also to prevent interference between the adjacent channels and the modulating of the RF by the ordinary telephone service.

The rejectors are necessary in cases where the inherent selectivity of the receiving set is not adequate to separate the different programmes.

Comparatively simple in construction the small RF wired-wireless transmitters can easily be mounted in close proximity to the broadcast repeaters in the trunk exchanges. Also provision is readily made for extension lines to community reception points so that any number of non-telephone subscribers can be linked up with the main system.

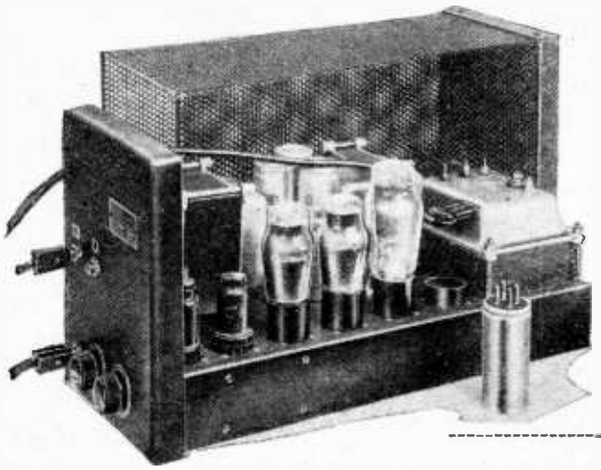
Only a few of the main features of this new German wired-wireless system can be given in this brief description, but it serves to show how the problem of broadcasting is being handled in countries where communities are widely scattered, and where satisfactory direct reception by radio is sometimes only possible with the aid of comparatively expensive sets.



German RF wired-wireless transmitter made by Siemens. One of these sets is required for each programme relayed.

New Apparatus Reviewed

Recent Products of the Manufacturers



Vortexion Type CP20 AC and 12-volt DC 15-watt amplifier.

VORTEXION TYPE CP20 AC AND 12-VOLT DC AMPLIFIER

THIS small portable amplifier is designed to operate either from the AC mains or from a 12-volt battery, and it is rated to give 15 watts undistorted power output. There are three stages using American-type valves; the first is resistance-capacity coupled to the following stage, while this in turn is coupled to a pair of 6B5 valves in push-pull by a parallel-fed centre-tapped choke of very high inductance.

The 6B5 valve is a special type of double-triode output valve in which the output section is cathode-coupled to the driver portion, the coupling being in the valve.

For microphone reproduction the two pre-amplifiers are used, but for gramophone only one is needed to give the full output. The pick-up jack is, therefore, connected to the grid of the second valve. In this grid circuit are two independent volume controls, and it is thus possible to adjust the gain of the amplifier for the same power output from both sources, as well as superimpose one on the other, or fade one out and bring the other up to full volume.

When it is desired to operate the amplifier from a 12-volt battery, a four-pin plug on the chassis is removed and an HT vibrator fitted in its place. This device is quite silent in action and provides the necessary HT voltage to operate the amplifier at full volume. With the valves fitted for normal AC operation, the amplifier consumes between 6.5 and 7 amps. at 12 volts, but this can be reduced to about 5 amps. by replacing the HT rectifying valve, a Type 83, by the Type BA, which is a cold-cathode rectifier, and thus leads to a saving of 3 amps. in filament current.

During tests on the amplifier its undistorted power output was measured and the frequency response checked from 30 c/s. to 20,000 c/s.

An output of 14.7 watts was obtained without any trace of distortion, so that the rating of 15 watts is quite justified in this case, since only a small percentage of harmonics is present at this power.

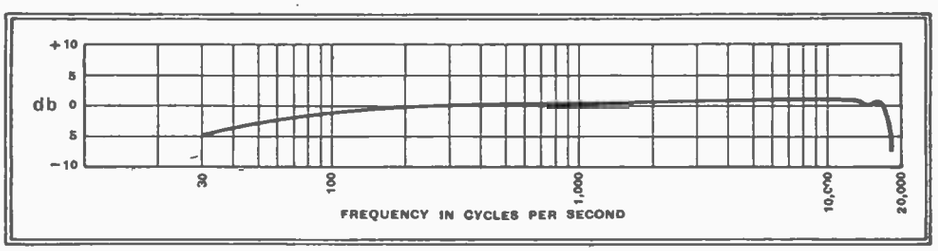
The curve reproduced here shows the measured response of the amplifier, which, allowing an arbitrary variation of ±5 db. compared with 400 c/s., has an upper limit of 18,000 c/s. and a lower of 30 c/s. As the output transformer was included in the test circuit, its performance is exceptionally good for a versatile amplifier costing but 12 guineas complete. Another outstanding feature of this amplifier is its exceptionally low hum level when AC operated even without an earth connection.

In order to obtain the maximum undistorted output, an input to the microphone jack of 0.037 volt was required. Thus the overall gain is adequate for most types of high-grade transverse current carbon microphone or other styles giving a comparable output.

The secondary of the output transformer is tapped for loud speakers or line impedances of 4, 7.5, and 15 ohms.

This model is described as the CP20, and an amplifier with a similar circuit and power output is also available for AC operation only, in which form the price is 8½ guineas. These prices do not include the perforated cover, which costs 12s. 6d. extra, or the Type BA rectifier, the substitution of which adds one guinea to the price.

The makers are Vortexion, Ltd., 182, The Broadway, Wimbledon, London, S.W.19.



Frequency response curve of Vortexion Type CP20 amplifier taken with AC operation.

MORSE PRACTICE SET

THE beginner contemplating taking an active part in amateur radio, even as a listener only at the outset, must acquire a knowledge of the Morse Code, for, despite the widespread use of telephony, the code is frequently employed in amateur experimental work.

A compact and inexpensive practice set for learning Morse and so becoming familiar with the "sounds" of the various letters can now be obtained from the Premier Supply Stores, Jubilee Works, 167, Lower Clapton Road, London, E.5.

This practice set consists of a battery, a sending key, a buzzer, a lamp for visual signalling, and means for reproducing the "click-clack" signals of the old-style P.O. Morse sounders.

Provision is made for joining two sets by a pair of wires so that sending and receiving can be effected between two persons not necessarily in the same room.

Premier Radio-Telegraph Signal Set.

The buzzer note is rather coarse and the key a little frail, yet it is a perfectly sound and practical instrument and it serves the purpose of learning Morse just as well as would a more expensive set.

A metal plate with the standard code printed on it is secured to the top of the case, where it is conveniently placed for quick reference.

Included in the equipment is an instructional leaflet giving some useful hints on learning the code, and a short list of the usual abbreviations employed in signalling.

Described as the Standard Radio-Telegraph Signal Set, this useful practice outfit costs only 3s. 6d. complete.

T.C.C. CERAMIC CONDENSERS

THE Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, London, W.3, has now introduced for home constructors' use a range of the latest pattern ceramic condensers.

The new ceramic condensers are different in every respect to the familiar fixed pattern. Their shape is unusual, for they are made in the form of very small discs and cups; the cup type, for example, measures $\frac{7}{16}$in. in diameter and is approximately the same in length.

A ceramic moulding is used, and on both sides of it is deposited a film of metal. During the process of manufacture the metal film penetrates the pores of the ceramic, and it has been found possible with this form of construction to effect accurate adjustment of capacities during manufacture. Such condensers are also stable under all normal conditions of use and operation.

Owing to the fact that stable condensers

New Apparatus Reviewed—

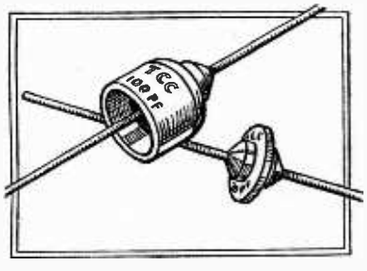
of very small capacities can be produced in this way, the ceramic pattern are particularly well suited for use on the ultra-high frequencies.

The T.C.C. disc ceramic condensers are available in sizes of 2, 5, 10, and 20 m-mfds. The smallest has a tolerance of ± 10 per cent., while the remainder can be supplied with tolerances of ± 1, 5, or 10 per cent., as desired.

The cup pattern are made in 50 and 100 m-mfds. sizes with tolerances of ± 1, 5, or 10 per cent.

A specimen 20 m-mfds. disc condenser of 10 per cent. tolerance was measured and found to have a capacity of 19 m-mfds. One of 5 m-mfds. with a 5 per cent. tolerance measured 5 m-mfds. on a test set having a discrimination of 0.25 m-mfds., i.e., 5 per cent. at this capacity, whilst a 100 m-mfds. size, also of 5 per cent. tolerance, measured 99 m-mfds.

In order to ascertain the effect of heat on the condenser, particularly in the smaller sizes, such as might arise when soldering with the wires cut short, the 20 m-mfds. disc model was heated by applying a hot soldering iron to the connecting wire within ½in. of the condenser and left in contact for a far longer period than would normally be the case. An immediate measurement revealed a change of minus one m-mfd. in its capacity. After allowing sufficient time for the condenser to revert to room temperature, a second measurement was made and the capacity found to be, as near as could be determined, the same as before the application of heat.

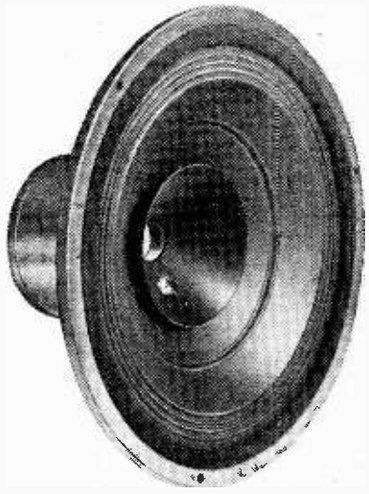


T.C.C. disc and cup ceramic condensers.

Ceramic disc condensers cost 1s. for all values with 10 per cent., 1s. 3d. with 5 per cent., and 1s. 6d. with 1 per cent. tolerance. Cup models cost 1s. 3d., 1s. 6d., and 1s. 9d. each with 10, 5, and 1 per cent. tolerances respectively.

WHARFEDALE TWIN CONE AUDITORIUM SPEAKER

THIS is a permanent magnet unit employing a ring-type nickel-aluminium-cobalt magnet housed in a rigid cast aluminium framework. An auxiliary cone is used to reinforce the top register and advantage has been taken of this to employ a rather softer paper for the main cone. As a result, the

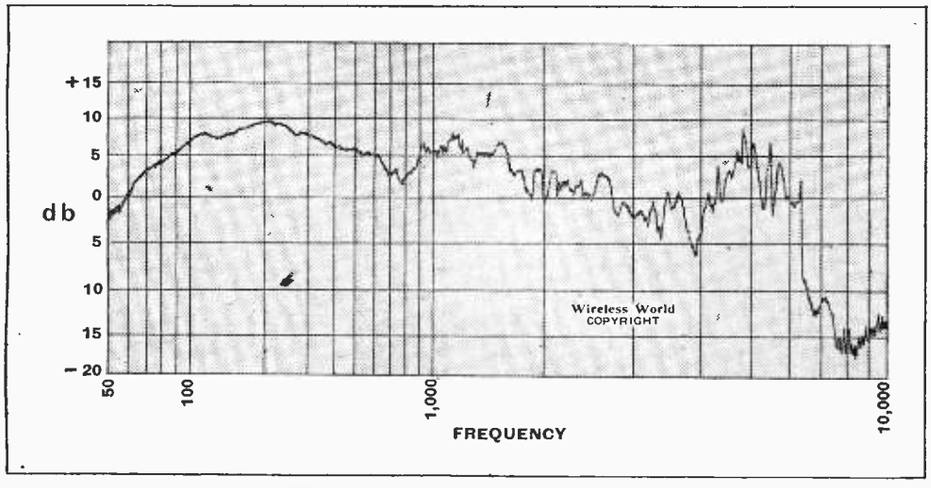


Wharfedale Twin Cone Auditorium loud speaker.

complex system of resonances in the region of 2,000-5,000 cycles due to "break-up" of the diaphragm has been avoided and the reproduction is free from the hard brilliance which can be attributed to this cause.

Although there is an unusually sharp cut-off at 6,500 cycles on the axial response curve, the reproduction does not appear to suffer from lack of "top," and in reproducing gramophone records the advantage of this cut-off is at once apparent in the low level of the needle scratch. We were particularly impressed with the authentic tone of the piano as reproduced through this loud speaker, and when the performance is satisfactory from this point of view it is safe to assume that other types of transmission will be dealt with faithfully.

Without transformer the price is £3 15s., and with universal output transformer £4 10s. The makers are Wharfedale Wireless Works, 62, Leeds Road, Bradford. Coil impedances of 2, 6, 10, and 15 ohms are available at the same price.



Axial response curve of Wharfedale Twin Cone Auditorium loud speaker. Microphone distance, 4 ft.; input, 1 watt.

RANDOM RADIATIONS

By "DIALLIST"

The Voice of Japan

PROBABLY you've discovered J Z K, the Tokio station on 19.79 metres, when you've been trying the short waves. It's quite on the cards, though, that you've heard it and have passed on to something else in the belief that it was just a European "local," if it happened that the announcer was speaking German or French when you lighted upon it. The strength at which Tokio is received on many nights is simply astonishing. At my home I have several times heard it at full loud speaker strength with the volume-control in the position where I normally have it for reception of the London Regional on the medium waves. Transmission starts at nine o'clock each night and news in English is generally given at that time or a little later. I am afraid that I can't say that the news is very thrilling, for it's mainly confined to items about the war in China, given in immense and wearisome detail. If the Japanese authorities would prune these broadcasts, keeping the items to news that mattered and to places that one had heard of, or could, at any rate, find in an ordinary atlas, they'd have a bigger audience.

Queer Music

If the Tokio news bulletins in English are not exactly thrilling, the Japanese music, which is given at intervals, provides a completely new experience for Western folk who have never been in the Far East. Some of it is the most extraordinary stuff. There is a rhythm, marked chiefly by taps on what sounds like a toy drum, interspersed with tintinnabulations that remind one of a Swiss cow-bell. The tune, which seems to consist of queer little tootlings on a penny-whistle-like instrument, strays up and down over a range of only four or five notes. Sometimes another kind of instrument is used which sounds like a banjo of some sort. This, I imagine, is the famous *samisen*. Sometimes, again, there is orchestral music with quite a Western flavour. The most curious items of all are what the announcer calls "popular songs," though when he breaks into German you realise that he means folk songs. To our ears, untrained in the subtleties of Japanese music, the singers produce effects not unlike those associated with a meeting of tom cats on a garden wall in the small hours. That, at any rate, is a first impression; the more you listen, the more you realise that this strange music has a charm of its own and, despite its utter difference from anything that you've ever heard before, you begin rather to like it in small quantities. Try it for yourself and see what you think.

On the "Wireless World" Map

IF you were asked to guess the bearing of Tokio from London it's ten to one that you'd answer—always supposing that you're not a seafaring man—that it was due east, or perhaps a little south of east. *The Wireless World's* special map, which shows the true bearings and distances from London to any part of the world, gives a very different answer. The real bearing of Tokio is a good deal north of north-east, being approximately 30½ degrees east of north. The great-circle line joining the two places passes close to Oslo and Murmansk, cuts through the southern part of Nova Zemlya, skirts the mouths of the rivers Ob and Yenesei, traverses Siberia, passing not far from Yakutsk and Vladivostock, and so reach Tokio. You mightn't think that the shortest cut to Japan would take you a long way into the Arctic circle—within not much more than a thousand miles of the North Pole, as a matter of fact—but so it is. How about the distance? Here, again, you'd probably be a long way out in your estimate. It takes about as long to go by sea to Japan as it does to Australia, so my first guess, at any rate, was between 9,000 and 10,000 miles for the distance between Tokio and London. *The Wireless World* map shows that it is actually about 5,700 miles. Tokio is thus over a thousand miles nearer to us than Buenos Aires, whose programmes we sometimes hear so well from LRX on 31.06 metres.

Why Did the Numbers Fall?

IT'S interesting to hear or read the variety of reasons given in different quarters for the falling-off in the numbers of those who visited Radiolympia this year as compared with 1936 and 1935. Some suggest that the thousands of people who came to London from the provinces for the Coronation spent all their available money then and couldn't manage another trip; others, that national prosperity enabled far more people to take seaside or country holidays in August this year; others, again, that the "stars" appearing in the theatre were hardly of sufficient magnitude to attract vast crowds. I stick to it that the real reason is that when it comes to Radiolympia the public, or the part of it that really matters, wants to see wireless sets or television demonstrations and to discover for itself what improvements the new apparatus had to offer. Those who came this year didn't find really interesting things in wireless sufficiently in evidence; nor were there facilities enough for them to find out what they wanted to know. Many of those who stayed away did so, I am sure, partly because some of the advance publicity of the exhibition suggested the fun-fair rather than the wireless show, and partly because of the tendency of some advertisements to indicate that the manufacturer regards his prospective customer as a complete ignoramus in matters wireless, to whom it would be a waste of time to explain the "secrets" within the cabinet of a set.

Quite True, But . . .

I have seen it stated that the wireless receiving set is now as much a piece of household furniture as the piano and that the average customer, therefore, doesn't want technical details. With the first part of the statement I agree; with the second I don't. I seem to remember that when Mrs. Diallist and I invested in a piano the salesman had quite a lot to tell us about the "works" of instruments of different makes, demonstrating how the action and so on of one differed from those of another. He wasn't just content with saying "Buy this instrument and the world of music is yours"! Though you can hardly class motor cars, perhaps, as domestic furniture, they form part of the equipment of a vast number of households nowadays. I seem to have noticed that those who make motor cars are pretty active in bringing to the notice of the average man and the average woman the advantages of the technical improvements that they effect from year to year. That's what sells new cars and brings people to motor shows. It's about time that the wireless industry, too, settled down to realise these things to the full.

American Big 'Uns

IN the United States some manufacturers are going in for bigger receiving sets than ever this year. One, I see, boasts 30 tubes, no less, and there are a good many others with 20 or more. I have heard it said by those who didn't know American sets or American designers that large numbers of valves are employed just to make an impression on the customer, and that a good many of them (the valves, I mean) don't really do very much. So far as my experience goes that's certainly not true, though few of us probably would want quite such extensive audio-frequency departments as some of the American sets have. In one design that I came across not long ago there were 8 amplifying valves on the audio side—2 in parallel in the first AF stage and 6 in parallel push-pull in the output stage. If I remember rightly that particular set was capable of between 20 and 30 watts of undistorted output. Comparatively few people in this country want anything quite so big as that, though now that automatic volume expansion is becoming better known here larger outputs are coming more into favour.

How They Use Them

In the big American set one signal-frequency stage is invariably found, and sometimes there are two. Another interesting use for an extra valve sometimes found is a

TELEVISION IN ITALY. The latest large tube cathode-ray television receiver shown by the "SAFAR" Company at the ninth annual wireless show held in the Triennial Palace, in Milan.

screen grid or RF pentode with aperiodic circuits acting simply as a coupler between aerial and set. Having valves *ad lib*, to play with the American designer often uses both separate oscillator and an oscillator amplifier to prevent "creeping." Then he aims at making the receiving set that he turns out as easy to work and as automatic as it possibly can be. Automatic tuning correction, amplified automatic volume control and automatic selectivity control are normal adjuncts of his big set. He doesn't try to get huge amplification out of a single IF stage; instead, he uses two at least, and three if he feels that this arrangement is likely to give better and quieter reception.

And the Results

The American designer of large receiving sets is working definitely for the luxury market. American sets are a great deal cheaper in their own country than they are when they reach us, but, even so, the cost of some of them in the States is quite as much as that of a smallish motor car. Their designer aims at giving his public the very best that can be obtained, pretty well regardless of cost, in modern radio. And what does he achieve? Well, he's forgotten that such things as second channel whistles ever existed; he turns out a set which is remarkable in its low level of background noises; he provides such a reserve of sensitiveness that the set is practically never called upon to work all out; as regards selectivity, some U.S.A. models will enable the dyed-in-the-wool DX-er almost to separate a station from its call-sign if he feels so minded—you can adjust it to give you something like a 2-kilocycle separation. The screening, too, is extraordinarily thorough; I've handled a big American set which would have nothing to do with London Regional at a range of 15 miles if aerial and earth leads were disconnected. Effective screening is a better protection against man-made interference than many people realise.

Television Engineering.—By J. C. Wilson. Pp. 492+xv. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 30s.

IT is claimed, and with every justification, that this is the first comprehensive text-book of television. For reference purposes, and for those taking advanced courses in television engineering the book will be indispensable. It is authoritative, it has been excellently planned, and every chapter is provided with a very full list of bibliographical references. Theoretical treatment which assumes fair ability in the differential calculus has been adopted in many parts, but the mathematical work is so lucidly set out that the conclusions will be readily comprehensible to the less skilled reader.

The book, however, is not without its faults. For a text-book it is too comprehensive and much too much space has been devoted to historical work and antiquated methods which have no relation whatever with modern technique. This is all the more to be regretted since the modern technique, Emitron cameras, pulse generators, illumination correcting circuits, and so on, are dismissed in half a dozen pages. For example, the chapter on "Modern Television Equipment" deals with the Baird 30-line gear, 240-line telecine scanners, spot-light scanning and intermediate film gear—apparatus which cannot possibly be considered as "modern." Less than a page of this chapter is devoted to the Iconoscope and only a brief reference is made to cathode-ray receivers.

Against this, however, it must be said that much of the mathematical work is of a general nature, applicable to any system of television. For this and many other reasons the book is one which should be in the hands of all engaged on television design and engineering. A second edition, however, shorn of all irrelevant historical references and very greatly amplified in respect of present-day technique in both transmitter and receiver design is required immediately.

G. R. M.G.

Complete Electrical Engineering, a part-publication to be complete in about forty weekly issues, has been produced by Messrs. George Newnes, Ltd. The first part appeared on September 29th, and subsequent parts will be issued each Friday commencing October 8th, price 1s. a part. The whole work will comprise over 2,000 diagrams, and photographs and useful data sheets will be included throughout the work.

News from the Clubs

Dollis Hill Radio Communication Society

Headquarters: Braintcroft Schools, Warren Road, London, N.W.2.
Meetings: Alternate Tuesdays at 8 p.m.
Hon. Secretary: M. J. R. Hodgkyns, 102, Crest Road, Cricklewood, London, N.W.2.

The new season was inaugurated by a talk given by Mr. C. J. Search on Frequency Oscillators to work with artificial aerials.

West Sussex Short Wave and Television Club

Hon. Secretary: Mr. J. Williams, H. Q. Flight, 43 (F) Squadron, R.A.F., Tangmere, Near Chichester.

A club under the above title has been formed at Chichester. An enthusiastic attendance of twelve were present at the opening meeting, the majority being R.S.G.B. members. A programme including local field days, technical lectures and discussions, and demonstrations of radio and television apparatus will be arranged. It is hoped to have a club transmitter working shortly. Among the members already enrolled are three G calls and two A.A. calls.

Exeter and District Wireless Society

Headquarters: Y.W.C.A., 3, Dix's Field, Southernhay, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Secretary: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

At the first meeting of the season the Treasurer presented the balance-sheet, showing the Society to be on a sound financial footing. Mr. A. T. Batten gave a talk on the Olympia Exhibition and also demonstrated the Murphy All-Wave receiver. The Society proposes building a high-quality amplifier and members are submitting designs for this.

The Television Society

Hon. Secretary: Mr. J. J. Denton, 25, Lisburne Road, London, N.W.3.

The following lectures on television have been arranged:—

Morley College, 65, Westminster Bridge Road, London, S.E.—A course of twenty-four lectures, to be held on Friday evenings. Elementary: 7-8.30 p.m. Advanced: 8.30-10 p.m. Fee 11s. The lecturer will be Mr. J. J. Denton, the Hon. Secretary of the Television Society.

Borough Polytechnic, Borough Road, London, S.E.—A course of lectures will be held on Thursdays from 8-9.30 p.m. A certificate will be granted to students who pass the examination at the end of the course. Fees: students under 18, 10s.; over 18, 20s.

Amplifier Gain

A COMPREHENSIVE METHOD OF CALCULATION

By THOMAS BLASHILL, B.Sc.
(Engineering Dept., Western Electric Company)

IN the leading article of our issue of September 17th we pleaded for a uniform and generally accepted basis for assessing the gain of amplifiers. The author of this article describes a method of calculation that is certainly comprehensive and is, in fact, used throughout the Western Electric organisation.

THE present article describes an application of the decibel notation to the gain rating of electrical networks. The system has been in use for several years and permits the algebraic summation of individual group values to give the gain of a complete transmission system.

The difference in output power level caused by removal or change of any link in the chain is immediately available, together with other facilities which become apparent during the course of this text.

At this stage it may be useful to note that the power engineer's conception of efficiency as a function of output-to-input power ratio can have but limited application in a technique which frequently deals with devices having a so-called infinite input impedance. Furthermore, the power engineer is interested in his commodity quantitatively, whereas the communication engineer is primarily concerned with the qualitative aspect. The wide frequency band with which he has to deal, and such artifices as equal impedance matching where the efficiency is only 50 per cent., militate against power conservation. Fortunately, the power can, within limits, be recovered locally.

Recent correspondence in this journal indicates that the published gains of various amplifiers require an agreed interpretation to provide a true picture of their relative worth, and as a palliative it has been suggested that performance is adequately expressed in terms of an input voltage required to give a stated output.

It is as well, however, to point out that the characteristics of an amplifier cannot be regarded as fully defined if the impedance of the source from which it is designed to operate is not specified. The input impedance is usually partially reactive, and coloration on this account is evinced, as, for example, in the change of frequency response at the higher frequencies due to amplifier input capacity. The output content of the same amplifier having a constant voltage across its input may differ very materially according as the impedance of the source is high or low.

"Insertion Gain"

All these factors are taken fully into account in the concept of Insertion Gain. This term relates to a change in power made available by the insertion of a network between a source of power and a receiver. An expression which provides the necessary data for determining gain on this basis is developed below.

Reference should now be made to Fig. 1. If a source of EMF e, of internal impedance Zo, supplies W1 watts into a receiver of impedance Z1, the choice of Z1 would be made with due regard to considerations of output harmonic content and frequency characteristic requirements, and would not necessarily be equal to Zo. Let it be supposed that W1 watts are inadequate and an amplifier loaded with Z3 is to be used. The gain of the amplifier is a function of the ratio between the power W2 watts, actually dissipated in Z3, and the power which would have been available in Z3 had the latter been connected to Zo through an ideal transformer. This no-loss device would make Z3 as seen from Zo equal to Z1.

The amplifier gain in decibels is

$$10 \log \frac{W_2}{W_1}$$

It is assumed that this amplifier has its correct frequency characteristic when operating from Zo, and that under this condition a voltage E1 across its input will produce a voltage E2 across its normal output load Z3. In order to simplify working, the impedances in the following expressions have been regarded as resistive.

Suppose $E_2 = K E_1$.

In Fig. 1*a* the available power

$$W_1 = \frac{e^2 Z_1}{(Zo + Z_1)^2}$$

In Fig. 1*b*

$$E_1 = \frac{Z_2}{Zo + Z_2} \cdot e$$

$$E_2 = \frac{K Z_2}{Zo + Z_2} \cdot e$$

Power in Z3

$$W_2 = \frac{K^2 Z_2^2 e^2}{(Zo + Z_2)^2 Z_3}$$

Amplifier Insertion Gain in decibels

$$G = 10 \log \frac{W_2}{W_1}$$

$$= \frac{K^2 Z_2^2 e^2 (Zo + Z_1)^2}{(Zo + Z_2)^2 Z_3 e^2 Z_1}$$

$$= 20 \log K + 10 \log \frac{Z_1}{Z_3} + 20 \log \frac{\frac{Zo}{Z_1} + 1}{\frac{Zo}{Z_2} + 1} \quad (1)$$

(a) (b) (c)

These three quantities, (*a*), (*b*), and (*c*), are indicative of the factors which influence Insertion Gain. The quantity (*a*) 20 log K is the criterion of frequency response which has been put forward in *The Wireless World*, but with the qualification that the amplifier is operating from an impedance which will provide the published frequency response. This has been termed Voltage Amplification in decibels, a term which is liable to lead to confusion, so that it is preferable to think of it as Voltage Amplification Ratio expressed logarithmically.

The second factor, (*b*), $10 \log \frac{Z_1}{Z_3}$, recognises that a measure of power must take suitable note of the impedances across which the output voltage is applied.

The third term, (*c*), expresses the fraction of the open-circuit voltage of the source which is accepted for voltage amplification,

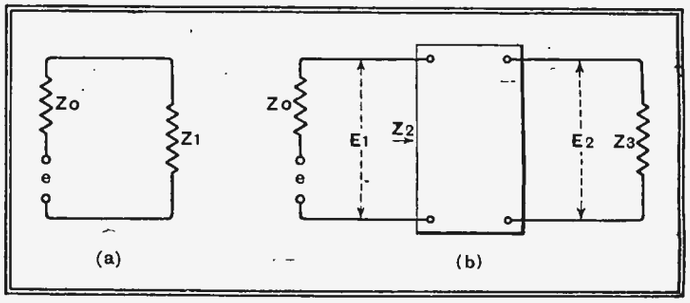


Fig. 1.—Diagrams to illustrate the calculation of amplifier gain.

due to the shunt effect of the amplifier input impedance Z2.

Referring once more to Fig. 1, it may be said that the choice of Z1 instead of the more apparent matched load Zo is made so that the final expression shall be perfectly general. Cases where Z1 is not equal to Zo occur in transmission systems having amplifiers in sequence. As an example a power amplifier having an output impedance (Zo) of 10 ohms might normally supply a load of 20 ohms, but if extra power handling were required might become the source for a high-power stage. In order to standardise on single amplifier systems, there would possibly be a case for assuming identity of Zo and Z1. The insertion gain expression would then become

$$G = 20 \log K + 10 \log \frac{Zo}{Z_3} + 20 \log \frac{2}{\frac{Zo}{Z_2} + 1} \quad (2)$$

This would allow manufacturers to state the gain of their product on a decibel basis in a strictly comparable manner.

In conclusion, it will be appreciated that the symbols which have been used may be complex quantities, and a rigid treatment would demand their recognition as such. All information regarding frequency characteristic as well as gain (usually expressed as a 1,000-cycle value) is embodied in these terms. An approximation to pure resistance conditions will in most cases be justifiable.

The term Insertion Gain is to be applied in an algebraic sense, the the procedure outlined is valid for volume controls, special cases such as paralleled output amplifiers, and, in fact, most electrical networks.

On The Short-Waves

NOTES FROM A LISTENER'S LOG

THERE now seems to be little doubt that we are in for a bumper ultra-short wave season this winter; only to-night I had an R9 contact both ways with W1COO until nearly 8 p.m. on 28 Mc/s. A little earlier in the evening there had been quite a number of good signals on 33-35 Mc/s, too, including one unidentified N.B.C. high-fidelity relay. In addition to these very high frequency signals, the 26 Mc/s band (11 metres) has already given a good account of itself through W9XAZ in Milwaukee and others.

This spate of good ultra-high frequencies so early in the autumn is very significant, especially as conditions are likely to be at least as good as this until we reach the equivalent point on the other side of maximum of the sunspot cycle.

If we take the maximum to occur in 1938-39, then these 10-metre conditions will continue, between September and April, of course, until 1940 at least; it seems to be even possible that in 1938-39 they may just continue through the summer, too (down to 10 metres only), if the present rate of increase in activity is maintained.

The wisdom of some of the more progressive manufacturers in catering for the 26 Mc/s (11 m.) band on their better all-wave models this year is therefore seen to be more than justified.

I am also told that on some receivers the sensitivity on the so-called "television-range" of 60-25 Mc/s (5-12.5 m.) is also adequate, in spite of the absence of an RF stage, to pick up U.S. police and high-fidelity transmissions on good days.

State of Ionosphere

If you want the latest information regarding the actual state of the ionosphere, listen to W1XAL on 11.79 Mc/s at 10.45 p.m. B.S.T. (9.45 G.M.T.) on Mondays, at which time the measurements made of E, F and F_2 layer heights and critical frequencies by the U.S. Bureau of Standards are read out, together with details of magnetic activity.

On Monday, September 13th, the layer height and density figures for September 8th were given, and at 6 p.m. B.S.T. the maximum critical frequency (for vertically incident signals) was 11.0 Mc/s, for which measurement the layer height was 700 kM.

In order to obtain the highest possible transmission frequency from this figure it is necessary to multiply it by 2 or 2.25 (the secant of the angle of incidence of the glancing ray). This gives a value of 22-25 Mc/s, and, although I find from the log that no observations were made on September 8th here, it is not without significance that on the previous day, September 7th, my log reads: "Note 24 Mc/s about the highest to-night, but query NSS on 25 Mc/s multiplex?"

One would, therefore, expect good 28 Mc/s conditions when 14 Mc/s stations situated between 20 and 100 miles away come in with R9 signals; I mean, of course, "locals" which are normally either inaudible or have very weak ground rays, but which are reflected at nearly vertical incidence when "28 Mc/s conditions" appear.

Reviewing conditions in detail since September 9th we find that on this day both W2XAD and W3XAL were excellent at 11 p.m., the ground noise level was very low, too; even W2XAF on 9.48 Mc/s was good and W1XAL on 11.79 Mc/s very strong, but spoilt by hum.

Listening on the ultra-high frequencies on Saturday afternoon was rather spoilt, at least for me, by the particular virulence of car ignition interference this afternoon * (I wonder what would happen if I went out and laid barbed wire in the road, something no less offensive than forcing several millivolts of highly distorted and unwanted signal down one's private aerial). Nevertheless it was possible to hear VU2CQ, from Bombay, on 28 Mc/s, and quite a good signal was intercepted from this amateur 'phone station until 7 p.m., which was 11.30 p.m. I.S.T. incidentally, quite late for 10 metres.

Really excellent signals were obtained from W2XE on 21.52 Mc/s on Sunday afternoon, September 12th, and plenty of G-W contacts were being effected on 28 Mc/s.

The next significant note appears for Monday, September 13th, to the effect that the news from the Christian Science Studio at Boston, via W1XAL at 11 p.m., was read much too quickly; a useful bulletin, but "gabbled," I am afraid.

Neither W3XAL nor W2XAD were really good until late on Wednesday, and by 11 p.m. even W2XAF was good; then the 28-Mc/s band again appeared in the evening on Thursday, September 16th, the best signals being W6IFJ, W8JFC and W4DYY.

Conditions were still very good on Friday, but W3XAL was now blasting badly, the distortion occasionally apparent earlier in the week now having become pronounced. At 10 p.m. W2XAD was excellent, W2XE good, and W8XK weak and fluttering, all in the 15 Mc/s band.

Reception on 10 metres was again good on Saturday afternoon and evening, September 18th, W9YQN being a good signal, and in addition W9XAZ was good on 26.4 Mc/s. Other 28-Mc/s signals worth noting were W3BZJ, W4CYU and W8QKI. Extremely strong and good signals from W2XE on 13 metres were a feature of Sunday afternoon and for evening listening I tuned in to W2XAD at 9.30 p.m. for the weekly "School of the Air" broadcast, which on this occasion was followed, at 10 p.m., by Paul Whiteman and his orchestra from San Francisco. The numbers played were mostly "popular tunes of yesterday." They were announced, in the manner of chamber music, in "groups of two or three."

On Monday evening at 10.30 p.m. for the first time I noticed that the "R" meter showed a slightly greater deflection on W3XAL when compared with W2XAD, the former also being the steadier signal, a rare occurrence.

By the way, have you noticed that when W2XAD changes to his South-American beam at midnight B.S.T., the signal drops very noticeably, but when W3XAL does the same thing between 11.40 and 11.50 p.m., there is very little change in the signal, in fact, occasionally the S. American aerial gives just stronger signals?

ETHACOMBER.

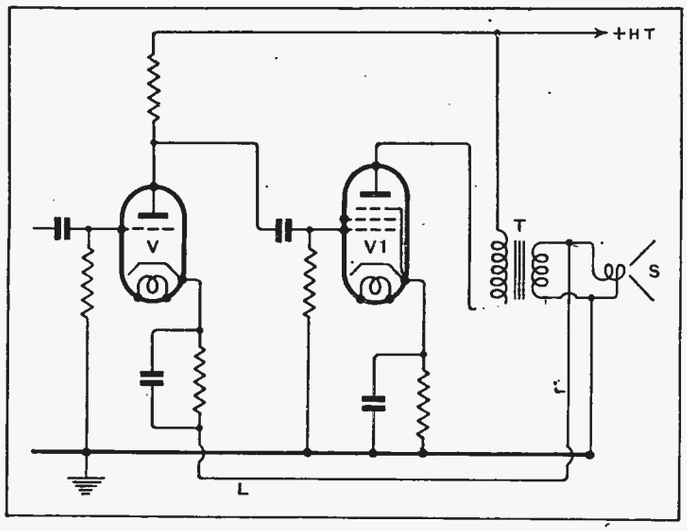
* A third television relay via the 4½-metre lorry transmitter has now had to be abandoned owing to electrical interference.

Recent Inventions

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

NEGATIVE FEED-BACK

A CERTAIN amount of negative feed-back is deliberately introduced in order to offset the distortion effect due to valve curvature. As shown, the output amplifier V1 is transformer-coupled at T to the loud speaker S, and negative reaction is applied by including the secondary winding of the transformer in the cathode circuit of the first valve V. Alternatively, the feed-back connection L may be tapped off from a potentiometer shunted across the transformer.



Application of negative feed-back to correct for distortion in a non-linear amplifier.

Instead of a potentiometer, an inductive shunt may be used so as to permit of frequency discrimination. The arrangement may also be used to correct for distortion due to the magnetic saturation of the output transformer.

N. V. Philips' Gloilampenfabrieken. Convention date (Germany), December 23rd, 1935. No. 466404.

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LIGHT VALVES

WHEN two smooth bodies, such as two plates of glass or polished mica, are pressed close together, they are found to "adhere" in a peculiar manner so that a definite force is required to pull them apart. The generally accepted explanation of this phenomenon is that where the contact between polished surfaces is exceptionally close, molecular forces of attraction come into play, similar to the cohesive forces which bind a solid together. They are, however, of less intensity, since at the outer surface the normal internal forces of molecular attraction are already partly balanced. According to this theory, the "adhesion" effect must be due to electrostatic forces, and can therefore be controlled by an applied field of force.

The invention utilises this principle. One face of a lens or prism is coated with a very thin layer of mica crystals, and the "field" from the electron stream of a cathode-ray tube is then applied to vary their adhesion to the prism. A ray of light focused on the prism from an external source is thus modulated so as to throw an image of the received picture on a screen mounted outside the cathode-ray tube.

Marconi's Wireless Telegraph Co., Ltd.; L. M. Myers; and E. F. Goodenough. Application date November 20th, 1935. No. 466031.

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NAVIGATING BY WIRELESS

ONE method of indicating a desired course, particularly to a pilot in the air, is to transmit two overlapping radio beams from a beacon station B, Fig. 1, and to modulate one beam, say, with the morse letter A, and the other with the complementary letter N. In the overlapping part of the radiated fields the dots and dashes of the two morse signals "interlock" and merge into one continuous note, which tells a pilot, say, at the point O that he is on the correct course. Any deviation to port or starboard makes one signal or the other predominate, and the pilot knows how to correct his course accordingly.

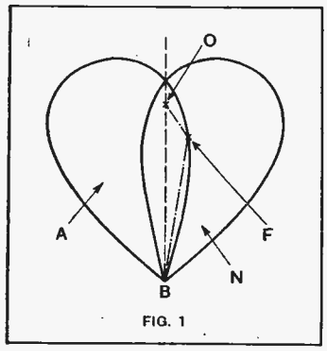

FIG. 1

Radio beams sent out by aircraft beacon station though intended to give a steady signal . . .

In practice the two signals are rectified and fed to a differential meter, so that the correct course is being flown when the indicator needle remains steady. Usually, however, there is a tendency for the needle to "wobble" about the centre zero as shown in Fig. 2, particularly when a near-by aeroplane, such as F, reflects waves, as shown by the dotted line, on to the observer's craft at O.

To prevent such fluctuations, the indicator is made slightly "sluggish" in its response, preferably by using thermo-couples or bolometers to rectify the signal currents before they are applied to the indicator.

Telefunken ges für Drahtlose Telegraphie m.b.h. Convention date (Germany) August 16th, 1935. No. 466241.

IN order to keep a navigator on his course when flying in foggy weather, two "lopsided" directional beams are transmitted from a beacon station, so that they overlap along the desired line of flight. One beam is modulated, say, with the syllable "CROY," whilst the other beam carries the syllable "DON."

On any path of flight outside the direct line to the beacon the pilot hears one or the other of these syllables constantly repeated. He can only hear the complete name "CROYDON" by keeping his machine inside the zone where the two beams overlap.

D. N. Sharma. Application date, November 21st, 1935 No. 466122.

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TELEVISION RECEIVERS

TO separate the picture signals from the synchronising impulses, both are applied to a pair of diodes arranged in push-pull. The output from the diodes is fed to a pentode valve, which is so arranged that the synchronising voltages are developed across an impedance in its cathode circuit and are passed from there to a valve which is normally biased to the cut-off point, so that only "peaks" of current can pass through. The picture signals appear across the anode impedance of the pentode, from which they are fed direct to the modulating grid of the cathode-ray tube.

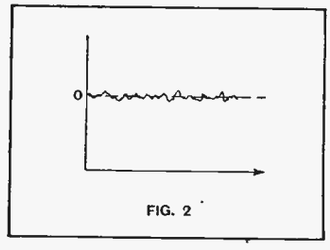
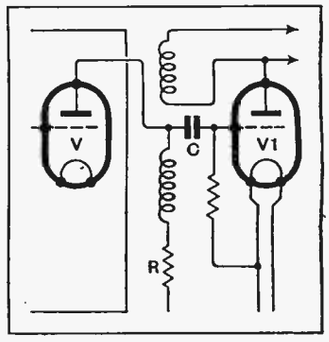


FIG. 2

. . . with a visual indicator the needle is inclined to "wobble" about *its* zero.

Baird Television, Ltd. and L. R. Merdler. Application date November 23rd, 1935. No. 466419.

THE valve V represents the last IF stage of a superhet television receiver, and V1 is the second detector. In order to preserve the higher picture frequencies in such an arrangement, the usual tuned output circuit is replaced by a resistance R of at least 50,000 ohms, and the coupling condenser C has such a value that its effective impedance is negligible as compared with R. In addition a coil L is back-coupled to the coil L1 of the detector valve.



Method of improving high-frequency response in a television superhet receiver.

E. Michaelis. Convention date (Germany) September 26th, 1935. No. 466545.

o o o o

CATHODE-RAY TUBES

WHEN making large CR tubes of the kind used for television transmission, it is found necessary to support the weight of the bulb from the neck of the tube in the process of handling the molten glass. This, in turn, means that the walls of the neck must be made thicker than is desirable. Also it increases the difficulty of blowing bulbs of uniform or graded size.

According to the invention, the difficulty is avoided by making the tube in two operations. The bulb and neck are blown separately, and the part of the bulb to which the neck is to be sealed is made larger in diameter than the main part of the neck. A part of the latter is then expanded at the point of sealing. This allows nearly the whole length of the neck to be made of comparatively thin glass.

Baird Television, Ltd. and A. H. Johnson. Application date November 27th, 1935. No. 466426.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Television

Problem of Distribution

AS far as we are ourselves aware, no statement has been made by the B.B.C., or any other competent authority, which relieves us of anxiety on the question of the distribution of television programmes throughout the country.

There can be no doubt that the Television Committee, at the time they prepared their report, visualised the distribution of television by means of a number of stations, so that eventually the whole country would be served as is the case to-day with sound broadcasting. A general service of this kind seems to be the only reply to those in areas not yet served who continually complain that their licence fees are being diverted to television in which they can take no part. When, however, we take a map of the country and, assuming a service area of 30 or 40 miles radius for television stations, the number of stations required to cover the whole country reaches an impressive figure, and if the necessary wavelengths could be made available for this purpose, where do we stand with regard to the problem of mutual interference? What, too, will be the position of those users of television receivers who find themselves just within the service area of two or more stations?

The possibility of employing still shorter wavelengths must not be ruled out but this would entail changes in reception conditions and it must be remembered that the Television Committee laid it down that no such change should be made for a period of two years.

The use of common wavelengths has been a problem to the B.B.C. even on the sound broadcast bands, and we dare not think how such a scheme might work in practice on frequencies suitable for television distribution. It is curious that up to now no reassuring statements have been made on these problems, with which it would seem to us the future of general development of television in this country is inextricably associated.

Our Questionnaire

A Word of Thanks

THE response which our readers have given to the Questionnaire which we published last week has been extremely gratifying to us. We take this early opportunity of expressing our sincere thanks, not only for the spontaneous way in which our request has been met, but also for the painstaking care with which the Questionnaire has been answered and the valuable remarks which have been added in the space provided.

It is difficult for individual readers to appreciate fully how valuable this information can be to those whose task it is to prepare week by week a journal with the object of making it as useful as possible to the unseen readership.

It is not possible to have too many replies and we hope, therefore, that readers who have not yet sent in the Questionnaire will do so. As it is not intended to repeat the Questionnaire, the form which appeared in last week's issue should be used. We shall, no doubt, have the opportunity of discussing later some of the information which replies to our Questionnaire convey, and there is already ample evidence that readers have supplied us with most valuable material in their replies.

Electron Multipliers

THE NEW BAIRD PHOTO-CELLS DESCRIBED

By N. W. MAYBANK
(Baird Television Limited)

THIS article contains the first description of the Baird Multiplier Photo-cell, in which is incorporated a secondary electron multiplier electrode system which makes it possible to produce with certainty photo-electric cells of extraordinarily high sensitivity. With a primary cathode sensitivity of 30 microamperes per lumen the overall sensitivity of the multiplier photo-cell is over 1 ampere per lumen. These cells are designed to be specially suitable for amplification of small signals without distortion over an exceedingly wide band of frequencies, and, in fact, were employed in conjunction with the 240-line mechanical scanners at Alexandra Palace.

FOR the benefit of readers who are not familiar with the phenomenon of secondary emission, on which the electron multiplier depends, it is proposed to describe this effect briefly.

It has been observed that when certain metallic surfaces are bombarded with electrons with a velocity above a certain value, other electrons are released from the surface, of a number in excess of the impinging electrons, these released electrons being known as secondaries. The ratio of secondary electrons released to primary impinging electrons depends not only upon the primary electron velocity, but also upon the surface that is being bombarded; certain metals possessing a greater secondary factor than others. With good conditions, factors of 8 to 10 can be obtained. That is to say, for every primary electron striking the surface, 8 or 10 secondary electrons are released. It has been observed that secondary emission commences with electrons possessing a velocity corresponding to a potential difference of approximately 10 volts and reaches a maximum somewhere between 250 and 500 volts.

One of the best and more stable secondary emitting surfaces, and, incidentally, the one that is used in the cells to be described, is caesium. It should be noted when considering the Baird cells that the secondary factor obtained with caesium on a plain, non-permeable metallic surface is approximately three times that obtained from cæsium on a permeable wire mesh, because a proportion of the secondaries liberated from the wire of the mesh are attracted straight through the apertures by the potential applied to the succeeding mesh.

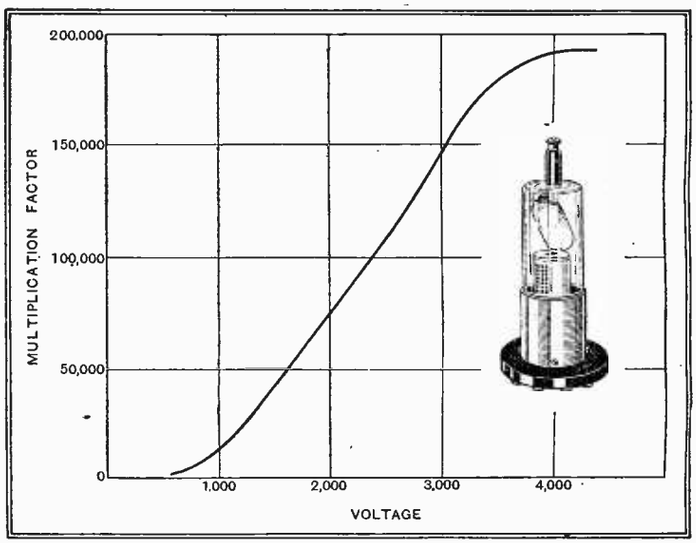


Fig. 2.—The Type MS cell, with its characteristic curve.

The action of the cell may best be explained by referring to the schematic diagram, Fig. 1. Light incident upon the photo-sensitive cathode surface P liberates electrons which are accelerated towards the first electrode A, which is composed, as are also the other electrodes B to H inclusive, of a fine silver wire mesh oxidised and sensitised with cæsium for optimum secondary emission. It can be seen that each of these meshes is at a higher positive potential than the preceding one and, therefore, electrons leaving any one mesh will be accelerated through the holes in the mesh towards the next one by virtue of this potential difference. As each of these meshes is sensitised for secondary emission a large number of secondary electrons will be released if the velocity of the impacting electrons is sufficient, this velocity being controlled by the relative potentials of the meshes. The secondaries emitted are then drawn through the mesh and attracted towards the next mesh. This successive multiplication results in a number of electrons emerging from the last mesh considerably in excess of the original number passing through the first. It will be seen that the emergent electrons are attracted towards the plate J, which is non-permeable and has on its surface facing the meshes a similar secondary emitting substance. The electrons striking this plate will, of course, release further secondaries which, in turn, are collected by a wide-mesh collecting electrode I, from which the final multiplied output is taken.

In these cells the secondary factor normally obtained is 3.0 per stage at 200 volts for the meshes, and 6.5 for the final reflecting plate.

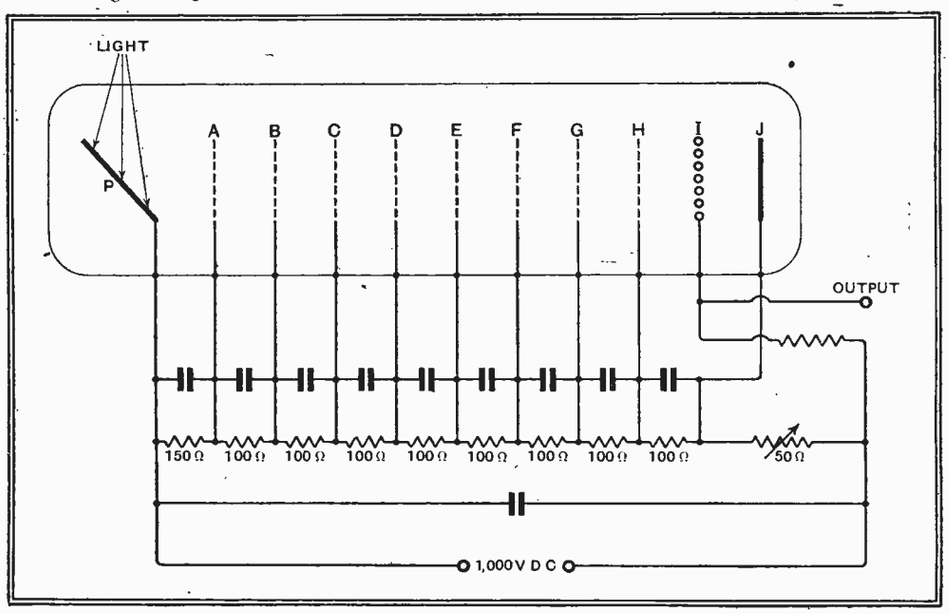


Fig. 1.—Explaining the action of the multiplier photo cell.

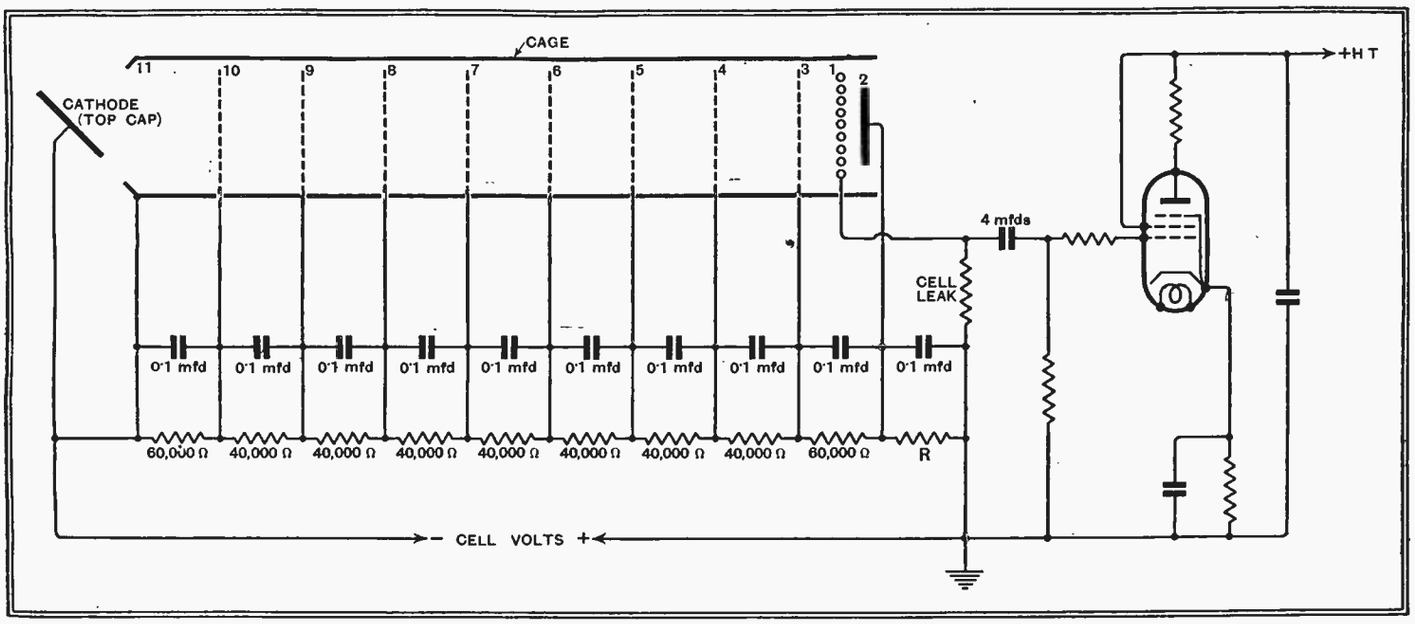


Fig. 3.—Internal and external connections of the MS cell

It will be seen from the next diagram that the multiplier electrode system is enclosed in a nickel cylinder to provide screening. This cylinder has a narrow window provided, the purpose of which is to facilitate the observation of the oxidising process on the meshes during manufacture.

Two types of cells are at present available and will be dealt with here. The first is the Type MS, which is a small cell having a cathode of 15 sq. cms. area, designed for use with a concentrated light source. This cell is illustrated in Fig. 2, together with its accompanying characteristic curve. This possesses a 9-stage multiplier and has been used with an overall voltage of 1,000-1,500 volts, which corresponds to 100-150 volts between successive meshes. Under these conditions a multiplication of 10,000 to 20,000 has been obtained with this 9-stage cell, but higher voltages and more stages can, of course, be employed, which would result in a far larger multiplication factor. There is, however, a limit to the useful number of stages and voltages which can be used, in that the output current must not be allowed to exceed one milliampere if stable operation is to be ensured.

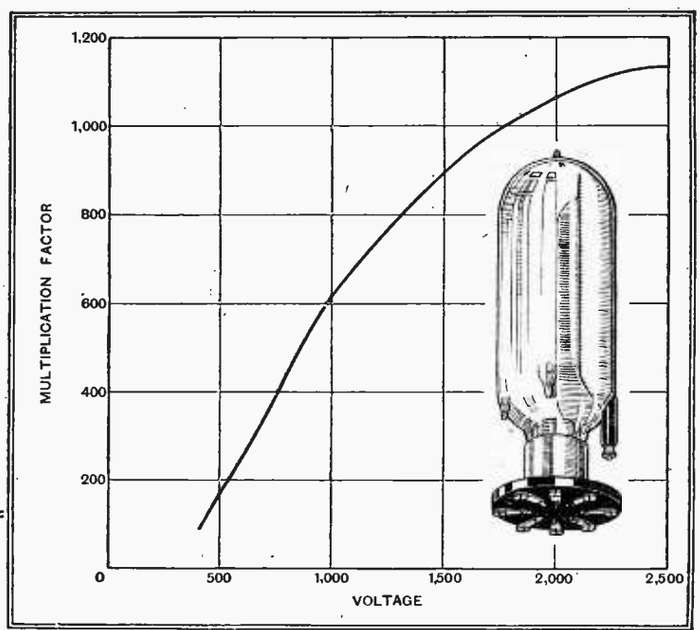
The scheme of connections shown in Fig. 3 is as follows:

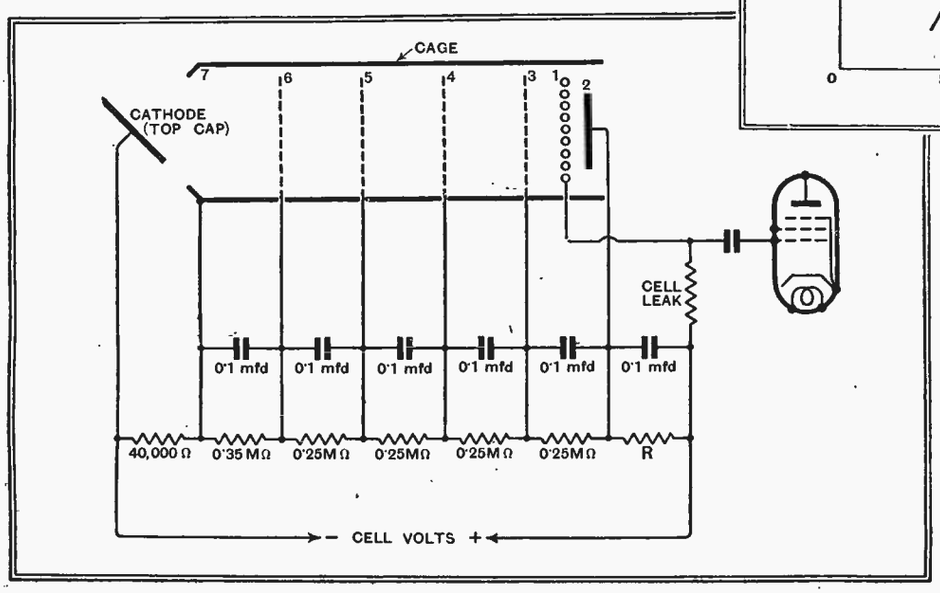
1. Collector or output terminal.
2. Reflector plate.
3 to 10. Multiplying meshes.
11. Screening cage inside cell.

There is a metal cap surrounding the lead-out wires.

Fig. 4.—The 5-stage multiplier, type ML, has a large cathode area.

Below Fig. 5.—(Compare with Fig. 3). Connections of the 5-stage multiplier.





The other cell to be dealt with is the ML type, shown with its characteristic curve in Fig. 4. This cell possesses a far larger cathode than the one mentioned above, and has an area of 250 sq. cms., being designed for operation in apparatus where diffused light is used. Incidentally, this is the largest size photocathode manufactured. This cell has a 5-stage multiplier and is identical in operation with the type MS. The schematic diagram for the connection of this cell is given in Fig. 5, and the connection scheme is as follows:

1. Collector or output terminal.
2. Reflector plate.
3 to 6. Multiplying meshes.
7. Screening cage inside cell.

There is also a connection to metal cap outside cell. The cathode is brought out to a separate terminal.

In the standard form of these cells a

Electron Multipliers—

caesium surface is used which has a primary sensitivity of about 30 microamperes per lumen for light from a tungsten filament lamp and possesses the usual spectral sensitivity for caesium which makes it possible to use these cells for work in the infra-red region of the spectrum. For special requirements, however, cells with a rubidium surface can be used.

Stability of Operation

Various types of secondary emission multipliers have been described from time to time, but it is found that in comparison with the mesh type multiplier, as included in the Baird cell, they all suffer from a necessity for exceedingly critical adjustment, and there is a tendency for large variations of the overall gain of the multiplier when used in a service installation. In the Baird multiplier cell very great stability of operation is achieved since no magnetic guiding fields are used whatsoever.

The frequency characteristic of the multiplier cell in a video amplifier position with 1.5 megacycles band width seems to be only due to the earth capacity of the output collector grid across the output impedance because the current amplification at the multiplying meshes is not associated with any appreciable impedance. In fact, as will be seen in the circuits, these meshes are normally tied to earth by large capacities.

As compared with that of the thermionic valve amplifier of equivalent gain, the ratio of signal to noise in these cells is of the order of 200 : 1 when used for a bandwidth of 1.5 megacycles.

Fig. 6 shows that the output is proportional to the photo-emission input, or the amount of light received on the primary cathode, within the working range of the multiplier.

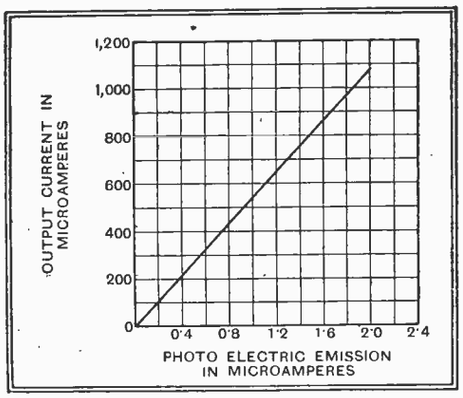


Fig. 6.—Input-output current characteristics of the ML cell.

Warning is given to users of these multiplier cells that serious damage can be done by overloading the latter stage meshes due to overheating if too much light falls on the cathode.

The writer wishes to express his thanks to Baird Television, Limited, for permission to publish this article.

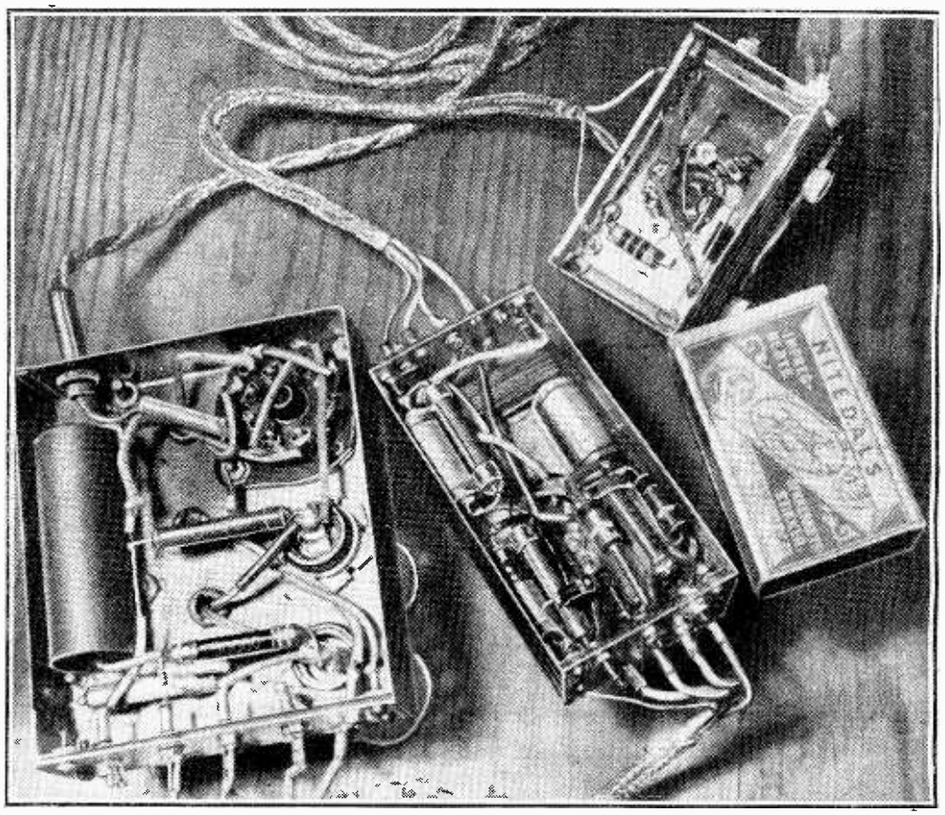
The World's Smallest Wireless Station?

A Norwegian Challenge

FROM time to time we hear of somebody building a portable wireless set which, for compactness and lightness, is a long way ahead of anything which has been produced. This passion for ultra portability now includes combined transmitter and receiver.

The honour of being the designer of the world's smallest wireless station is believed to belong to Mr. Birger Holth, a young Norwegian engineer. His apparatus, which was exhibited at a wireless exhibition in Oslo, is not only small but it is thoroughly efficient, a feature not always to be found with miniature equipment.

Ultra-short waves are used, the actual waveband covered being from 1.2 to 2.5 metres. Needless to say, all the components, including the valves, are of the midget type. One of the AF smoothing chokes has a diameter of only 4 millimetres and a length of 10 millimetres. There are several pieces of subsidiary apparatus, such as a microphone amplifier, to increase the usefulness of the gear and all this additional apparatus is also built to miniature specifications. The output valve of the tiny AF amplifier delivers 500 milliwatts to the loud speaker.



Miniature wireless equipment designed by a Norwegian engineer. The size of the power unit, amplifier and receiver can be compared with the match box seen in the picture.

Les Mesures du Radiotechnicien. By Hugues Gilloux. Pp. 112. Published by Les Editions Radio, 42, rue Jacob, Paris. Price 21 fr.

Manuel Technique de la Radio. By E. Aisberg, H. Gilloux and R. Soreau. Pp. 224. Published by Les Editions Radio, 42, rue Jacob, Paris. Price 23 fr.

BOOK REVIEW

Radio Engineering.—By F. E. Terman. Second edition. Pp. 813+xiii. Published by McGraw Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 30s.

THE second edition of this book has been completely revised and now forms a very valuable reference book for the engineer as well as being a sound text-book for the student. All stages in transmission and reception are dealt with, but particular emphasis is laid upon circuit design.

The early chapters deal with the properties of circuits and valves and then a large section with the different applications of valves. Voltage amplifiers first receive attention and then power amplifiers; it is particularly gratifying to note that the discussion of power amplifiers is not limited to the case of Class A types, for Class AB and Class B AF amplifiers receive detailed attention. The treatment given on Class C RF amplifiers is one of the best the reviewer has yet seen and has the great merit of being extremely practical.

Oscillators and modulators are dealt with and are followed by a good chapter on detectors in which the diode receives the attention it deserves. The treatment of HT rectifiers and smoothing equipment is unusually complete.

After discussing generally typical transmitter and receiver designs, the author goes on to deal with wave propagation, aerials and sound equipment. A chapter on television is included, but this is quite brief.

The book is well bound and printed and free from errors. It is up to date and thorough, and can be confidently recommended to all interested in the theory of wireless and the design of apparatus.

W. T. C.

Speech Coil Design

AN IMPROVED METHOD OF CONSTRUCTION USING AN ALUMINIUM FORMER

By

H. S. HARING

SINCE the advent of the moving-coil loud speaker manufacturers have, with very few exceptions, used paper as the supporting medium for the actual winding of the speech coil. This assembly combines rigidity and low weight, and the paper collar is easily attached to the cone. Paper, of course, has the additional advantage of being an electrical insulator.

It is well known that metals expand when heated. This means that the diameter of the speech coil increases with the temperature rise which normally takes place in varying degrees when the loud speaker is operating. It is, however, not quite so well known that when paper is subjected to the same treatment shrinkage occurs. Now it will be realised that, if a paper former is used, the adhesion between the paper and wire must be exceptionally good to counteract their pulling in opposition. This inherent fault is, as most truthful speaker manufacturers will admit, the most prevalent cause of failures.

In Search of a Remedy

A series of experiments was undertaken to discover a reliable remedy. The type of former used during these tests was the popular gapped single turn of paper, over which were wound two layers of enamelled copper wire.

A summary of the experiments is detailed below:—

(1) Numerous grades of paper were tested and a number selected for minimum shrinkage and good adhesive qualities.

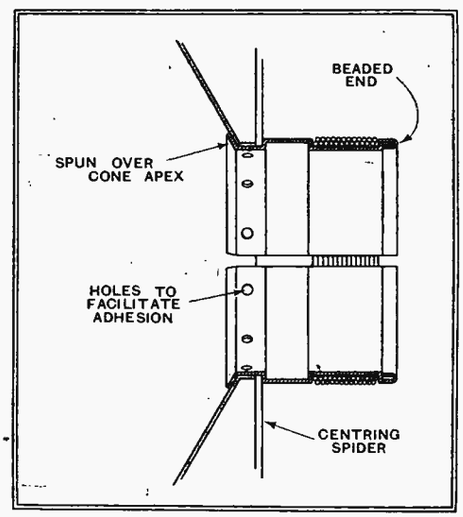
(2) Experiment (1) was repeated with a selection of papers which had been rolled down from twice their working thickness in an endeavour to provide additional stiffness and hardness.

(3) Selected papers were impregnated with various materials, being thoroughly dried both before and after treatment, and the effect noted.

(4) Many adhesives, both air drying and baking, were tried and the resulting assemblies were subjected to both humidity and temperature tests.

The experience gained in these experiments resulted in a coil assembly which, although apparently satisfactory for normal working conditions, did not have a factor of safety appreciably greater than could be expected of something which was mechanically incorrect, and the writer did not feel that a final solution had been reached.

From the foregoing it will be seen that the ideal is a former which has the same coefficient of expansion as the copper winding itself. A copper former was thought to be impracticable on account of its weight, and 0.003in. aluminium foil was therefore used. This thickness was chosen as being approximately the same weight as the 0.005in. paper previously used, the thinner material having the obvious advantage of making it possible to reduce the magnetic gap and thus obtain greater sensitivity.



Constructional details of improved coil former. The inside end is beaded to increase stiffness and the outside spun over to fit the cone apex.

The coefficient of expansion of aluminium is slightly greater than that of copper, and the tendency therefore is for the former to tighten on to the winding as temperature increases. A gapped single turn was used, as with paper, and presented no difficulty in manufacture. The aluminium has mechanical advantages over paper, inasmuch as the front end can be spun over the cone apex and the rear end beaded or turned back on itself to provide extreme stiffness.

Lead-out Wires

Some difficulty was experienced in avoiding a risk of the lead-out wires short-circuiting to the former. This, however, is not so serious as it might at first appear, for the voltage is very low, and a satisfactory solution was found by forming the holes in the aluminium into eyelets so that the wire passes over rounded edges both inside and out.

An experimental batch of speech coils using aluminium formers was tested as follows:

(1) Coils were tested for breakdown between winding and former at 500 volts DC and all were found to withstand this test.

(2) A 2-ohm coil wound on an aluminium former was connected in series with an identical coil wound on paper, and 12 volts AC applied across the two. The paper former immediately commenced to smoke, finally becoming charred and separating from the winding, whilst the aluminium former remained in apparently perfect condition and could be stripped from the winding only with the greatest difficulty.

(3) Aluminium formers were fitted to a batch of 24 commercial 8in. speakers, normally operating with about 6 field watts. 25 watts were applied to each field and 4 volts AC to the speech coils and each enclosed to prevent heat dissipation. These were run continuously for 80 hours, after which each speaker was carefully tested and found to be satisfactory in every respect.

(4) The speakers used for test (3) were then supplied with 14 watts AC to each speech coil and the field watts reduced so that the speech coils had an amplitude of $\frac{5}{16}$in. A time switch was inserted so that the current was switched at half-hour intervals. Thus, the coils operated for half hour becoming thoroughly hot, and then cooled for half-hour, a maximum movement of metals taking place. This test was run for 80 hours, and the speakers were again found to function in a satisfactory manner.

(5) Coils on aluminium formers were fitted into speakers and checked for response against similar speakers using paper formers. There was a marked improvement in the high-frequency response of the redesigned speakers, probably due to the increased stiffness of the aluminium former.

It is believed that the aluminium former will practically eliminate the far too prevalent speaker troubles hitherto experienced, and it should be welcomed by the set manufacturer on account of the consequent service costs and loss of goodwill, as a faulty component is, from the customer's point of view, a faulty receiver.

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Frequency - Response

THE REQUIREMENTS FOR GOOD REPRODUCTION

By W. T. COCKING

IN this article the special waveforms of television are discussed and their correlation with sine waveforms explained. It is shown that a wide frequency-response is necessary in a television amplifier in order that rapid changes in voltage may be handled faithfully.

IT is generally accepted that for high-quality sound reproduction all frequencies from 30 c/s to 10,000 c/s must be handled by the amplifier; sometimes even higher frequencies are considered desirable, but nothing greater than 20,000 c/s ever seems necessary. In television the frequency range is much wider and ideally stretches from zero to infinity. Such a range is impossible in practice, and it is accordingly important to determine the minimum range necessary for a high standard of performance.

When dealing with sound equipment we are accustomed to think of the voltages and currents as being of sine waveform, largely because circuit analysis and design is greatly simplified by this procedure. There is some justification for this, because a sustained musical note really does consist of a series of sine waves of the fundamental and its harmonic frequencies. In television, however, a sine wave is a rare occurrence, and we are dealing with abrupt changes in voltage or current. This does not make it necessary to discard the conventional methods of design, however, but we must find the required correlation between the two types of waveform.

It would be quite possible to design an amplifier directly from a consideration of its response to the peculiar waveforms of television, but it would be much more difficult to do this than to design it for a given frequency response in the conventional manner. Furthermore, measurements are much easier to carry out with sine waveforms.

Our present problem thus resolves itself

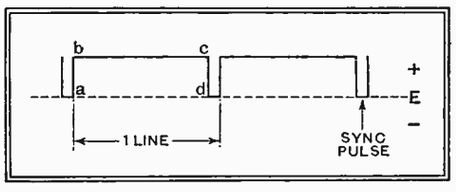


Fig. 1.—The signal waveform for an evenly illuminated surface is shown here. The only changes of amplitude are those brought about by the sync pulses.

into this: Given the extremes of waveform present in television, to find the limits of sine wave frequency response which our apparatus must have for negligible distortion.

Let us first of all consider the low-frequency response. Obviously, the voltages and currents are changing least rapidly when the television camera is looking at a blank evenly illuminated surface. In fact, there is then no change in the picture modulation at all. The television signal, however, is interrupted once every line for the synchronising pulse, so that we actually do get a varying current or voltage. The voltage output of the detector in these circumstances is of the form shown in Fig. 1, and it is the interruption of the sync pulses which enable us to place a limit other than zero to the low-frequency response.

The Low-Frequency Response

Suppose we use the usual resistance-capacity type coupling. If the low-frequency response is not good enough, or, in other words, if the time-constant of the grid-leak-coupling-condenser combination is not great enough, it will distort the waveform in the manner sketched in Fig. 2 (a). With a large enough time-constant the waveform will be undistorted, but since zero frequency is not transmitted by the

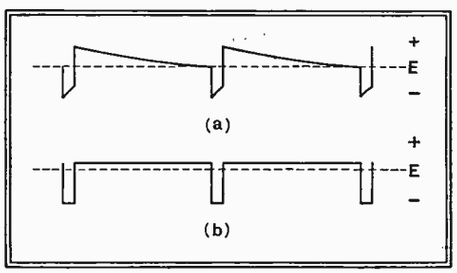


Fig. 2.—Passing the waveform of Fig. 1 through an RC coupling of low time-constant distorts the waveform as shown at (a). With a large time-constant (b) the changes are reproduced properly, but the DC component is missing.

coupling it will be like that shown in Fig. 2 (b). Instead of the bottoms of the sync pulses all resting on the same baseline, marked in Fig. 1 as being at earth potential, and the changes in voltage taking place on one side of earth only, the changes of potential are on both sides of earth as shown in Fig. 2. Actually, this condition is reached only after a number of lines and the steady state is achieved when the area beneath the dotted line of Fig. 2 (b) is equal to the area above it.

For completely faithful reproduction the DC component must be transmitted, but at present DC amplifiers seem impracticable for more than one stage. It is, however, possible to replace the DC component artificially in the output of an amplifier, so that for the time being we can ignore this aspect and concentrate on the *changes* in voltage.

We obtain a waveform such as that of Fig. 1 across R1 of Fig. 3, and we desire to choose the coupling components C and R so that the voltage across R is as nearly as possible like that of Fig. 2 (b). R1 may, of course, be a diode load resistance or the coupling resistance of an amplifier.

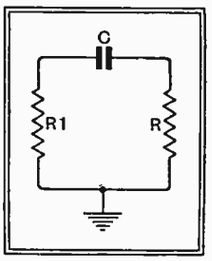


Fig. 3.—The essentials of an RC coupling are shown here. The low-frequency response is determined by the time-constant $T = C(R + R_1)$.

Assuming a perfect high-frequency response, a change of voltage across R1 is instantaneously communicated to R by the action of the condenser C. Such a change may be (ab) of Fig. 1, the subsequent change (cd) is also dealt with faithfully. Ideally, during the period (bc) there should be no change in potential across R, for there is none across R1. In practice, however, there will be a fall in potential unless C or R is infinitely large. We must, therefore, tolerate some change in potential, but we can make this as small as we like by using large values of C and R.

If the voltages across R1 and R are called E1 and E respectively, it is easy to show that $E/E_1 = \epsilon^{-t/T}$ where $\epsilon = 2.718$, t = the time in seconds since the application of the voltage E1, and T = time-constant of the circuit = C (R + R1), capacity being in farads and resistance in ohms. This equation is an awkward one for the non-mathematical to solve and the curve of Fig. 4 is consequently given and shows directly the relationship between E/E1 and t/T.

Suppose we say that we can allow the voltage to fall during one line to 95 per cent. of its correct value. Then E/E1 = 0.95 and t/T = 0.05. Now t is the time occupied by the picture portion of one line or (bc) in Fig. 1, and with the present transmissions this is 0.9 of the complete line time. There are 405 lines and 25 complete frames a second, so that $t = 0.9/(405 \times 25)$ sec. = 0.000088 sec. Consequently T = 0.000088/0.05 = 0.00177. If R = 0.1

in Television Amplifiers

MΩ, C is 0.0177μF., and the frequency at which the response to a sine waveform is −3 db. is about 90 c/s. The low-frequency requirements are thus less

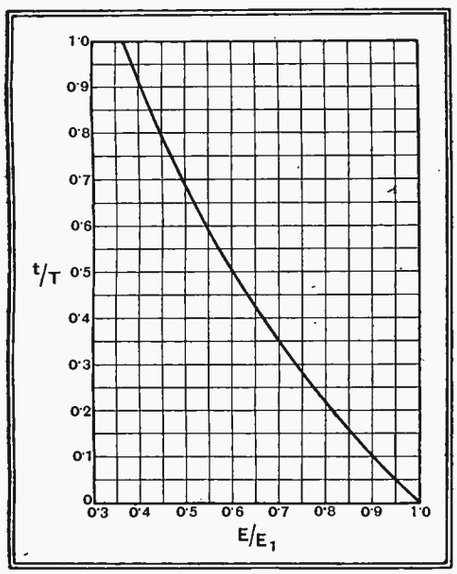


Fig. 4.—This curve enables the effect of the time-constant on a square-topped wave to be readily calculated.

exacting than in the case of an audio-frequency amplifier.

This result seems rather surprising because the view is generally held that the response must be maintained down to very low frequencies indeed. Actually this belief is a relic of the days of mechanical television systems. No line sync pulse was used with these, and it was consequently necessary for the couplings to be able to maintain a pulse lasting for the *frame* time. For the old 30-line transmissions this meant a time about 800 times as great as that needed for modern television, so that ideally the response had to be maintained well below 1 c/s! Needless to say this was rarely attempted.

D.C. Restoration

Although the low-frequency response need not be maintained at exceptionally low frequencies with the present transmitting system, it is necessary to do something about the DC component of the signal. If the response extends to zero frequency the DC component is automatically retained, but unfortunately DC amplifiers are usually impracticable.

The signals corresponding to black and white lines in a picture are shown in Fig. 5 (a) and (c) and to an intermediate shade in (b); after the DC component is removed the corresponding signals take the forms shown in (d) (e) and (f). If the tube is biased so that black corresponds to the signal (d) it is obvious that the increase of brilliancy for white lines is less than it would be were the DC component present. This can be overcome by increasing the signal, but this course is not permissible, for the precise changes shown are only obtained when sufficient time has elapsed for the steady state to be reached. A change of short duration during a line will be represented by the full change from the voltage value existing immediately before. Thus the brilliancy obtained with a change from 30 per cent. modulation to 100 per cent. and back again will be greater when the duration of the pulse is a fraction of the line time than when it lasts for several lines. The practical result of the omission of the DC component is thus a generally dull background with excessive brilliancy in white detail and, of course, changes in the mean light value at the studio cannot be followed.

Owing to the presence of the sync pulses it is readily possible to replace the DC component artificially by means of a diode connected as shown in Fig. 6. Without the diode the signals developed across the resistance R would be of the form of Fig. 5 (d, e and f). With the diode, however, the cathode is driven negative on each sync pulse. This is the same as the anode being driven positive, and the result is that the diode passes current on each sync pulse. This current flows into the condenser C and charges it to a voltage which depends on the amplitude of the signal and the duration of the sync pulse. During the line intervals the condenser discharges through R. Equilibrium is reached when the quantity of electricity leaking away during the line intervals equals that entering the condenser during the sync pulses.

This charge on the condenser can be expressed as a steady voltage across R which is added to the signal. With 100 per cent. efficiency the signal would become the original one of (a), (b) and (c), Fig. 5. In practice, the efficiency is lower and the final result is more like that shown at (g), (h) and (i).

The larger the values of C and R the greater the efficiency, but if the values are too great the condenser may take too long to change from one value of charge to the

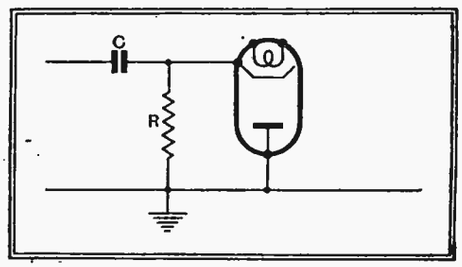


Fig. 6.—The circuit of a DC restorer is shown here.

next. If CR were infinite, for instance, the condenser would become charged to the value corresponding to white parts in the picture and it would lose no charge on dark parts; consequently, the effect would be merely that of changing the tube bias.

The time-constant CR should be fairly large, but smaller than any time-constant in the preceding couplings. The time-constant CRa should be small, however, which means that a low-resistance diode is advisable. Actually, the DC restorer does more than replace the DC component, for it will also restore very low-frequency components of the signal.

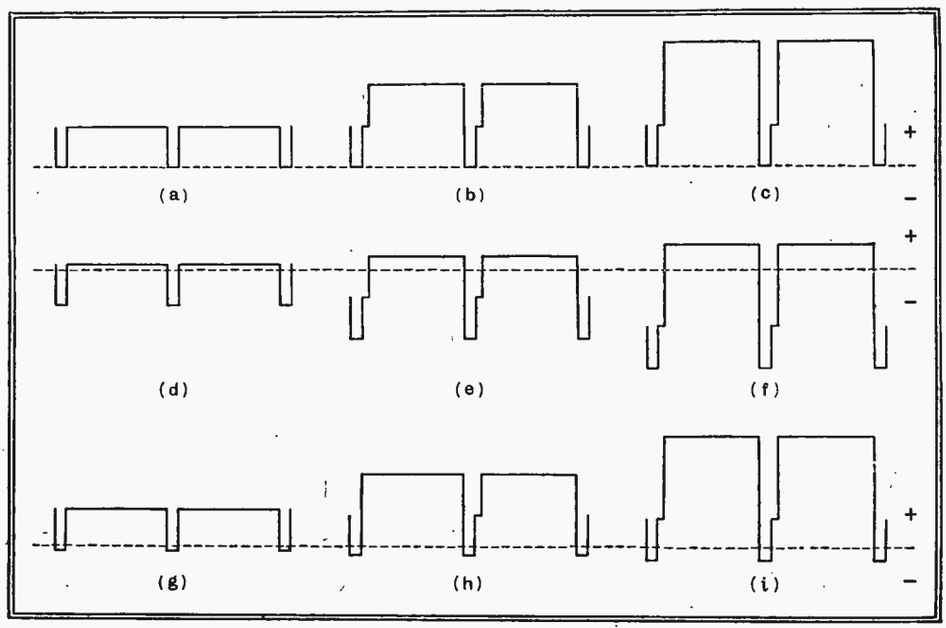


Fig. 5.—At (a), (b), and (c) are shown typical waveforms, corresponding to black, grey, and white, and at (d), (e) and (f) the effect of removing the DC component. The waveforms (g), (h) and (i) show how DC restoration brings matters back very nearly to normal.

Frequency Response in Television Amplifiers—

To conclude this section, we see that so far as the picture is concerned it is not necessary for the low-frequency response to extend below 90 c/s with the present transmissions, but that the DC component must be replaced artificially in the output. This results in a theoretical imperfection which is probably negligible in its effect on picture quality. Perfection thus demands a response extending to zero frequency; in other words, the use of a DC amplifier; this, however, is usually impracticable for more than a single stage.

Now let us consider the high-frequency response. This is much more important as regards picture quality, for on it depends the detail obtainable. There are 25 complete frames a second and 405 lines in each frame, while the picture ratio is 3:4. We can imagine the picture divided into a series of squares, there being as many squares vertically as there are lines; that is, 405. Horizontally, there would be $405 \times 4/3 = 540$. The total number of squares, or picture elements, is $405 \times 540 = 218{,}700$, and the total number occurring in one second is $218{,}700 \times 25 = 5{,}467{,}500$. This method of calculation by dividing the picture into elements is based upon the attainment of equal detail in the vertical and horizontal directions.

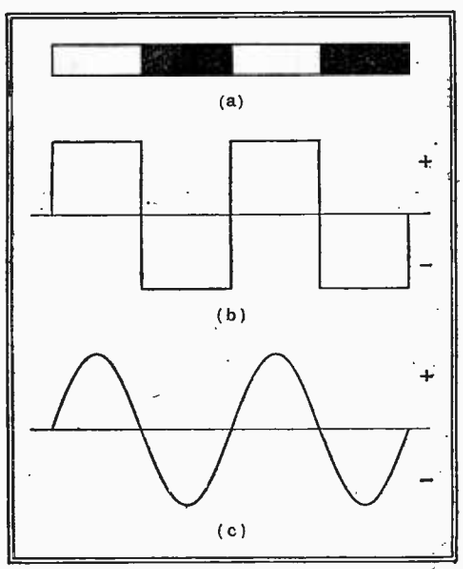


Fig. 7.—A line with alternate black and white elements (a) gives rise ideally to the square waveform (b), ignoring the DC component. This can be built up from a sine wave (c) and a series of harmonics.

If the picture to be transmitted is actually composed of such black and white squares, a portion of one line will be as shown in Fig. 7 (a) where there are four elements, and the corresponding ideal electrical waveform would be rectangular as in (b). This waveform can be considered as built up of a sine wave (c) plus an infinite series of harmonics. For four picture elements there are two sine waves of fundamental frequency, consequently the maximum fundamental frequency is one-half the number of picture elements per second, or 2,733,750 c/s.

For a good approximation to the square waveform harmonics up to about the tenth should be catered for, and this gives a maximum frequency of the order of 27 Mc/s! This is, of course, absurd, and in practice such frequencies do not occur owing to the finite size of the scanning spot in the transmitter; because of the spot size on the receiving tube they would be of no value even if they could be fed to it.

Since the spacing of the sound and vision transmitters is 3.5 Mc/s, frequencies higher than this are out of the question, and in practice frequencies above 3.0 Mc/s cannot be retained owing to the necessity for sufficient selectivity to avoid interference from the sound transmission. It will be seen, therefore, that we cannot go appreciably above the fundamental element frequency, and this is consequently usually taken as the upper limit of response necessary. Indeed, it is very doubtful whether higher frequencies are broadcast.

We thus see that the vision-frequency circuits should be capable of dealing with frequencies from 90 c/s to 2.7 Mc/s in order to handle with reasonable fidelity the complex waveforms of television.

Distant Reception Notes

BY all the rules, or what we thought were the rules, of sunspot cycles the reception of medium-wave American stations in this country should be something like a wash-out now that we are on the very verge of a "maximum" period. For a year or so on either side of the last maximum very little could be heard of Transatlantic stations on wavelengths between 200 and 500 metres; if they were coming in at all the set had usually to be run all-out to get them at respectable strength—and that generally meant that they were just about drowned in the accompanying roar of background noises and atmospherics.

It's a very different story now, as you will find if you consume the post-midnight watt and devote it to the medium waves. Many—perhaps most—D-Xers nowadays regard the 31-metre and the 49-metre bands as the best bets for distant stations after midnight, and are thus inclined to neglect the wavelengths between 200 and 500 metres.

Believe me, this band should not be neglected if you *are* sitting up and if a preliminary try-round shows that atmospherics are not bad enough to be annoying.

It happened the other night that I had been testing a new set on the medium and long waves between 9 p.m. and midnight. It turned out to be a receiver of useful, though not outstanding, sensitiveness and had given a quite respectable account of itself on European stations. As I wasn't feeling ready for bed, I spent half an hour or so in jotting down results. Then it occurred to me that it might be interesting to see whether anything was coming in from across the Atlantic.

Much to my surprise, I picked up at once LR6, of Buenos Aires, and soon afterwards LS8, both at excellent strength.

Interested, I banished all thought of immediate turning in, thinking tuning in a far, far better thing.

And I was rewarded for my vigil. The bag within about an hour and a half included some 18 North American stations, in addition to those logged from South America. Amongst the best were WHAM, WCAU, WJZ and WABC.

Since then I have explored the medium waves more than once in the small hours of the morning and I have never failed to get hold of from eight to a dozen American medium-wave transmissions.

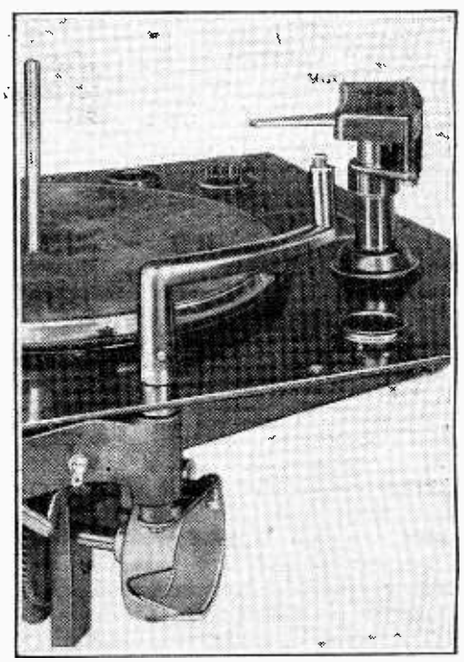
If any of my fellow D-Xers have been shy of the medium waves, feeling that the short were more productive of results, I heartily recommend them to try at such times as they ought to be in bed but aren't a tour over the the medium band, with particular attention to wavelengths between 250 and 350 metres. With a really sensitive set—the one I was using was nothing to write home about—a remarkably good bag of medium-wave Transatlantics should be obtainable.

I don't know how you feel, but I'm thoroughly fed up with the present method of naming European stations in the official lists. In my humble view, there should be consistency in the matter of using or not using genuine English names for foreign towns. As it is, there is none. Here are some examples.

Vienna (locally Wien) and Florence (Firenze) are given their English names. So are Lyons (Lyon in French), Cologne (Köln) and Munich (München). But Gothenburg becomes Göteborg; Nuremberg, Nürnberg; Stamboul (better known as Constantinople), Istanbul; and so on.

Let's have it one way or the other. Either give foreign towns which have real English names those names, or print Roma (Rome), Bruxelles (Brussels), Lisboa (Lisbon), Torino (Turin), Napoli (Naples), København (Copenhagen), Praha (Prague), Anvers (Antwerp), and so forth. Mongrel mixtures are no good to anyone. D. EXER.

THE NEW GARRARD RECORD CHANGER



Close-up of one of the three record platforms in the new RC1A Garrard record changer. The thin selector tongues are now protected by a moulded bakelite cover and do not require adjustment for records of different diameter. The arm in the foreground gauges the record diameter and automatically sets the pick-up for 10" or 12" records

Current Topics

EVENTS OF THE WEEK IN BRIEF REVIEW

New African SW Station

A 50-kW short-wave station is to be built at Lourenço Marques, the Portuguese possession in South-East Africa.

French Broadcasting Tax

A STORM of protest has arisen in France as a result of the increase of the tax on the receipts from time on the air bought by advertisers. It is pointed out that the tax will drive many of the smaller privately owned stations out of existence.

Australia Works the North Pole

FOLLOWING the establishment of communication between the Russian Polar station and amateurs in the U.S.A. and the Hawaiian Islands, two Australian amateurs have now succeeded in linking up with the famous UPOL station established by the Russian scientific expedition to the North Pole.

New Norwegian Stations

THREE new broadcasting stations, each having a power of 1 kW, are to be erected by the Norwegian broadcasting authorities at Bergen, Grong and Mosjoen. The Marconi Company is to build one of them, the orders for the others going to the Telefunken Company.

During the past year more gramophone music has been radiated from Norwegian broadcasting stations than any other single type of programme matter. Actually, gramophone music has occupied 21.61 per cent. of broadcasting time, topical talks and news coming second with 19.79 per cent. With the exception of children's hours, which total only 1.49 per cent., symphony orchestras come at the bottom of the list with 1.51 per cent.

Transatlantic Long-wave Stations

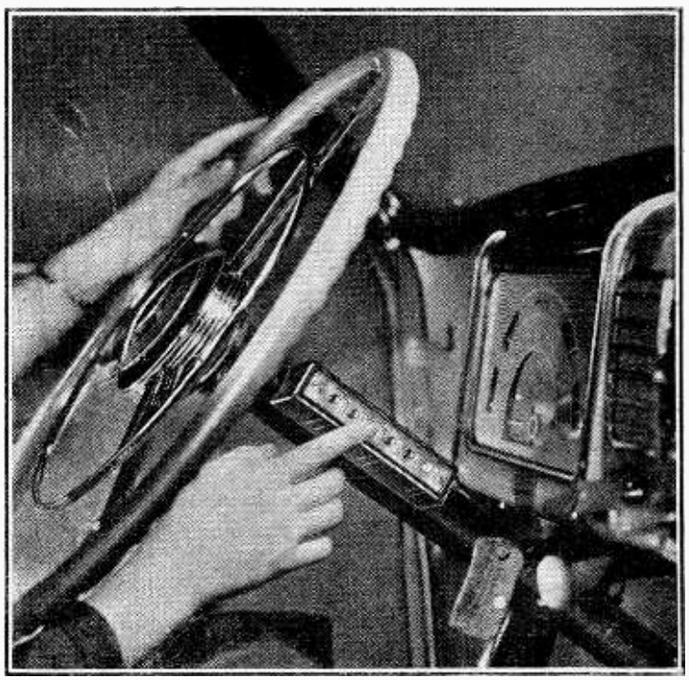
NOW that Canada has decided to go in for long-wave broadcasting, important changes may be made by U.S. manufacturers in the design of receiving sets. A large number of American sets are in use in Canada, but these cover the medium-wave-band only. When the 50-kW long-wave transmitters are opened at Toronto and Montreal there will naturally be a big demand for new sets, and it is said that the designs departments of both Canadian and U.S. manufacturers are busily engaged in getting ready for the anticipated boom in sets to cover the new wavelengths.

In addition to long-wave broadcasting Canada is also turning her attention to short-waves, and a SW station is being erected near Ottawa.

The amount of advertising in Canadian programmes will shortly be increased from 5 per cent. to 10 per cent. of the total transmitting time.

Indian Broadcasting House

A SITE in Parliament Street, New Delhi, has been chosen for the erection of a building to house the studios and administrative offices of All-India Radio. The cost will be in the neighbourhood of half-a-million rupees. Details of the architectural features of the proposed building are not, at the moment, available, but it is known that the design has been a great bone of contention between the broadcasting authorities and the Government department responsible for preserving the beauty of the Indian capital. The leading lights of All-India Radio had set their hearts on a skyscraper, but this was sternly frowned upon by the Government experts. It will be interesting to learn what kind of a compromise has been arrived at.



AUTOMATIC TUNING FOR CAR RADIO. With the help of this control panel, any one of five stations may be tuned-in instantaneously by pressing the appropriate button. An associated unit, measuring $2\frac{1}{2} \times 4\frac{1}{2} \times 4\frac{1}{2}$ ins, is clamped to the side of the receiver. By pressing the "off" button, the normal manual tuning system comes into operation. The control system, which has been introduced by an American firm, is stated to be applicable to any car set; its use is claimed to make for greater safety on the road.

Japanese Broadcasting Expansion

NO less than two million pounds is to be spent during the next three years by the Japanese Government on improvements in the broadcasting service. A transmitting station is to be built in every one of the forty-eight prefectures of the country. Preparations are to be commenced already for an elaborate scheme of world-wide wireless propaganda for the Olympic Games, which are to be held in Tokio in 1940. Some of the two million pounds is to be spent in developing television. Existing broadcasting stations are to be brought up to date, and for this purpose a separate sum of money is to be provided.

Television for India

BEFORE many months are passed Bombay hopes that a television transmitter will be operating there. The President of the Bombay Technical Institute, Mr. N. A. Printer, has come to Europe to buy television transmitting and receiving apparatus. It is hoped to organise a circle of interested people in Bombay and to get them to install receivers, and thus become the first viewers in India. At first, only cinema films will be televised. Three potential television engineers have accompanied Mr. Printer to Europe in order to acquire the necessary technical experience.

American Manufacturers Optimistic

ACCORDING to reports received from America, wireless manufacturers anticipate that there will be a demand for some nine or ten million new receivers during the coming season. A considerable proportion of the demand will, it is prophesied, come from the farm population, which, for the most part, depends on battery-operated sets.

Wireless Aids Burglars

IN a recent police-court case it was revealed that the number of "cat" burglaries occurring between 8 p.m. and 11 p.m. was greatly on the increase. It was stated that the reason for this was that during this time the most popular part of the day's broadcasting took place, and burglars realised that in the average home the loud speaker would be operating and its noise would cover up any small sounds they might make.

Guiding Transcontinental Airmen

WIRELESS aids to air navigation in Canada are to be extended; a new beacon station is already in operation in Vancouver and another will be sending out its signal from Princetown, British Columbia, during the present month. Engineers of the Transport Department, working under the Dominion Government, are erecting stations at two other points in British Columbia—Grand Forks and Cranbrook. Eventually there will be thirty-two beacons between the west coast and Montreal, the eastern terminus of the Trans-Canada route. Beacons will also be erected in the Maritime Provinces, on the Atlantic seaboard, when the route is extended in that direction.

The Canadian "homing" beacons are to transmit signals on the well-known interlocking A and N. system.

Electrolytic Condensers

PART II.—TESTING AND MEASUREMENT

By MAURICE V. PIRIE
(Manager, Ferranti Condenser Works)

THE first part of this article dealt with the function and design of electrolytic condensers; this, the concluding instalment, discusses practical details of manufacture and gives useful information on appropriate methods of testing and measurement.

SO far as wet condensers are concerned, manufacture on a large scale is mainly a matter of engineering when once the essential difficulties of the electro-chemical process have been overcome.

The anode foil in strip form is secured to the anode rod by swageing, riveting, or welding, and then wound or folded to suitable size for suspension in the can. Alternately, the anode may be die-cast in one piece.

The foil may be perforated to provide a short path from the inner walls of the can to the more distant surfaces of the anode. A perforation pattern of many small holes is better than a few large openings, as the former provides multiple short paths. An average power factor of about 10 per cent. can be obtained with, say, $\frac{1}{32}$in. holes at 14 holes per inch, whereas a few large slots badly placed will result in a PF of 25 per cent. under the same conditions. It is preferable to design the unit with as little insulating material in contact with the solution as possible; liners which are used to prevent short-circuits between anode and can are a very frequent source of slow poisoning.

Although pure rubber is now available for bushings, gas vents, and gaskets, many good designs have been spoiled by too large an area of rubber being exposed to the solution. The main difficulties in assembly are met in providing rigidity and adequate sealing and gas vents.

"Forming" is carried out, as a rule, by mounting a batch of anodes on a rack and immersing them in a forming tank. In the forming of foil for dry condensers two distinct methods are used. In one method a rack is provided with banks of removable pins on which a continuous length of, say, 200ft. of foil is supported. The loaded rack is immersed in the solution and the forming current applied.

Where a large number of condensers of one voltage is required, continuous forming of long rolls of anode foil is common. The foil passes in turn through forming and washing baths, and is rewound on suitable cores after passing through a drying tunnel.

It will be obvious that the first method lends itself to rapid production of widely varying foil widths and voltages. Various processes are used for the actual forming of both wet and dry types, but the processes may be roughly divided into two classes, with rather long or relatively short forming cycles.

It is interesting to note that in a widely used process which takes, say, 8 hours to complete a batch of about 200ft. in a stationary tank, at one stage of the process the solution must be boiling. If this period at boiling point is omitted, leakage is high. Yet in another process which takes about $2\frac{1}{4}$ hours for the same amount of foil the solution must be kept down to about 15° C. throughout, and, if allowed to boil, the results are very poor. This example illustrates the wide variations between method.

In any case, the forming cycle of voltage and current variation follows a curve of the general type illustrated in Fig. 8, which applies to 160ft. of 3in. foil, formed in a stationary tank of electrolyte.

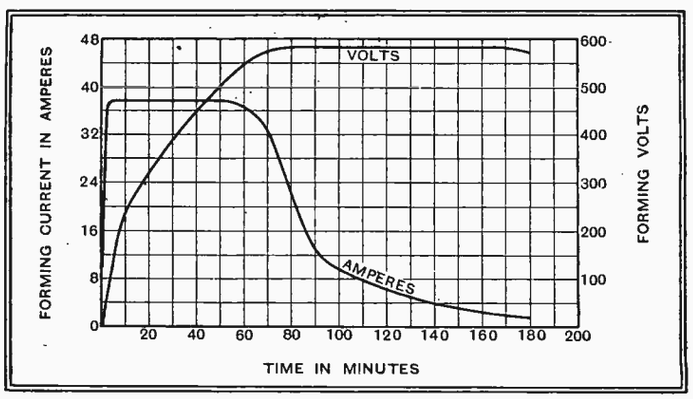


Fig. 8.—Curves illustrating a typical forming cycle.

The foil is normal when voltage is first applied, and as the insulating oxide film builds up on the surface the current falls. Voltage is gradually increased until the desired maximum is reached. The voltage is then held at this figure, while current falls to the desired minimum with the perfecting of the film.

Many complicated effects occur during forming, and the following instance may prove of interest.

In a given batch of foil, presumably from one ingot, certain reels were found which would not form satisfactorily. Chemical analysis showed that there was no difference between "good" and "bad" foil. As the effect persisted, the foils were submitted to spectrographic analysis which showed them to be identical even to content of rare earths.

However, it was established by X-ray diffraction analysis that there was a difference in the orientation of the crystallites and a slight change in the lattice constant of the aluminium, and the trouble was cleared up by eliminating all such foil.[1]

Preparatory processes are often included and vary between mere washing of the foil surface and chemical oxidising designed to assist the main processes. Sealing processes intended to close the inter-crystalline spaces are also used.

Stills and storage tanks for distilled water are an important feature of the plant on account of the extreme care which must be taken to prevent contamination. Tanks are usually built throughout of stainless steel or monel metal to avoid undesired chemical reaction.

The water is analysed at regular intervals and is frequently tested in conductivity cells consisting of platinum electrodes in glass or stainless steel vessels. The conductivity cells are sometimes used to operate alarms by tripping a relay in the event of water becoming contaminated by, for instance, absorption of gases or frothing in the boiling chamber of a still.

The anode foil may be cut to correct length for a given capacity prior to or after winding, but in any case the cutters must be designed to allow for the frequent sharpening necessary to avoid fine burrs on the edges of foils, as the hard film damages cutters.

The electrolyte presents many interesting problems; certain paste electrolytes, if subjected to even very slight friction, will impart high internal resistance to the finished unit, although there is no chemical change detectable by ordinary analysis. With most paste electrolytes, if the absorbent separator is passed through a bath of the paste, the liquid phase is absorbed preferentially, with the result that the first units pro-

[1] For examples of X-ray and electron diffraction analysis see: "X-ray Examination of Oxides of Lead." J. A. Darbyshire. *Journal Chem. Soc.*, Jan., 1932; also "Diffraction of Electrons by Metal Crystals, etc." J. A. Darbyshire and E. R. Cooper. *Proc. Royal Soc., London*, October, 1935. (Investigation on Aluminium by X-ray Diffraction was carried out by Dr. Darbyshire in Ferranti Laboratories.)

Electrolytic Condensers—

duced have good power factor and tendency to "wetness," while the last out of that batch have high PF and are very dry.

The designing of a machine to wind and impregnate in one operation naturally presents some interesting problems. The anode, cathode, and separator may be wound dry and impregnated with electrolyte afterwards. In this case the wound unit acts as an edgewise filter, and there is a tendency for the middle of the winding to contain paste of a different consistency from that at the ends, and it is difficult to maintain similar characteristics in succeeding batches.

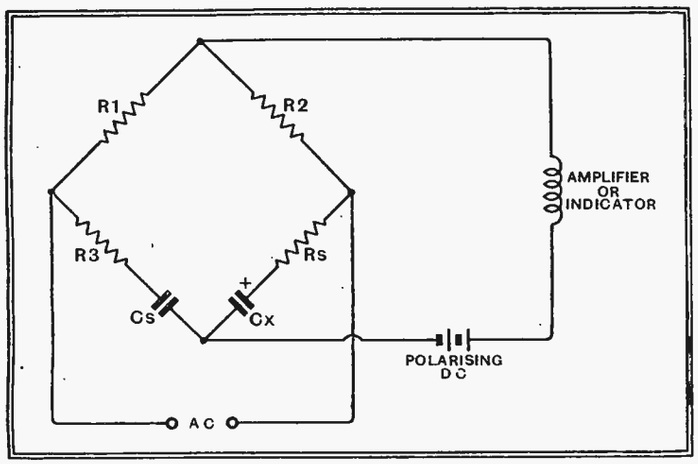


Fig. 9.—Bridge circuit for measuring the capacity of an electrolytic condenser.

After winding and impregnating, the unit is sealed to prevent escape of electrolyte and absorption of moisture. Connection must be made to the anode and cathode foils, and it is usual to pass an eyelet or rivet through several folds of the foil, as soldering direct to such thin aluminium foils is not successful.

With the addition of the leads, the condenser is complete, but it is found desirable to apply peak voltage to the unit for from 2 to 6 hours before putting it in service.

During this period the raw edges where anode foil has been cut to length are healed, and the film undergoes a slight change which renders it suitable for working with the electrolyte employed. The process is usually referred to as ageing. The unit after this final process is ready for insertion into its housing.

Tests are normally applied to determine leakage, capacity, and power factor, and in testing quantities a few should be selected for breakdown voltage test. These tests are normally applied at room temperature (20° C. to 22° C.), and before any test is applied the unit should be subjected to peak voltage for about 5 minutes.

DC leakage depends on voltage and capacity of the unit, and reference should be made to the table given in the first part of this article. The figures given are a useful guide to the leakage which may be expected. Note that leakage is always expressed on a basis of milliamps. per mfd. and that the value is doubled for a non-polarised unit.

The test is made by connecting a suitable meter in series with the condenser and applying peak volts. It is advisable to arrange for a resistance to be shunted across the meter through a press button, the resistance being about a quarter that of the meter, the shunt being cut out when the button is pressed. Leakage is first taken with the meter shunted, and if this reading is such that it would fall on the scale of the meter without the shunt, then the button is pressed to disconnect the shunt and the correct leakage read off. The purpose of the shunt is, of course, to protect the meter in case of a faulty or reversed unit.

When large quantities are to be tested it is advisable to include a relay which will trip the meter out of circuit in the event of overload and to provide means for maintaining a number of units at peak volts ready for test. Suitable upper limits of leakage are 0.1 mA per mfd. for high-voltage and 0.05 mA per mfd. for low-voltage units.

To measure capacity with reasonable accuracy requires some form of bridge network, and the following is based on the earlier paragraphs on power factor, the vector diagram of Fig. 5 and the reasoning presented with that diagram.

A capacity–PF bridge may consist of two resistive arms and two capacitive arms, one of which is the condenser under test. Null indicator may be 'phones or output meter operated by an amplifier, and the bridge can be operated on 50 or 100 cycles, thus approximating to average conditions when used in a normal radio receiver.

When the bridge is balanced, products of impedances of opposite arms are equal. Referring to Fig. 9 where Cs is a standard condenser and Cx the unit under test, we have:—

$$R1 \times \frac{1}{\omega Cx} = R2 \times \frac{1}{\omega Cs} \quad \text{or} \quad \frac{R1}{\omega Cx} = \frac{R2}{\omega Cs}$$

$$\text{and } \frac{R1}{Cx} = \frac{R2}{Cs} \text{ and } Cx = \frac{R1Cs}{R2}$$

For testing of large quantities it is useful to make R2 100 ohms and Cs 1 mfd. Then R1 reads 1 mfd. per 100 ohms, and its control scale may be calibrated in mfds.

So far no account has been taken of the effect of series resistance of the unit under test, which is to unbalance the bridge. Rs in Fig. 9 represents this internal series resistance, and for a balance another variable resistance R3 must be included and must be varied to obtain a balance.

When the bridge is balanced,

then $R1 \times Rs = R2 \times R3$

$$\text{therefore } Rs = \frac{R2R3}{R1}$$

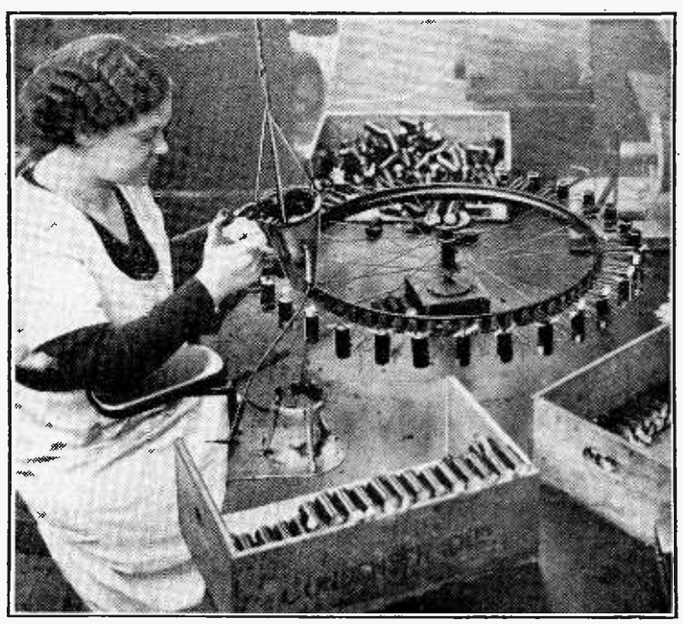
PF has already been given as $R\omega C$, which in this case is $Rs\omega Cx$, and Cx has been evaluated as being $\frac{R1Cs}{R2}$ and Rs as being $\frac{R2R3}{R1}$.

$$\text{Therefore PF} = Rs\,\omega Cx = \frac{R2R3\omega R1Cs}{R1\,R2}$$

$$= R3\omega Cs.$$

As Cs has been made 1, and ω is constant for a given frequency, the PF is proportional to R3, which can be calibrated in percentage PF for dealing with large quantities.

A DC polarising voltage of correct polarity must be applied directly across condenser under test Cx during the test, and this must be such as to prevent reversal of polarity of the condenser by AC. ripple. The ripple should be about 3 volts peak.



Sealing dry condenser units with compound, which is supplied from an electrically heated reservoir.

The DC polarising voltage should be such that the sum of AC and DC applied to the condenser is the peak voltage rating of the condenser for units up to 15 volts, and about 80 per cent. of peak

Electrolytic Condensers—

voltage for units of higher rating. Standard condenser Cs should be a good grade mica condenser, and if readings are to be accurate, then capacity of Cs should be near that of Cx.

Replacing the 50-100-cycle ripple by an AF oscillator will permit of the bridge being used to obtain curves of the type of Fig. 4.

Service engineers often need to test electrolytic condensers when suitable gear is not available. In such circumstances leakage tests present little difficulty, and an estimate of capacity may be made by comparing the impedance with that of a known variable resistance. The condenser is connected in series with a calibrated variable resistance across a 50- or 100-cycle AC supply, and a vacuum-tube voltmeter is connected across the condenser and the resistance in turn, the resistance being adjusted until the same reading is obtained across the condenser as across the resistance. Impedance of the condenser then equals that of the resistance. From the formula for condenser impedance (or abacs published in *The Wireless World* Radio Data Charts) the capacity is found.

It should be noted that this method does not take into account the effect of series resistance, and would be misleading if PF of the unit under test is high; there is no suitable PF test applicable with very limited apparatus.

Breakdown voltage test is merely a matter of raising voltage above peak volts and noting value resulting in breakdown, but it should be remembered that a very gradual increase of voltage will allow the temperature to rise and may lead to earlier breakdown than is the case if voltage is raised quickly.

It is advisable to include a fuse, cut-out, or voltage limiting resistance in series, as the electrodes may weld together. It is often difficult to decide the actual breakdown voltage when the meter needle is rising rapidly, and a peak voltmeter which holds the maximum reading is advisable.

Life tests mainly concern engineers using quantities, and a satisfactory test is had by applying to the units a voltage which is approximately 90 per cent. of peak voltage rating, 6 per cent. of this applied voltage being AC ripple. For example, a 500 peak volt condenser would be tested at 423 V DC, 27 volts peak AC ripple. The voltage is applied at 20° C. to 25° C. for 5,000 to 15,000 hours, and a good condenser will show no corrosion during the test, but may be rather dry by the end of the longer test.

An accelerated test may be had by holding the ambient temperature at 45-55° C. A test of 500 hours at this temperature will provide useful indications, and higher temperatures are used to test units for tropical conditions. Fig. 10 represents a suitable circuit for life test.

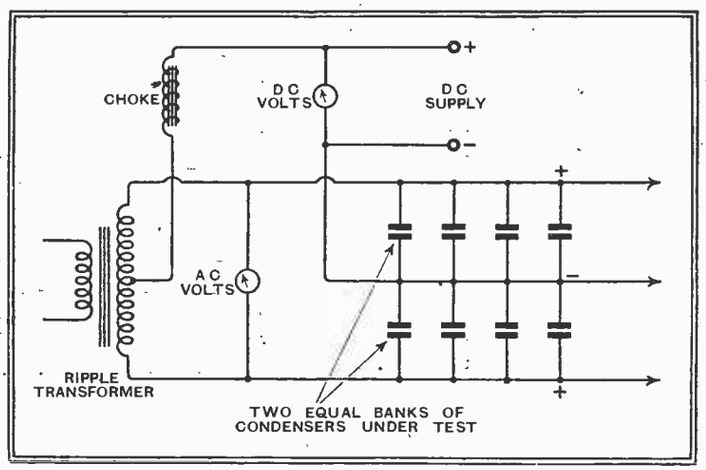


Fig. 10.—Circuit for carrying out life tests of a number of condensers.

Condensers under test are wired in two equal banks in order to divide the current from the ripple transformer, and so the AC voltmeter reading must be halved. The choke prevents the AC ripple from passing to the rectifier, and the AC and DC supply voltages should be controllable.

In these notes it has not been possible to do more than touch on those points most likely to be of more general interest, but it is hoped that the article will not lose in value by attempting to cover the three most important phases of the subject in a short space.

The Autocar Handbook.—The thirteenth edition of this well-known publication has just been issued. It forms a complete guide to the modern motor car.

The new edition contains a large amount of additional matter, whilst much of the text of the last edition has been revised and brought up to date.

Published by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, price 2s. 6d., by post 2s. 10d.

Club News

Thames Valley Amateur Radio and Television Society

Headquarters: The Albany Hotel, Twickenham.
Meetings: Wednesday evenings at 8.15 p.m.
Hon. Sec.: Mr. J. N. Roe, 19a, The Barons, St. Margarets-on-Thames.

Mr. W. G. J. Nixon, of the General Electric Co., Ltd., recently gave an interesting talk on the manufacture of valves. He illustrated his lecture with the aid of a film showing the whole process from start to finish.

Owing to an unfortunate error it was stated in a recent issue of this journal that Mr. Nixon's lecture would be given on October 20th. Actually, on that date Mr. H. E. Stokes, of the Gambrell Radio Communication Co., will give a lecture on the construction and application of home-made test apparatus.

The Irish Radio Transmitters' Society

Hon. Sec.: Mr. W. H. Coombs. 23, South William Street, Dublin.

On a recent Sunday a DF field day was held. The transmitter, using a power of 15 watts from a battery driven generator, was operated on 3,551 kc/s and was located at Tallaght, County Dublin. The first member to locate the station was EI2J, closely followed by Ex-EI4D. The station was found within three hours, which was a particularly good piece of work as the transmitter was so well hidden that it could not be seen further than twenty yards away. All searchers reported good signals from the transmitter, strengths of R7 and R8 being obtained as far away as twelve and fifteen miles.

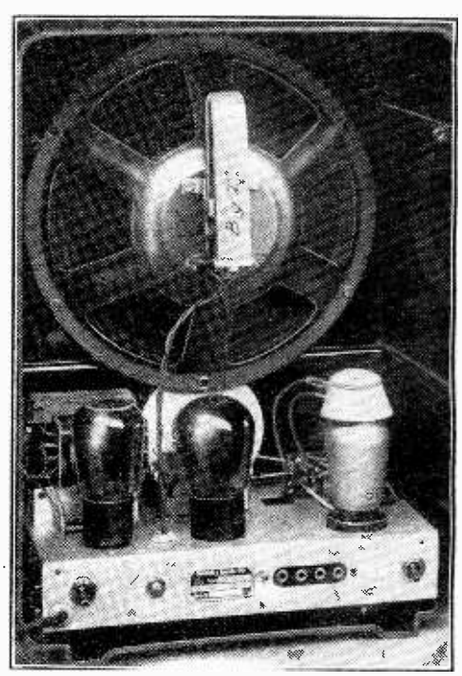
Germany's New Volksempfänger

From our Berlin Correspondent

THE new models of Germany's famous People's Set became available to the public on September 15th. The AC costs Rm.65, and it can also be bought on deferred terms spread over a period of eighteen months. The electricity supply companies finance this scheme, and the instalments can be paid every month as an addition to the electricity bill. The first instalment is only about 6 shillings and the subsequent ones about 4 shillings.

The new Volksempfänger has easier tuning, better quality and higher sensitivity than its predecessor. The only external difference between the two is the German station names on the tuning dial. In the older set the dial was calibrated on a purely arbitrary scale.

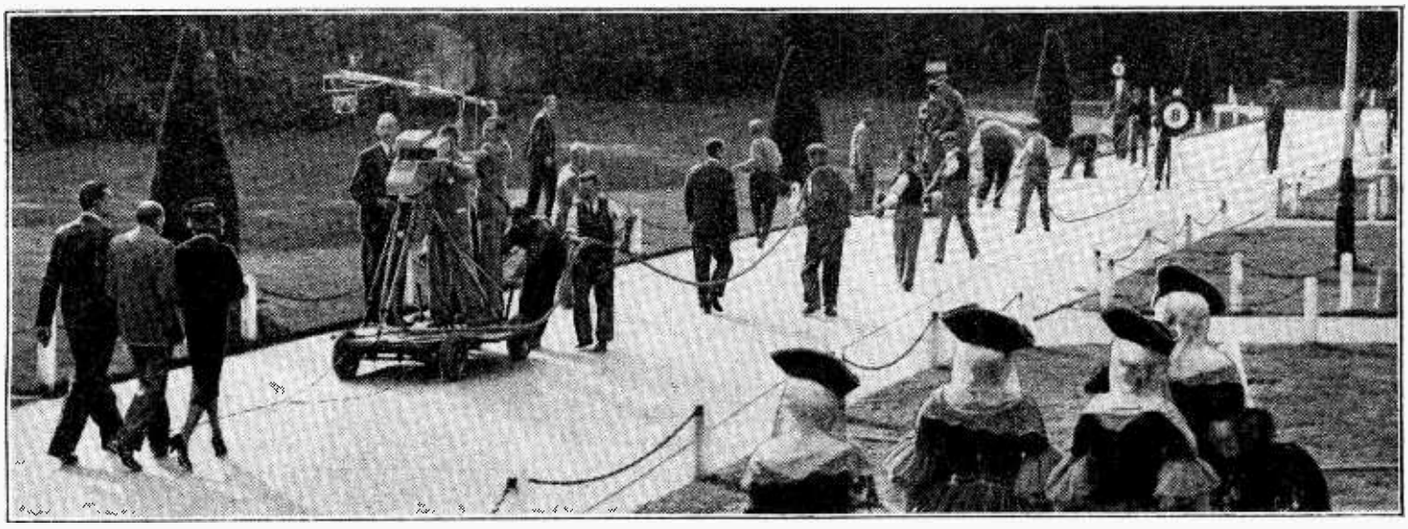
An improved electro-magnetic loud speaker is used, and resistance-capacity amplification has been introduced. A screened-grid detector valve gives more sensitivity than the triode of the first model. The Volksempfänger circuit, a two-valve detector-AF arrangement with a single tuned circuit, is retained. Continuously variable aerial coupling has been introduced.



An SG detector valve and an improved moving-iron speaker are used in the new "People's Set."

The Volksempfänger consumes only 18 watts on 220 volts (AC or DC). The battery model requires 4 mA at 90 volts and 0.3 amps at 2 volts. From these figures it will be seen that the receiver is not only cheap, but that it is also inexpensive to use.

Oberingenieur Griessing, the designer of the original Volksempfänger, is also responsible for the new and improved model.



BROADCAST BREVITIES

NEWS FROM PORTLAND PLACE

Back to School Again

DUCHESS STREET was all agog last Monday when the B.B.C.'s Staff Training College began its new term. The College is probably the most democratic institution inside the B.B.C., not excepting the canteen. Everybody from public relations officers to producers and accountants rub shoulders in these extraordinary "refresher" courses, the aim being to provide students with a bird's-eye view, so to speak, of the whole broadcasting organisation.

Uncle Tom Cobleigh and All

The current enrolments include studio executives, at least one public relations officer, balance and control experts, secretaries and representatives from almost every branch of the Corporation. During the course, which will last until the breaking-up party on Christmas Eve, the students will learn both the theory and practice of broadcasting.

Their travels will take them to Brookmans Park, the Maida Vale recording plant, the London Television station, every nook and cranny of Broadcasting House, and perhaps Droitwich or one of the regional stations.

Getting Down to It

During their studies the pupils have opportunities to put their knowledge to practical use. Sometimes they are given the run of a studio and its accompanying control room to stage a radio play over a closed circuit. One of the class may prepare a talk; the others "vet" it, incidentally learning how to use the blue pencil, and then go through the routine of rehearsal and transmission.

By the time the course is finished each student can normally be regarded as a "compleat broadcaster," qualified to take a job in any British broadcasting corporation.

Christmas Day

THIS year, as last, there will be no Round-the-Empire broadcast on Christmas afternoon. In 1936, it will be remembered, the country was just settling down after a time of great excitement and, with a new King only just on the throne, it was manifestly impossible to arrange for a Royal message to the peoples of the Empire as part of the Christmas broadcast. It was decided, therefore, to drop the programme altogether. The Programme Committee at Broadcasting House now considers that as a Round-the-Empire feature is bound to be in large measure repetitive, it can very well be given a rest for another year; and so Lawrence Gilliam, of the Drama and Features Department, to whom it generally fell to produce the Empire programme, is concentrating on the preparation of a feature which shall be redolent of the town and countryside at home.

Mr. Rex Haworth

REX HAWORTH, the very young man who has just been appointed head microphone technician in the B.B.C.'s new "Music Productions" branch, began his career as an engineer, gained valuable experience in the films, and when he joined the B.B.C. several years ago was discovered to have a musical ear. To this he added a good knowledge of music, and it was not long before he gravitated to the Balance and Control Department.

Multi-Mike Technique

It is Mr. Haworth who has been mainly responsible for the elaborate system of microphones in St. George's Hall. In many ways his work with music-hall and variety orchestras has been more exacting than that required in the case of "straight" music. Most orchestras (as distinct from dance bands) follow well-tried formations, and so far as their composition is concerned there is no foundamental difference between, say, an octet and a fully blown orchestra.

A Difficult Job

But in balancing and controlling dance bands and "show" orchestras Mr. Haworth has had to cope with combinations and permutations of the most fantastic kinds, calling for microphone arrangements which would give the straight musician a sick headache.

Good News for Swansea

THE new B.B.C. studios at Swansea, which were opened last week by Lady Bridgeman, are much more ambitious in layout than the original "small-town" studios which were dotted up and down the country at places like Bournemouth, Plymouth and Liverpool. Swansea now has a really large music studio in addition to two smaller ones for drama and talks. There is also an effects department and a control room.

Another apartment, still unfinished, is obviously intended for television.

Another "Luxembourg"?

SOME years ago the Postmaster-General quelled a proposal to erect a giant sponsored programme station in the Isle of Man. The P.M.G. will be unable to exercise the same powers in the case of a new "Luxembourg" which, according to rumours, is now planned for the Irish Free State.

This latest competitor of the B.B.C. would, of course, require a long wave to carry its message across St. George's Channel with the certainty of being well heard in London, so it looks as if the International Broadcasting Union will soon have another knotty wavelength problem.

From Pinewood

THE televising of scenes from the Pinewood Film Studios on five days during the past week has shown the vast possibilities of material available for television programmes outside Alexandra Palace. It was the first occasion on which the mobile ultra-short-wave transmitter had been used successfully at such a distance (17 miles) from A.P. Apart from a little trouble from interference, the results were remarkably good. This was largely due to the geographical situation and also to the fact that it was possible to erect a much higher aerial than was practicable at Hatfield aerodrome.

Man-Handled

As will be seen from the picture on this page, very long cables had to be run from the trolley carrying the camera and microphone to the transmitting van and a considerable amount of man power was necessary to guide these during the tour.

In the Pinewood Club, which adjoins the studios, Marconiphone television receivers had been installed, thus enabling stars to see their fellow artistes being televised.

These transmissions from Pinewood heralded a series of programmes from film studios, the second and third of which will come from Denham, beginning on Thursday next, and Elstree.

Listeners' Guide for the

IT will be with delight that listeners will learn that the series of programmes "From the London Theatre" will be restarted on Wednesday with the most sensational stage success of recent years, "Victoria Regina," which is playing to packed houses at the Lyric Theatre. Bruce Belfrage, who will be presenting the extracts, has made special adaptations of four out of the nine short plays, each complete in itself, and for him it was no easy matter to decide which of these he should choose. He has, however, succeeded in giving as complete a picture as possible, in the short space of time at his disposal, of the intimate life of the Queen from girlhood to old age.

"HAPPY AND GLORIOUS." A scene, showing the aged Queen Victoria at Buckingham Palace in 1897, during a playlet in "Victoria Regina" from which excerpts will be heard on Wednesday. Inset is Pamela Stanley, as the Queen in 1839.

The first play chosen, "Morning Glory" (1840), is a small domestic interlude showing the Prince Consort shaving and Her Majesty's naïve interest in the spectacle. Next comes "The Rose and the Thorn" (1846), which demonstrates that even royal personages are conscious of the pin-pricks of jealousy. Then, after a long lapse of time in "The Queen, God Bless Her," the Royal Widow is seen at Balmoral in 1877 with two of her most loyal subjects and most intimate friends, Benjamin Disraeli and John Brown. Finally, in "Happy and Glorious," listeners will hear a speech by the Queen Empress made at Buckingham Palace on the occasion of her Diamond Jubilee in 1897.

Members of the cast of the Lyric Theatre production who will be taking part in the broadcast on Wednesday at 6.40 (Nat.) include Pamela Stanley as the Queen, Carl Esmond as Prince Albert, and Ernest Milton as Disraeli.

"I WAS THERE"

THE tragic earthquake which occurred in Valparaiso in 1906 followed closely that at San Francisco but with far more serious consequences, for 8,000 people were killed and 2,500 injured. On Tuesday at 9.20 Mr. R. A. Blyth will describe the earthquake for National listeners in the series "I Was There." At the time he was an accountant in one of the big foreign banks in Valparaiso. Extensive damage was sustained by the bank building where he was employed, his desk being smashed to atoms, but, fortunately for him, and, indeed, for the whole business community of the city, the earthquake occurred in the evening when business houses had closed down, thereby lessening the death rate considerably.

A LAMENTABLE COMEDY

SCOTLAND'S greatest living dramatist, James Bridie, has adapted for broadcasting his play, "The Anatomist." He describes it as a "lamentable comedy of Knox, Burke, and Hare and the West Port Murders." In the play, which will be heard Nationally on Sunday at 6.20, and again in the Scottish programme on Tuesday, Dr. Knox, teacher of anatomy in Edinburgh, moves against the grim background of the West Port Murders. It was this series of murders which ended the depredations of the body snatchers and brought about the system of issuing licences for the obtaining of bodies for dissection. The three acts are set in a drawing-room, a tavern and the lobby of Dr. Knox's rooms in Surgeon's Square, Edinburgh, in 1828. When the play was produced at the Westminster Theatre in 1930, Dr. Knox was played by Henry Ainley.

◇ ◇ ◇

TAUBER

THE last appearance before the microphone of Richard Tauber, prior to his sailing to America, will be on Saturday evening at 9.35 in the National programme. He will be heard in a forty-minute programme with the Theatre Orchestra, singing some of his famous songs.

HIGHLIGHTS OF THE WEEK.

FRIDAY, OCTOBER 8th.

Nat., 7.10, Sir Walford Davies: "Music and the Ordinary Listener." 8, Jack Hylton and his Band with guest artistes.

Reg., 7.30, Harold Ramsay from the Union Cinema, Kingston. 9, Relays from Blackpool.

Abroad.

Brussels I, 8.30, Belgian War Widows' Benevolent Fund Concert from the Conservatoire.

SATURDAY, OCTOBER 9th.

Nat., 8, Music Hall. 9.35, Richard Tauber. 10.45, Julian Huxley on Saving Wild Life.

Reg., 6.30, Ambrose and his Orchestra. 8, Recital: Adolph Busch (violin) and Rudolph Serkin (piano).

Abroad.

Rome, 8, Verdi's opera "Il Trovatore."

SUNDAY, OCTOBER 10th.

Nat., 5, The Rev. Donald Soper on Popular Fallacies about the Christian Faith. 9.5, Pianoforte recital: Myra Hess.

Reg., 5.30, The Busch String Quartet. 6.45, The Richard Crean Orchestra and Raymond Newell.

Abroad.

Stuttgart, 7, Puccini's opera "Tosca."

MONDAY, OCTOBER 11th.

Nat., 7, Monday at Seven. 8.30, Pianoforte recital: Egon Petri. 9.35, Swing Music from the Hotel Pennsylvania, New York.

Reg., 8, Carroll Levis and his Discoveries. 9, Henri Temianka (violin), and the B.B.C. Orchestra.

Abroad.

Lille and Toulouse PTT, 8.30, Concert by the National Orchestra of works by the "Group of Six" modern composers.

TUESDAY, OCTOBER 12th.

Nat., 6.45, Debroy Somers and his Band. 9.20, I Was There: The Valparaiso Earthquake, 1906.

Reg., 8, Theatres of Variety: programme from the Palace Theatre, Bath. 8.30, Short Story: Kipling's "The Lost Legion."

Abroad.

Radio Paris, 8.30, Concert from the Labour Pavilion, Paris Exhibition.

WEDNESDAY, OCTOBER 13th.

Nat., 5, Big Bill Campbell and his Hillbilly Band. 6.40, "Victoria Regina." 8, "Arlette"; operetta.

Reg., 6, The Alfredo Campoli Trio. 9.30, Billy Merrin and his Commanders.

Abroad.

Paris PTT and Brussels I, 8, Gala Evening in honour of Maurice Maeterlinck's 75th birthday.

THURSDAY, OCTOBER 14th.

Nat., 6.40, Jack Payne and his Band with guest artistes. 7.40, The Clarkson Rose Company.

Reg., 7.30, Feature programme on Slave Traffic. 8.45, "Arlette."

Abroad.

Warsaw, 8, Szymanowski concert from the Théâtre des Champs-Elysées, Paris.

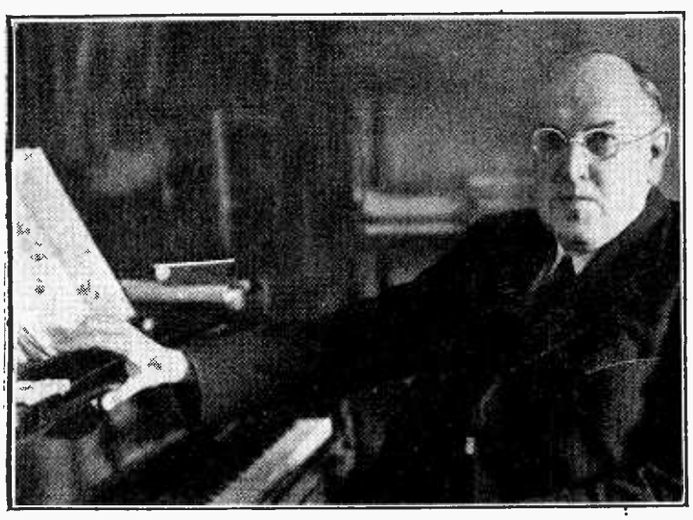
Week

Outstanding Broadcasts at Home and Abroad

A—Z

THE alphabetical miscellany, "The B.B.C. Presents the A.B.C.," which, although at the outset was decried by Press radio correspondents and listeners alike as being feeble and uninteresting, has proved to be a well-worth-while feature ends this week. It has been well produced, with good and often original material, even for the letter "X."

The twenty-sixth programme will be given on Saturday at 7.30 (Nat.), and there will be a lapse of two Saturdays before "In Town To-night," which has not been heard since Coronation Week, will be heralded by its well-known signature tune, "The Knightsbridge March."



MASTER OF THE KING'S MUSICK, Sir Walford Davies, who opens the series of programmes "Music and the Ordinary Listener" to-night (Friday) at 7.10 (Nat.) and will give the following five in the series.

DISCOVERIES

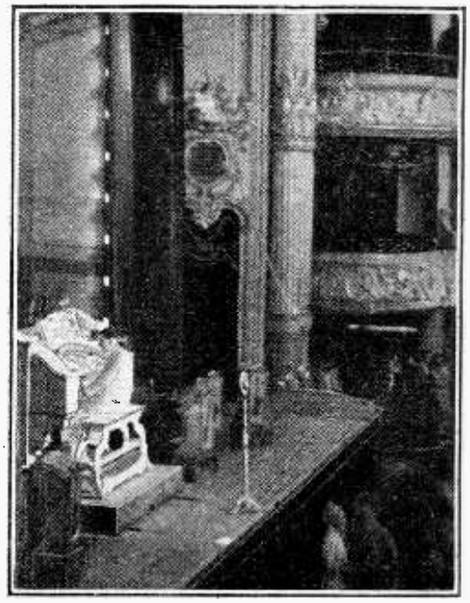
UNKNOWN artistes will come to the microphone again on Monday at 8.30 (Reg.) when Carroll Levis presents the first of the second series of programmes featuring his "discoveries." These artistes have been chosen from some five thousand auditions held by Carroll Levis over a period of three months, and for this purpose he takes with him on his tours a portable amplifier and microphone. The programme on Monday will consist of fourteen acts which will be brought to London from various parts of the British Isles. Previously the talent for these programmes was chosen by means of competitions, but Carroll Levis has decided to give straight auditions and finds that the artistes he has already "discovered" are of a higher standard.

QUICK CHANGE ARTISTE

DURING Saturday's Music Hall programme, which, of course, will be heard Nationally at 8, Billy Bennett will make a little bit of microphone history. He will be doing a twice-nightly performance at a London cinema, and after the first of these will dash to St. George's Hall, where he will blacken his face for his part as Mose in a ten-minute Alexander and Mose act for Music Hall. Following this turn he will wash his face and ten minutes later become himself again and appear on the bill as Billy Bennett. With a few minutes to spare he will then hurry back to the cinema for his second stage performance.

Some may wonder why it is necessary for Billy to blacken his face, as listeners cannot see him. First, because I believe it was he who said that he could not get his jokes over if he hadn't his face blacked, and, secondly, there will be an audience in St. George's Hall.

Other well-known artistes in Saturday's bill include Edith Day, and The Two Leslies.



A FAREWELL FLIGHT over Blackpool visiting a number of places of entertainment will be enjoyed by Regional listeners to-night (Friday) at 9. Reginald Dixon will be heard at the organ in the Tower Ballroom.

OPERA

BUCHAREST is giving a recorded version to-night (Friday) at 7.10 of "Andrea Chénier," the masterpiece of its composer, Umberto Giordano, the septuagenarian author of several fine works. First produced in 1896, it has remained a prime favourite ever since for its virile dramatic music. That the hero is a true historical character makes the work all the more interesting. Moussorgsky's fine drama, "Khovanstchina," which will be heard from Budapest No. 1 to-night at 5.30, is also a virile and colourful work. The scene is laid in the Russia of Peter the Great, when the country was divided between the old order and the new. Even though she has decided for the new order this opera remains a delight to the heart of all true Russians, and appears frequently at the Soviet opera houses.

There is hardly an opera of the early nineteenth century which appears more frequently on the boards than Boieldieu's "Dame Blanche," which Radio-Normandie is giving to-night at 9.0. Its success was immediate and unprecedented when first produced in 1825, and this was surely due to Boieldieu's peculiar sweetness of melody, so closely allied to French popular song.

Saturday brings a studio performance, with an excellent cast, of "Il Trovatore" from Rome at 8.0. Charpentier's delightful four-act "Louise," with a very fine cast, will be heard from Milan on Sunday and Rome on Tuesday at 8.0 on each occasion.

The main French broadcast of Wednesday is "Le comte Ory," Rossini's two-act opera to text of Scribe, which Radio Paris, Bordeaux and Nice broadcast at 8. It had its first production in Paris in 1828.

The Maeterlinck birthday celebrations from Paris PTT and Brussels No. 1 at 8.0 are a feature of Wednesday's programmes. "Pélleas et Mélisande," of which scenes are to be given with the Comtesse Renée Maeterlinck as Mélisande, is one of the best operas of modern times—and Debussy's only excursion into this field. During this programme addresses of homage from representative literary men of many European countries, including that of our own Poet Laureate, will be heard. Athlone, too, is honouring the Belgian seer and poet at 8.10. Few could be better fitted for the task he has set himself than Lennox Robinson, himself a dramatist of more than national distinction, and manager of the Abbey Theatre, who will speak of Maeterlinck and his work.

Karol Szymanowski, who died last April at the age of 55, was one of the greatest composers of the age. His versatility was remarkable, and he was a great believer in melody. His second symphony and his great choral and orchestral works such as the Stabat Mater are his chief claim to distinction, but he also composed a few choice operas. The famous Song of Roxana, from one of these, "King Roger," and excerpts from his ballet, "Harnasie," will be included in the great concert of his works which is being given by the Radio-Warsaw Symphony Orchestra at the Théâtre des Champs-Elysées, Paris, on Thursday to be broadcast at 8.0 by Warsaw.

THE AUDITOR.

H.M.V. MODEL 650

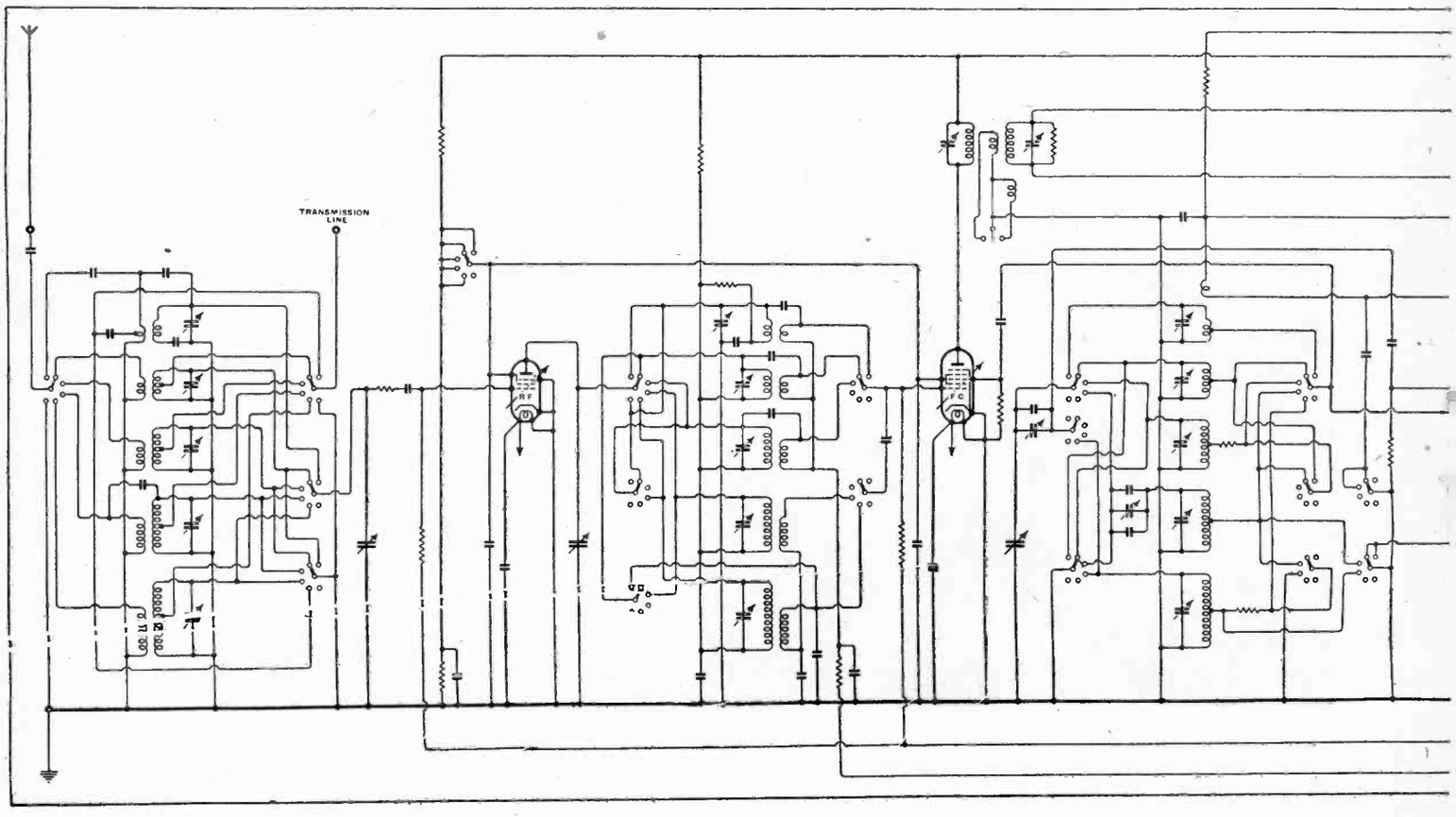
WHEN manufacturers produce a receiver of this calibre they generally house it in an expensive console cabinet complete with automatic record-changer and offer it exclusively in the luxury market. There must be many enthusiasts, however, who are prepared to pay for the performance which such a specification implies, but are not in the least interested in imposing cabinet work as such. It is gratifying to find that, although it is possible to pay as much at 62 guineas for this instrument in radiogramophone form, the makers have decided to produce it also as a table model in order that its performance may be enjoyed by people with more modest means.

Even as a table model it cannot fail to present an imposing appearance, for one cannot skimp cabinet work when a power output of 10 watts is on tap. The overall dimensions are 23 × 19¾ × 12¼in., and the sides are constructed of 14-ply material ¾in. in thickness. The corners have been rounded to give additional strength, and even at full volume there is not the slightest tendency for the cabinet to reinforce or absorb vibrations of any frequency.

The size of the dial affords some indication of the scope of this receiver as regards range. There are five wavebands, on each of which station names are indicated. The scales are semicircular with a long pointer, and a 360-degree subsidiary vernier dial is provided from which the exact setting of short-wave stations can be logged. The spaces at the top left-hand and right-hand corners are occupied by a cathode-ray tuning indicator and a waveband indicator respectively. The tuning control is of the two-speed variety and there are four subsidiary knobs of new design to facilitate ease of handling. The mains on-off switch is incorporated with separate bass tone control, and the high-note tone control is combined with the variable selectivity switch, giving two degrees of selectivity, one for high quality reception from the local station and the other for listening to distant stations when interference is likely to be more acute. The two remaining controls are for volume and waverange.

After a preliminary try-out on the medium waveband to get the feel of the controls and to sample the volume and quality provided by the 10-watt output stage, the set was switched to the ultra-short-wave range for the afternoon television transmission. Both the vision and sound signals were picked up with an ample reserve of volume in Central London, and we were particularly impressed, not only with the absence of microphony, which is an acute problem on these short wavelengths, but also with the stability of the local oscillator and the absence of drift and the necessity for retuning. Subsequently it was discovered when starting from cold on this range that a rather longer time must be allowed for the oscillator to strike than is required on any of the other waveranges. At the moment the television transmissions are the only features of interest on this band, but some CW signals were picked up near

Complete circuit diagram. Variable selectivity is provided first and second



A Ten-valve Table Model Receiver with Five Wavebands

FEATURES. ***Waveranges.*** *— (1) 725-2,000 metres. (2) 195-575 metres. (3) 34-107 metres. (4) 11.3-34 metres. (5) 4.85-12 metres.* ***Circuit.*** *—RF amplifier—frequency-changer—separate oscillator—first IF amplifier—second IF amplifier—double-diode second detector—first AF amplifier—push-pull tetrode output valves. Full-wave valve rectifier.* ***Controls.*** *—(1) Tuning. (2) Volume. (3) Waverange. (4) Selectivity and brilliance tone control. (5) Bass tone control and mains on-off switch.* ***Price.*** *—24 guineas.* ***Makers.*** *—The Gramophone Co., Ltd., 98-108, Clerkenwell Road, London, E.C.1*

10 metres, and the fact that the RF stage is still in operation on this band is a guarantee of efficient reception of other transmissions when this field is opened up.

The next highest waveband (11.3-34 metres) is the one which provides short-wave transmissions of the greatest interest from a programme point of view. The 13-metre band, which, in many sets, is at the extreme lower end of the short-wave band and often suffers through lack of accurate ganging, is in this case well into the scale, and the sensitivity at this point is such that W8XK (13.93 metres) ranks with W3XAL and W2XAD on the 16- and 19-metre broadcast bands as a first-class programme station. After a very short time with this set one expects the principal American stations as a matter of course, and there is every encouragement to seek out the lower-powered stations which are lost below the level of background noise in smaller sets.

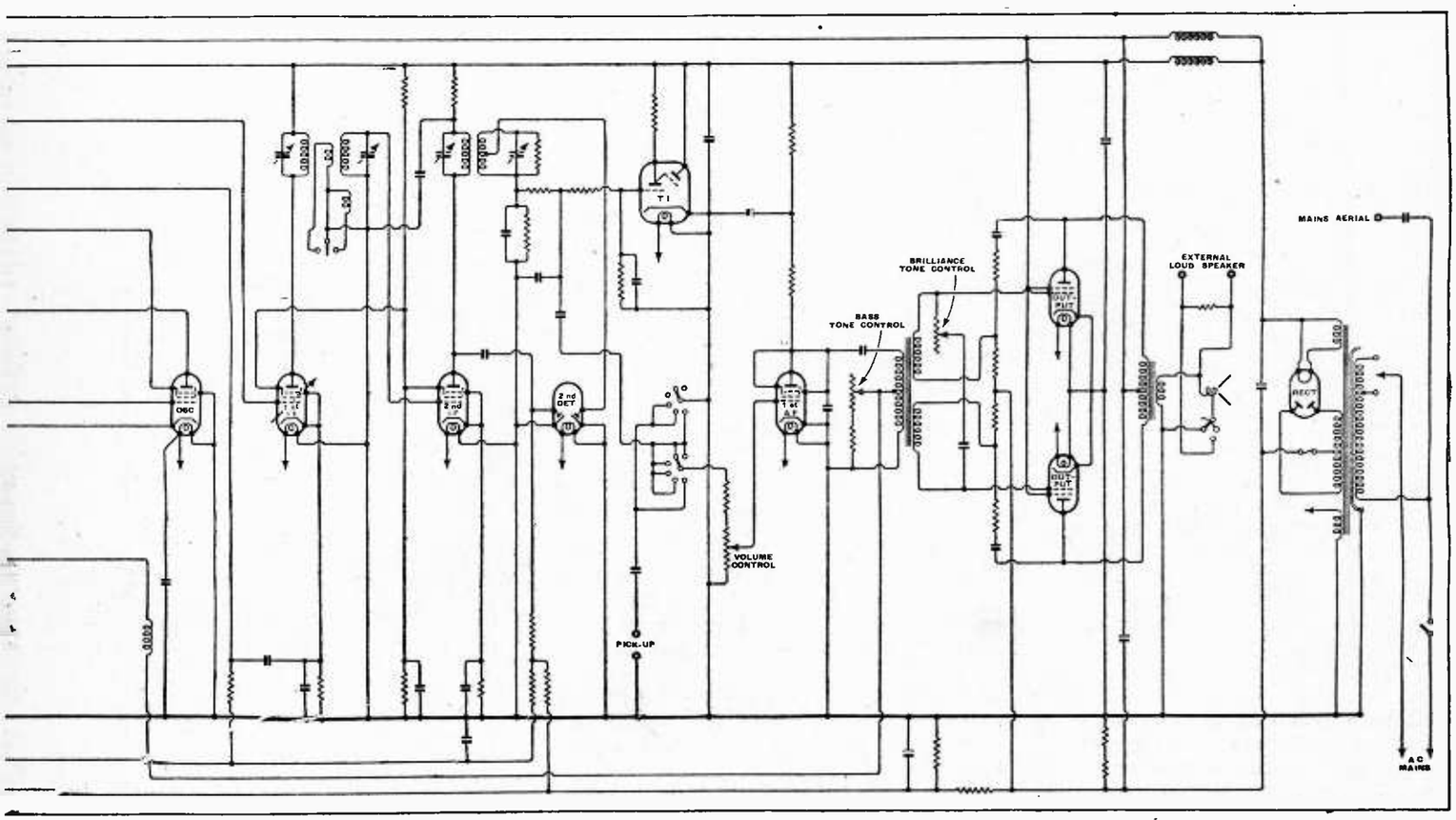
There can be no doubt that the signal-to-noise ratio is very much above the average in this receiver and that the additional stages of RF and IF amplification are fully justified. The third short-wave range overlaps the second at 34 metres and extends up to 107 metres, so that all the short-wave broadcasting stations of the world are within the wavelength range of the set.

The sensitivity on the medium- and long-wave bands is sufficient to bring in every transmission of programme value, but is not so high as to cause unpleasant background noise between stations even when the set is used with an ordinary outdoor aerial. There is a complete absence of self-generated whistles on both these ranges, and the selectivity on the medium-wave band is sufficient to give clear reception outside 1½ channels on either side of the London Regional station when using the set in Central London. On long waves with the high-note tone control brought into operation the Deutschlandsender is of sufficient strength to make the side-band interference from Radio-Paris and Droitwich negligible.

The combined selectivity and tone control is well arranged, for the position of greatest band-width and full high-note response is brought into operation only when the control is turned as far as possible in an anti-clockwise direction. For normal general listening a very good balance of tone is provided which in no way suggests a serious lack of top. On the other hand, the high-fidelity position undoubtedly gives a marked improvement in quality when it is brought into operation, say, on the local station. The separate bass tone control has a wide range, and when the type of transmission justifies it a bass response is obtainable which is seldom achieved in table model receivers.

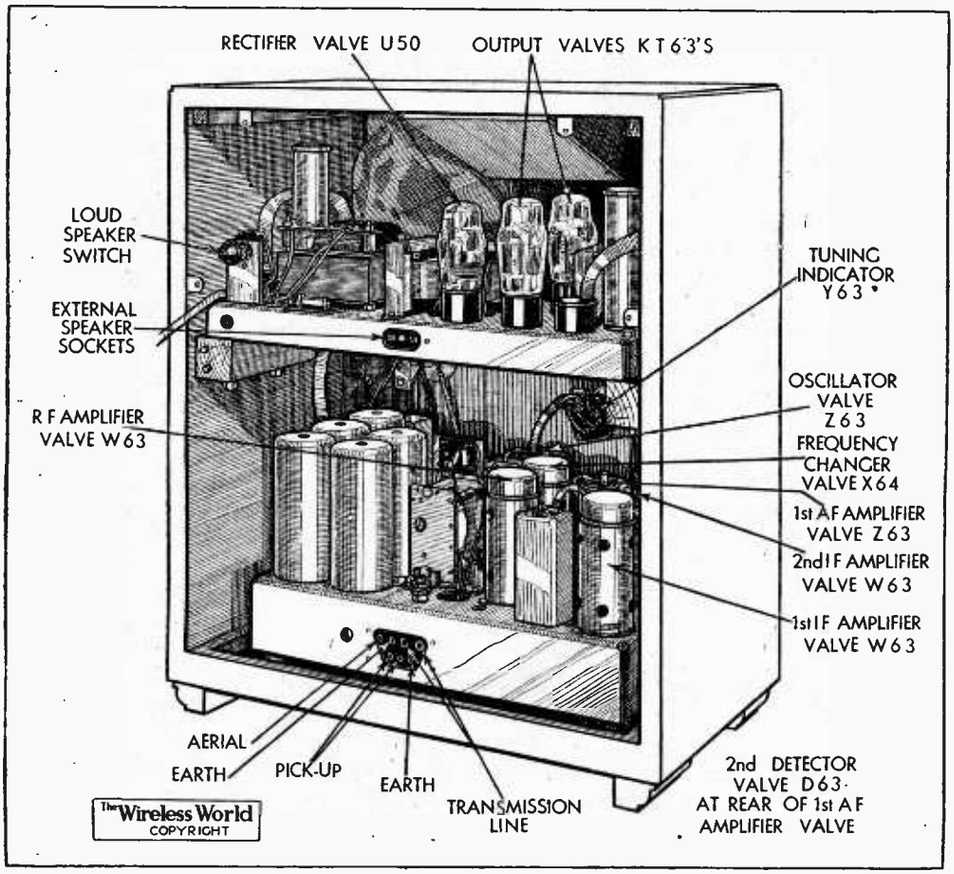
In this particular model only one loud speaker is available to handle the 10 watts output of which the set is capable, and if it occasionally shows signs of distress with the volume control at maximum, there is no indication of amplitude distortion at volume levels which can be tolerated for any length of time in the average living-room. The loud speaker is fitted with an elliptical composite diaphragm with a metal centre, and gives not only a wide frequency response, but also exceptionally good distribution of high frequencies. There is a switch at the back of the cabinet giving various combinations of the internal and external loud speakers when the latter are employed.

A glance at the circuit diagram shows many important additions to standard practice. In the aerial circuit a series of built-in transformers, controlled by the waverange switch, are provided for use



short-circuiting the auxiliary coils associated with the transformers.

H.M.V. Model 650—
with the H.M.V. anti-static all-wave aerial No. 214. The RF amplifier functions on all five waveranges, and there are separate valves for generation of local oscillations and frequency-changing. The local oscillator is a pentode operating on the Hartley principle with additional coupling coils associated with one of the varnish is an indication that the makers have given due consideration to the fact that the set may be called upon to give reliable service under unfavourable climatic conditions. Spare fuses are provided, and access to the underside of the main receiver chassis is readily obtained through a panel in the base without removing it from the cabinet.



The chassis is divided into two parts, the output and rectifier stages being mounted above the main receiver chassis.

screens on the ultra-short waveband. There are two stages of IF amplification, and the first two coupling transformers are provided with auxiliary coils capable of being short-circuited and arranged to provide alternative band-widths. A double-diode functions as second detector and a source of AVC, and this is followed by a separate "strapped" pentode first AF amplifier.

Negative feed-back is incorporated in the coupling between this valve and the push-pull tetrode output valves. There is less feed-back at low frequencies, resulting in a lift of the bass response, and this is controlled by a shunt across a portion of the primary of the coupling transformer. On the two lowest wavebands the degree of maximum low-frequency response is limited by an auxiliary choke connected in parallel with the bass tone control resistance.

The chassis is divided into two parts, the rectifier and output valves with their associated components being mounted on a platform above the main receiver unit. The fact that the mains transformer and smoothing chokes and output transformer are heavily impregnated with insulating

The extra cost of this model has been judiciously distributed, and no single aspect of the performance can be said to overshadow the rest. Altogether, a well-balanced design and one which stands head and shoulders above cheaper sets intended for the competitive market.

Tuning Made Easy

A Mechanical Automatic Tuning System

SINCE the introduction of automatic volume control, and the later idea of "muting" all signals below a certain strength, the tuning of a set has become a more ticklish operation than it used to be. The ear alone is, of course, no longer a safe guide, while the visual indicator is often more ornamental in appearance than satisfactory in operation.

Some makers accordingly prefer to take the control, to a certain extent, out of the listener's hands. That is to say, they allow him to turn the knob approximately to the station required, whereupon the set "takes charge" and automatically adjusts itself to the exact point of resonance.

In the case of a superhet receiver the local oscillator valve offers a convenient point from which to secure the required result. So long as the set is off tune, the beats produced between the incoming signal and the local oscillations will not be exactly in resonance with the intermediate-frequency circuits, but will be either a little above or a little below.

This "difference," one way or another, is manipulated to produce an unbalanced current, which is then applied to alter the frequency of the local oscillations until they do produce the correct beat frequency. The unbalanced current then automatically vanishes, and the tuning "stays put" at the correct point. Should any frequency "drift" subsequently occur—as sometimes happens when the set warms up—it is automatically corrected in the same way, so that there is no necessity for a listener to leave his easy chair and retune the circuits.

Another aid to easy tuning depends upon the use of a brake which is fitted to the condenser spindle, and checks it as the operator passes through the "peak" point of the desired station. Here the "deus ex machina" is an auxiliary control valve, which is normally biased to cut-off point, but is triggered into action as soon as a worthwhile signal arrives. Its output current energises an electromagnetic brake which holds the control spindle against further movement and so prevents the operator from overshooting the mark. The braking action, though definite, is only momentary, so that the spindle is automatically freed for further movement after a short check at each carrier. For rapid searching over the dial the control can be entirely cut out.

Another line of attack is to deliberately suspend the function of the AVC circuits when searching for a given station. Simultaneously the selectivity of the set is also reduced, so that it can readily be tuned by ear alone to the correct point of resonance. Once the station has been brought in, both selectivity and AVC are restored to normal. The temporary changes are produced by pressing the control knob inwards. This operates a switch to detune one of the IF circuits, and a second switch to insert a time-lag resistance into the AVC line.

Radio is Changing Us.—By D. Cleghorn Thomson. 143 pp. Published by C. A. Watts and Co., Ltd., 5 and 6, Johnson's Court, Fleet Street, London, E.C.4. Price 2s. 6d.

THE author of this recently published book was for seven years an official of the B.B.C. and therefore has an interesting story to tell of the B.B.C. from within. The book has been given the sub-title "A Survey of Radio Development and its Problems in our Changing World," and the author justifies this by dealing especially with the part

broadcasting can play in the evolution of democracy. He does some very hard hitting at officials and officialdom at Broadcasting House.

In spite of a disarmingly bantering tone, he never loses sight of the serious aspect of his thesis and apportions credit as readily as blame.

Chapter 3 is headed "The Man and the Machinery," and in this he paints a very original picture of the Director-General, Sir John Reith. He states that it is quite impossible to understand the policy of Portland Place or the essential qualities of our radio service in its good and bad aspects alike without attempting to study the personality of the man who has controlled its destinies from its inception and moulded its growth to his tastes.

"Criticism is the B.B.C.'s most pressing need to-day" is the final thrust in the epilogue of this interesting little volume on broadcasting from within and without.

H. W. B.

Lexington pocket index of valve-holder connections

LEXINGTON VALVE SOCKET ANALYSER

A VERY handy pocket index for quickly ascertaining the valve-holder connections for almost every type of valve, British or American, in general use, has been introduced by the Lexington Instrument Laboratories, Ltd., 155-157, Great Portland Street, London, W.1.

It consists of a series of cards, 88 in all, and on 85 of these is a diagram of a valve holder, giving the appropriate socket connections and the average operating conditions for the valve. One card gives instructions for use, another a list of the abbreviations employed, and a third the standard resistance colour code.

The cards are housed in a stout cardboard container and secured by a pin on which they swivel. Thus they cannot be mislaid or the cards in the various sections interchanged.

This valve-holder index should prove very useful to the serviceman as well as to the home constructor. It costs 4s. 6d.

Change of Address

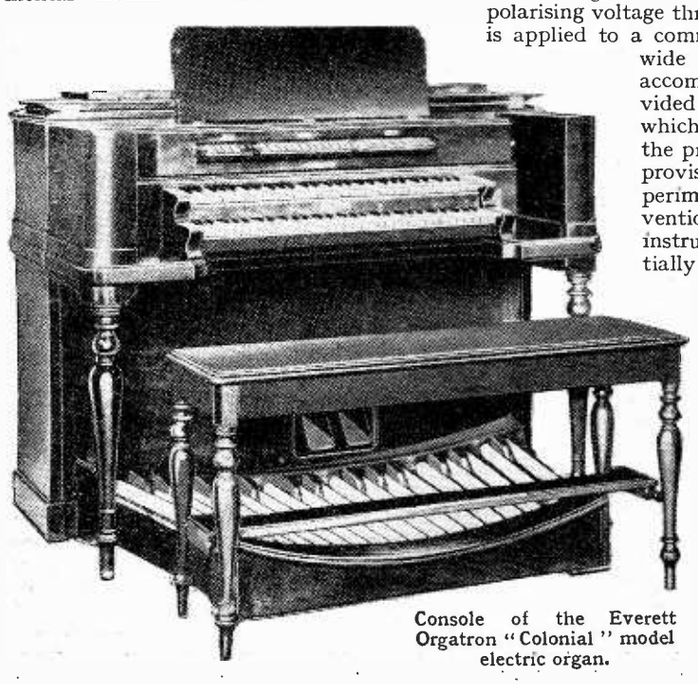
Wharfedale Wireless Works have now removed to their new factory at Hutchinson Lane, Brighouse, Yorks, to which address all communications should be sent.

The Everett "Orgatron"

Electrical Organ Tones with Pneumatic Excitation

A DEMONSTRATION of the Everett "Orgatron" was given recently in London. This compact electrical instrument is designed to give a faithful replica of standard organ tone and includes three of the four principal tone colours, viz., diapason, flute and string. Curiously enough, although reed tone is omitted, the fundamental vibrator units are metal reeds set in motion by suction from a central chamber in which a vacuum is maintained by a motor-driven exhauster. The reeds are voiced by variations in the ratio of width to length, auxiliary air resonance chambers, etc.

Associated with each reed is a fixed electrode forming a capacity microphone, and the EMF generated on the application of a polarising voltage through a series resistance is applied to a common pre-amplifier. A wide range of solo and accompaniment stops is provided, the tone values of which will be familiar to the professional organist. No provision is made for experimenting with unconventional effects, and the instrument is designed essentially as a compact substitute for the pipe organ of standard specification.



Console of the Everett Orgatron "Colonial" model electric organ.

The dimensions of the console with pedal clavier are approximately 58 × 64 × 42in., and the loud speaker "tone chamber" measures 47½ × 12 × 23in. The distributors in this country are Henri Selmer and Co., Ltd., 114-116, Charing Cross Road, London, W.C.2.

Letters to the Editor

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

Transient Response

AS a footnote to the correspondence on the subject of transient response, we thought it might be of interest if we described the aural and visual effects of an amplifier having inadequate frequency response on some typical transients.

In our experiments we made use of a simple photo-electric impulse generator. This consisted of a cardboard template rotated in front of a slit between a photo-electric cell and an exciter lamp. The output from the photo-electric cell was suitably amplified and applied to the vertical deflecting plates of a cathode-ray tube, which was at the same time provided with a horizontal sweep of constant velocity. The transients were first reproduced with an amplifier having a uniform response over a very wide frequency range, with correspondingly good phase characteristic. The high-frequency response was then modified by means of a resistance-capacity attenuator. The result of introducing this limitation into the amplifier was observed, visually in the change in shape of the trace on the cathode-ray tube, and aurally by the use of high-quality head telephones.

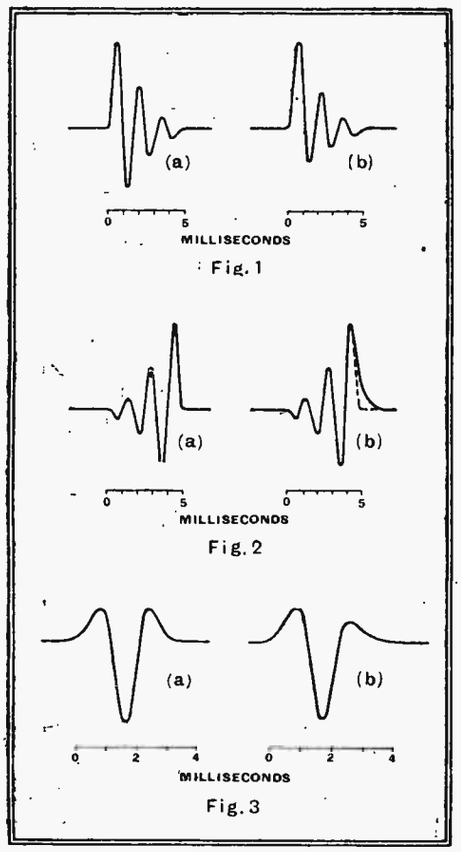


Fig. 1.—(*a*) Transient run forwards. (*b*) The same when reproduced with limited high-frequency response but with gain increased by 2.5 db.

Fig. 2.—(*a*) Transient run backwards. (*b*) The same when reproduced with limited high-frequency response but with gain increased by 3.5 db.

Fig. 3.—(*a*) Mr. Voigt's transient. (*b*) The same when reproduced with limited high-frequency response.

Among the wave forms examined were Mr. Voigt's self-supporting transient (shown in Fig. 4 of his article in your issue of July 30th), and also three cycles of a rapidly decaying sinoidal oscillation of the form $E = Ae^{-Bt} \sin\omega t$ which started suddenly at time $t = 0$. The results obtained with this wave form were the more interesting of the two, and may be briefly described as follows.

The wave form reproduced with the amplifying chain with wide frequency response is shown in Fig. 1(a). When the amplifier was modified to give the limited frequency response shown in Fig. 4, the wave form produced was as shown in Fig. 1(b). It should be noted that in this case, as also in succeeding cases, the gain of the amplifier was increased so as to bring the height of the diagram back to about its original value. This was done in order to obtain a better comparison between the two shapes. It will be observed that there is very little change in the appearance of this transient, although the response of the system is about 6 db down at 2,000 c/s.

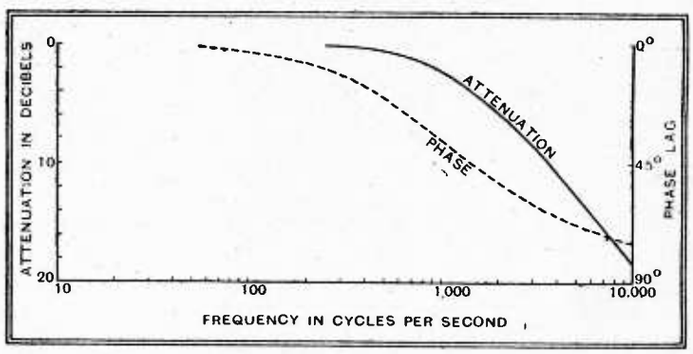


Fig. 4.—Frequency characteristics of amplifier with limited high-frequency response.

The same transient was then run backwards. With the amplifier with wide frequency response it was of course reproduced unchanged in shape, Fig. 2(a), but with high-frequency attenuation the appearance was as shown in Fig. 2(b). It will be seen that in this case there is a very substantial change in the appearance, and what was previously a sharp corner (where the transient suddenly stops) has become very much rounded owing to the limited high frequency response of the system. When the same transient was run forwards (Fig. 1) the sharpness of this corner appeared to be very little changed. The difference between Figs. 1(b) and 1(a) at this point is difficult to see except on a large scale and when switching quickly from one to the other. It is then seen that the bottom corner is very slightly rounded and the slope of the wave front somewhat reduced. This results in the whole of the rest of the diagram being moved over bodily to the right by a small amount.

As a result of these visual observations it might be expected that the effect upon the transient of a limitation of the high frequency response of the amplifying chain would depend on the direction of motion of the transient. In listening tests, however, all observers agreed that the modification of the "crispness" of the sound was as nearly as could be judged identical whether the transient was run forwards or backwards. In the forward direction (sudden start, see Fig. 1) the effect of the sound was very similar to that of a motor bicycle exhaust, particularly when run at a slower speed; when reproduced with limited high-frequency response the effect was simply that the sound was more muffled. When run backwards the onset of the sound was less impulsive in character, but it finished with a crack, as is to be expected. When reproduced with limited high-frequency response the same degree of muffling took place as occurred when the transient was run forwards.

Mr. Voigt's transient sounds very much like the one described above, and a similar degree of muffling of the sound is observed when the higher frequency response is cut down. The corresponding change in shape of the transient is quite small, as may be seen from Fig. 3.

These observations show that the shape of a wave form as judged by eye from a cathode-ray oscillograph is not an adequate measure of its character, and it appears that the ear judges the quality of a sound of this description on the basis of its Fourier analysis in the manner which would follow from Helmholtz's theory of audition.

E. S. L. BEALE.
R. P. G. DENMAN.

London, S.W.1.

"Scale Distortion"

"CATHODE RAY," in his article, "Scale Distortion," tells us that, disregarding the vulnerable speaker, a set having a level output from 30-10,000 cycles cannot be regarded as practically distortionless unless the following conditions are fulfilled:—

"The programme must be reproduced at the original volume. When a military or dance band, a symphony orchestra, or a cathedral organ are playing with all their might, the original intensity of sound must be reproduced in the home listening room."

We have heard this before, and at first consideration it certainly makes the plight of the quality enthusiast seem rather hopeless; but let us examine it and see if we cannot find a bigger catch in it than the one your contributor describes later in his article.

In the first place, a symphony orchestra, for instance, would seem much *louder* in the home listening room than it does to the conductor of the orchestra in a large concert hall where the absorption effect is very much higher indeed. Now, in the light of our knowledge of some of the peculiarities of the human ear we know that the im-

Letters to the Editor—

pression of sound created in the mind of the conductor is thus different from that of an imaginary person in the home listening room. The conductor, of course, receives an impression of much less bass for one thing.

The next step, which follows naturally, is to consider the position of a person, say, in the middle of the large concert hall where the sound intensity is very much lower than that in the position occupied by the conductor. He, in turn, suffers a further impression of loss of bass.

The poor wretches with really bad seats, like the back of the top shelf of Covent Garden, are naturally experiencing a hopeless travesty of the sound impression conceived by the composer.

In fact, when we come to think of it, they are in a much worse plight than the owner of a high-quality wireless set who can, if he likes, turn the volume up sufficiently to render the crackle of chocolate wrappings comparatively inoffensive.

The real catch (which has apparently escaped "Cathode Ray") is that we use the same peculiar ears whether we are listening to a reproduction or to the real thing. The proper application of the flexible tone control is under the conditions where the sound intensity at the ear in the home listening room is below that in a reasonably good position in the concert hall, cathedral, dance hall, etc. J. L. MONTAGUE.

Middlesbrough.

Scottish Radio Shows

FOR two years now we, in Scotland, have missed a real radio manufacturers' show, and are now reduced to our retailers rallying round and giving us a show which should, strictly speaking, be done by the manufacturers. It is good to see our retailers going to all this trouble to save the manufacturers that trouble of coming so far away from their homes to give us the necessary demonstrations and their much-sought-for advice and information regarding their products. Of course, Scottish sales may not warrant the manufacturers going to all this trouble, and it must have been very exhausting for these hard-worked representatives who used to come up here (half asleep in many cases) trying to explain to, and convince, Scottish people of the advantages of their products. Now, we even miss these poor tired-out souls, and if we want the pleasure of meeting them we must travel to Radiolympia, in London, or the show in Manchester, where, no doubt, they feel slightly happier. It is very refreshing to be able to meet some of the manufacturers, even at a retailers' show, such as Messrs. Hartley Turner, and to call on a demonstration by Messrs. Voigt, while in Scotland, as they are going a long way to stimulate their own trade and goodwill, and their tireless efforts show us that they find it worth while coming so far.

If we cannot have a real radio show in Scotland it is time we had Scottish manufacturers and a Scottish show, where, I have no doubt, the existing manufacturers would start and squeeze in their products.

After all, who better than the radio manufacturers can give technical knowledge and information, for it is for the lack of that knowledge that the radio public are suffering, and the radio sales are sometimes so depressing.

What do other Scottish readers think?

Edinburgh. JOHN R. GRANT.

Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Vision 45 Mc/s. Sound 41.5 Mc/s.

FRIDAY, OCTOBER 8th.

3, Peggy Cochrane in selections from her repertoire. **3.10,** Clifford Stanton in impersonations. **3.20,** British Movietonews. **3.30,** "Waterloo"; a play by Sir Arthur Conan Doyle. The scene is a small room in a house in Woolwich in June, 1881.

9, Ravel's "Bolero," played by the Television Orchestra. **9.15,** Gaumont-British News. **9.25,** O Rare Ben Jonson! Talk on the great wit, poet and dramatist with illustrations from the National Portrait Gallery. **9.35,** "Waterloo."

SATURDAY, OCTOBER 9th.

2.25, O.B. of Road Race for the Imperial Trophy on the Crystal Palace Road Racing Circuit. **2.55,** Cartoon Film. **3,** In Our Garden: C. H. Middleton. **3.15,** Road Race O.B. **3.31,** First Time Here. **3.46,** Road Race O.B. **4.5,** Punch and Judy: P. F. Tickner. **4.15-4.50,** Road Race O.B.

9, Variety. **9.20,** British Movie onews. **9.30,** Ballet: "The Golden Apple" and Play: "Two Gentlemen of Soho," by A. P. Herbert.

MONDAY, OCTOBER 11th.

3, Mixed Programme. **3.25,** Gaumont-British News. **3.35,** The Vic-Wells Ballet Company in "Carnaval," to music by Schumann.

9, Mixed Programme. **9.15,** Talk. **9.25,** British Movietonews. **9.35,** "Carnaval."

TUESDAY, OCTOBER 12th.

3, Bernard Shaw's "St. Joan." **3.50,** British Movietonews.

9, "St. Joan." **9.50,** Gaumont-British News.

WEDNESDAY, OCTOBER 13th.

3, Variety. **3.15,** Gaumont-British News. **3.25,** Eighty-fifth edition of Picture Page. **3.50,** From the North London Exhibition, Alexandra Palace.

9, A Little Show. **9.25,** British Movietonews. **9.35,** Eighty-sixth edition of Picture Page. **9.50,** North London Exhibition.

THURSDAY, OCTOBER 14th.

3, O.B. from Denham Film Studios. **3.20,** British Movietonews. **3.30,** Hans Andersen's stories:—"The Princess and the Pea" and "The Jumpers." **3.40,** The Mizzen Cross-Trees: a revue of nautical songs.

9, O.B. from Denham Film Studios. **9.15,** Hans Andersen's story, "The Top and the Ball." **9.25,** Gaumont-British News. **9.35,** Clothesline—No. 2:—The Spo ting Woman. **9.50,** Starlight.

NEW G.E.C. SETS

THE programme of G.E.C. receivers shown at Olympia has been augmented by two new instruments, the "AC All-wave Quality Eight" (a table model at 17½ guineas) and the "Fidelity All-wave 8 Automatic Record-changer Radiogram" at 44 guineas.

The table model is a three-waveband superhet with preselector RF stage, one stage of IF and two triodes in push-pull in the output stage giving 6 watts. It incorporates all the latest G.E.C. tuning refinements, and, in addition, a muting device actuated by a downward sliding movement of the tuning knob.

A flush-mounted control desk and a piano-type lid enabling the instrument to be placed close against the wall are features of the radio-gramophone. The circuit incorporates two IF stages and has four wavebands with a lower limit of 13 metres. As in the table model a 6-watt push-pull output stage is provided.

Random Radiations

By "DIALLIST"

A Queer Business

FOR years now *The Wireless World* has been endeavouring to persuade British radio manufacturers that there is a large market waiting for first-rate multi-valve receiving sets in this country. Most of them either couldn't or wouldn't believe it in the past, though this year at the Wireless Exhibition the number of bigger models to be seen on the stands made one hope fondly that something was at last going to be done about it. I am still hoping, though there are few signs at the moment that any attempt is being made by the makers to bring home to the public the fact that British-made receivers of high grade are now available, and that they offer an investment that is very well worth while to those who can afford them. The man in the street, unfortunately, has been educated *down* to the small set at a small price rather than *up* to a more expensive set with its many advantages. But despite this unhappy process there still remain large numbers of folk who are not satisfied with the performances of the small receiver and want something better, though not in radiogram form.

Is It Too Late ?

It has been obvious for some time that if our manufacturers wouldn't offer big receiving sets and push them, somebody else would come along and reap the harvest that they had neglected. And that, so I hear, is just what's going to happen now unless our people wake up and do things with a will at once. It is announced that an important American firm, which has always specialised in hand-made receiving sets—custom-built, they call them—of the luxury class, is about to make receiving sets here. This firm turns out nothing smaller than a 15-valve receiver. This, and one with 21 valves, will shortly appear on our market. There won't, it is said, be a set offered at less than £50, but unless I am very much mistaken this firm will find it difficult to turn out sets fast enough to meet the demand for them.

The Droitwich Question

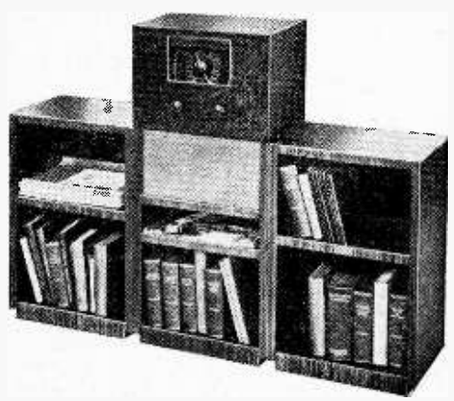
THE B.B.C. makes some queer statements at times, but it hasn't often managed a queerer one than its recent pronouncement about the quality of Droitwich. The programmes from Droitwich, they would have us believe, are receivable with much the same quality as those from the best medium-wave transmitters. If that is so, I am afraid that there must be something wrong with every receiving set that I have been using lately—and I've tried about a score of new models during the past few months. Also, I have listened to B.B.C. programmes during that time in several different parts of the country. Like pretty well everyone else I know, I never use Droitwich for reception of the National programmes if I can get them from a medium-wave source. And, apart from the question of absolute quality, there is the rather important matter of interference. Does the B.B.C. not realise that the man-made variety can be poisonous on the long waves, though comparatively innocuous on the medium? Surely members of its own staff who live in London, or Birmingham, or Leeds, or Bradford could enlighten them on this point? Then there are such things as atmospherics, which often make reception not too much fun on the long waves, especially in summer time. No, I am afraid that I can't quite follow here the workings of the B.B.C.'s collective mind. What I do know for certain is that numbers of listeners living in the areas served by the London and North Nationals are now unable to receive the National programmes at all before five o'clock in the evening from Monday to Friday each week, and that is hardly a satisfactory state of affairs.

Perfect Peace

IT is reported, though I cannot vouch for the genuineness of the information, that somebody or other is proposing to start a "Peace Station" in Ireland. The idea is to deluge this country with a flood of propaganda in favour of peace, which is a most laudable intention. But when I read that speakers of all political creeds will be allowed to use the station, if ever it comes into existence, I can't help feeling that its founders might well discover pretty quickly that they had bitten off more than they could chew, and that would-be pacifying words with the bias of a dozen different political outlooks behind them might have just the opposite effect to that which was intended. Nor is the proposed station to be entirely or even mainly a philanthropic venture. The proposal is that it should become self-supporting by selling time on the air to advertisers. And that raises awful possibilities. There is only one way nowadays in which a free-lance station of this kind can obtain elbow-room for itself, and that is by thrusting into one waveband or the other with such enormous power behind it that other stations are shouted down, and make a place for it in self-defence. If such is the intention of the promoters of the Peace Station I am afraid that they'll be a source of strife in the ether from the word "go."

The Gas Stove Complex

FOR a long time I have been hunting for an adjective which would describe comprehensively and adequately the shape of the typical wireless cabinet of to-day. A year or two ago it was quite easy to find one, for in their outlines so many resembled tombstones. And now I think I've found one for the set of to-day. It came to me in this way. I was turning over the pages of my daily paper without my glasses, and saw what I took to be an advertisement of a radio receiver. Reaching for the aforesaid glasses and placing them on my nose, I looked again. It wasn't a wireless set that was advertised; it was a gas stove. Don't you think that rather hits the nail on the head? Pause in front of a window of the next wireless shop you come across and just see whether about half the sets on view don't look (I am referring, of course, to outlines and not to materials) very much like what meets your eyes if you visit the showrooms of the gas company. There are, of course, lots of exceptions; I am not saying that *every* set suggests that its spiritual home is the hearth-stone with a fender in front of it. But I do think that, taking them by and large, cabinet designs exhibit the gas-stove complex too strongly.



WIRELESS FURNITURE.—The idea of the sectional bookcase has now been adapted by Philco to the housing of receivers. The central section, comprising set, speaker and shelves, forms a self-contained unit, to which extra bookcase units may be added as required.

Room for Originality

When you come to think of it, it is rather surprising that we haven't developed some far more original designs for the cabinets which house our wireless sets. In the early days the cabinet housed the "works" only, the loud speaker being a separate thing. Sets were than built on horizontal baseboards with the controls mounted upon vertical panels. Baseboard and panel slid like a drawer in and out of a rectangular cabinet of severe and not very pleasing design. When we began to build the loud speaker into the set the obvious step was to put it above the chassis; hence, first the tombstone and then the gas-stove cabinet. Nowadays the chassis of even the biggest set is comparatively small—efficient screening and modern methods of coil winding have seen to that—and there's no reason why the loud speaker should be mounted straight above it. Except that the tendency is, thank goodness, for tuning dials to become larger, the designer of cabinets has a much freer hand. I hope it won't be long before designers in general forget the gas stove and begin to give us wireless sets with much less of a family resemblance.

And . . . Gas-operated Sets

Speaking of gas stoves reminds me that I noticed on one of the stands at the Exhibition a gas-operated charger for accumulator batteries. I couldn't get very much information about it at the time, but I have since had some very interesting details from the head of the firm which will soon be placing it on the market. The idea isn't, of course, new, but, in the past, attempts to turn out satisfactory thermal chargers have not been very successful, one of the chief snags being that they had to be so bulky. In the charger under discussion two new alloys are used, which, it is claimed, give far better results in a thermo-junction than those previously available. With them as much as 0.1 volt can be obtained on open circuit with the hot joint at 200 degrees

Centigrade, and the cold joint at 100. I am told that there is hardly any appreciable EMF up to 100 degrees, and this, of course, greatly simplifies cooling. The charger, which is rated at 2 volts 3 amperes, will be quite compact in its final form, measuring only five inches in height, by eight in width, and twelve in length. I am hoping to get hold of one to try out shortly, and it will be very interesting to see what its performance is like.

If it works well it should be a very useful thing for those who haven't electric light. Actually, I suppose, there is no reason why it shouldn't be made to work from a paraffin or acetylene gas burner. If so, it would be very handy for those who live in the depths of the country, where even coal gas isn't available. As the apparatus worked by coal gas is said to need only three cubic feet an hour, it shouldn't be at all expensive to run. I can, however, see one possible snag; in many places nowadays the coal gas supplied contains quite a lot of weird things which might be troublesome. One of these, methane, I think it is, causes a thick white deposit to form on incandescent burners, and one imagines that there is the possibility of the thermo charger becoming clogged up unless it is designed in such a way that it is a very easy job to clean it. But the designers no doubt have this and other things well in mind.

SERVISOL

SERVISOL is a special solution which is supplied by the Servisol Chemical Co., 74-76, Renshaw Street, Liverpool, for removing any film, greasy or otherwise, that may accumulate on switch contacts, thereby rendering them non-effective or erratic in their operation. It is well known that high-resistance contacts can play havoc with a wireless receiver, so that this solution should prove extremely useful to servicemen and test-room operatives.

For example, it can be applied to switches *in situ* in a wireless set, for the solution rapidly evaporates when it has done its work, which is to loosen or so soften the deposit that the moving contact is able to bite through and make a clean trail on the metal of the fixed members.

Its usefulness is not restricted to switches as it will clean any metal part that acts as an electrical contact with another, such as valve pins and valve sockets, variable condenser spindles and bearings, etc.

Servisol is non-inflammable and quite safe to use, though it is advised that all work involving its use should be carried out in a well-ventilated room.

It is available to service engineers and those engaged in the wireless and electrical industries.

Cosmocord Pick-up
Model 25

THIS pick-up is of the electro-magnetic type and makes use of an improved method of pivoting and damping of the armature. Centring screws are provided, and these are adjusted and sealed at the works, but they are accessible from the underside of the head and the more knowledgeable amateur will no doubt avail himself of this fact.

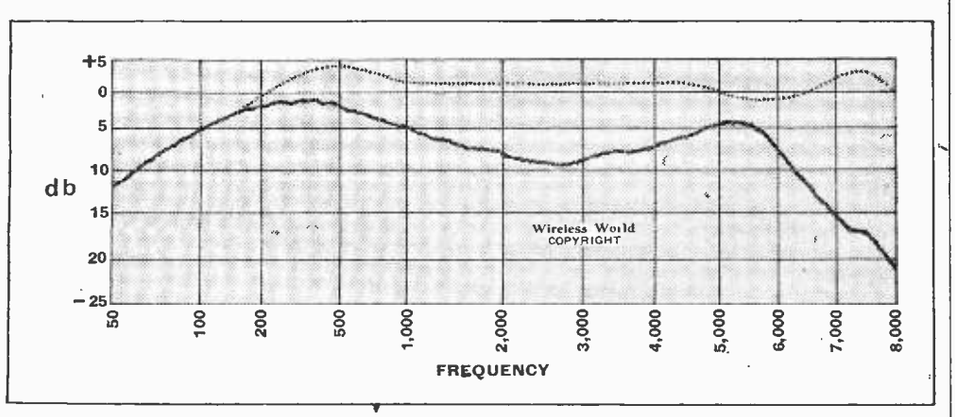
The frequency characteristic is smooth and lies within ± 5 db between 50 and 6,000 cycles. Needle scratch is low and the damping is light so that record wear should be negligible.

A moulded tone arm is carried on a pedestal incorporating a volume control and the head swivels to facilitate needle changing.

Cosmocord Model 25 pick-up. A moulded tone arm rest (not shown) is included.

Included in the specification is a moulded tone arm rest with needle cups.

The price is 25s. and the makers are Cosmocord, Ltd., Cambridge Arterial Road, Enfield.



Response curve of Cosmocord Model 25 pick-up. Zero db is equivalent to 1 volt RMS and the dotted curve shows the characteristic of the test record.

G.E.C. AC/DC SUPER SIX

THIS receiver, which has just been released, is an all-wave superheterodyne designed to give a performance comparable with the more advanced AC receivers. It incorporates an RF amplifier, triode hexode frequency-changer, single IF stage, double-diode-triode second detector and pentode output stage. In addition to a half-wave rectifier there is a barretter regulating lamp.

The set is fitted with all the current G.E.C. tuning features such as "Chromoscopic" dial, "Rotavernier" micro-tuner, and the valves are of the latest "International" type. The price is 15 guineas.

Recent Inventions

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

SCANNING SYSTEMS

IN a scanning system where synchronising impulses are produced by passing light from a white marginal line through an aperture in the rotating disc, it is often difficult to develop a sufficiently strong impulse owing to the small size of the aperture.

According to the invention, a small open passage, free from any light-absorbing material, is provided for the passage of the light forming the synchronising impulse, and in order to prevent this bright gap from being seen on the received picture a plano-parallel plate of glass is interposed between the film and the scanning disc. The plate is inclined at a slight angle to the disc, so as to project the image of the picture close up against the "gap" provided for the passage of the synchronising impulses.

Radio-Akt. D. S. Loewe. Convention date (Germany) December 1st, 1934. No. 466508.

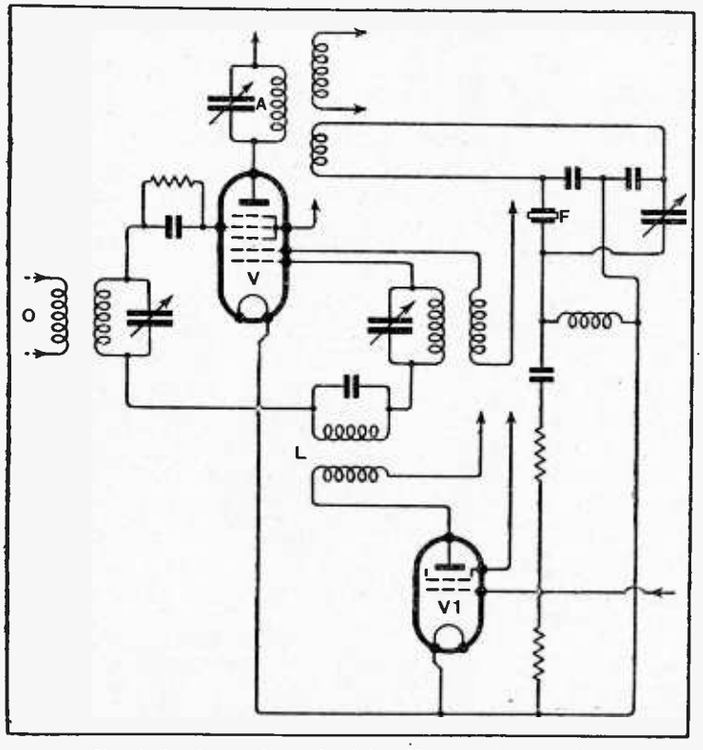
oooo

SUPERHET RECEIVERS

IN order to increase selectivity, a part of the signal output from the IF stage of a superhet is fed back, through a highly selective circuit, to the local oscillator valve, where it produces a beat frequency equal to the original carrier wave and so applies the well-known homodyne effect.

As shown in the figure, the incoming signals are fed at O to a pentagrid "mixer" valve V. Part of the resulting intermediate frequency is fed back from the output A through a balanced piezo-electric filter-circuit F to a control valve V1, where they are amplified and applied through a coupling L to the local oscillator circuit of the mixer valve V. The feed-back frequency modulates the local oscillations and so produces a beat frequency identical with that of the incoming carrier signal, upon which it then acts as a homodyne.

J. Robinson. Application date November 22nd, 1935. No. 466415.



Circuit for improving selectivity of a superhet receiver.

oooo

TELEPHONE HEAD-SETS

TO facilitate easy adjustment to the head of the wearer, the headband of a pair of earphones consists of two wires each of which is independently rotatable in the side blocks which support the ear-pieces. Wire loops carry the ear-pieces from the same sideblocks.

Owing to the flexible method of mounting, the two wires forming the headband can readily be separated from each other so as to rest on the skull over a wide angle.

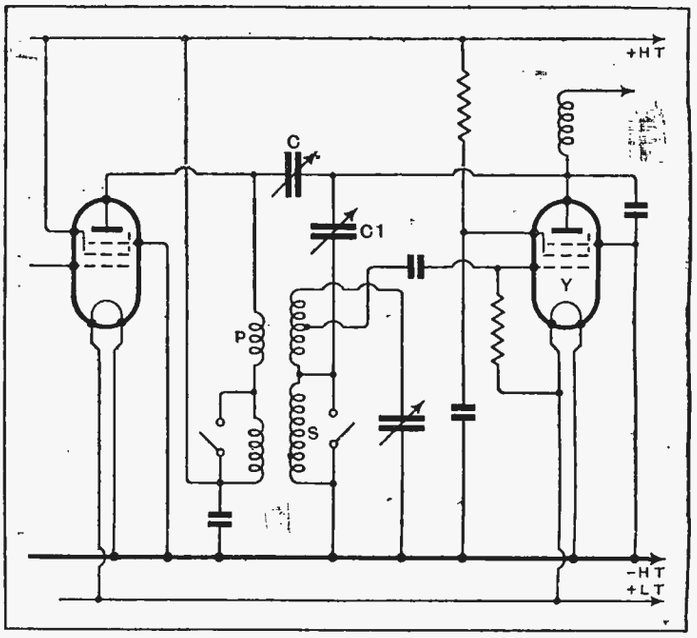
Standard Telephones and Cables, Ltd. and J. S. P. Robertson. Application date December 16th, 1935. No. 467435.

CONTROLLING REACTION

THE use of a single condenser to control reaction is unsatisfactory on different waveband settings, and it is usual either to produce special damping on the long waves, or else to limit the degree of reaction.

According to the invention, one condenser C, connected between the primary winding P and the anode of the detector valve Y, is used to control reaction on the medium wave-band, and a second condenser C1, connected to the secondary winding S, is used to introduce "negative" feed back on the long-wave setting. The winding S is, of course, short-circuited on the medium-wave setting. Reversed feed-back on the longer waves also serves to neutralise any inherent positive reaction, and so stabilises the set.

E. K. Cole, Ltd. and G. Bradfield. Application date January 31st, 1936. No. 466526.



Method of obtaining more uniform regeneration than is possible with a single reaction condenser.

oooo

CR TUBE DISTORTION

WHEN the filament of a cathode-ray tube is heated by alternating current parasitic magnetic fields are produced, at right-angles to the plane of the filament, and tend to deflect the electron stream out of its normal path.

In order to prevent this, one or more small deflecting plates are connected to the ends of the filament and are arranged at right-angles to its plane so as to produce an electrostatic field in opposition to that which tends to produce distortion.

E. Michaelis. (Communicated by E. Kinne.) Application date January 25th, 1936. No. 466046.

TELEVISION SYSTEMS

IN a television transmitter of the type in which the picture is projected on to a photo-sensitive electrode, an auxiliary scanning spot of light, of constant intensity, is used to augment the normal intensity of the electron emission without affecting the point-to-point differences which produce the light-and-shade effects of the picture.

The augmented stream of electrons is afterwards focused upon a multiple-condenser screen, located at the opposite end of the tube, so as to produce successive charges from which the picture signals are derived.

The British Thomson-Houston Co., Ltd. (Communicated by Allgemeine Elektricitate Ges.) Application date November 22nd, 1935. No. 465966.

oooo

PICTURE signals and synchronising impulses are both applied to the carrier wave at the same stage in a transmitter, but without previously mixing them. Two valves are arranged in push-pull and are fed with the carrier wave through a common input transformer. The picture signals are injected across a centre tapping in the input transformer, whilst synchronising signals from a separate source are applied to the screening grids of each of the valves.

Each screening grid is connected to its cathode through a common condenser, which has a high impedance to the synchronising frequency, but a low impedance to the picture-modulated carrier wave.

Baird Television, Ltd. and G. W. White. Application date December 2nd, 1935. No. 466715.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

High Quality

Will Cairo Find a Solution?

THE fact that there is no such thing as elbow room in the ether presents to-day the greatest obstacle to the achievement of high quality in broadcast reception.

Receivers can to-day be produced which will provide an extraordinarily high standard of quality on the local station, but the quality is restricted by the narrowness of the band allotted to the transmitter, and unless the receiver is located very near the transmitter interference from adjacent channel stations prevents the reception even of the degree of quality of which the transmitter is capable.

Until the transmitter frequency band can be increased and receivers can take full advantage of the wider band, there seems to be little hope of real quality improvement on the normal broadcasting wavelengths.

Will the Cairo Conference which meets next February devise a solution of this problem? Even one high power quality transmitter in each country would be a welcome gesture to music lovers.

Televisors

Number in Use

ONLY last month we drew attention again to the desirability of making public the total number of television sets sold in order that the growth of public interest might be gauged. We also quoted the recommendation which appeared in the Report of the Television Committee published in January, 1935, which reads: "We hope that it may be possible to negotiate an arrangement with the trade whereby periodical returns may be made of the total number of television sets sold in each town or district, since this would provide some measure of the growth of the demand."

In spite of efforts to obtain from authorities here a figure of the total sales for publication, we have been unsuccessful. The figure is, however, now available, but we think it deplorable that this should come to this country second-hand. Elsewhere in this issue we publish a statement made by Mr. David Sarnoff, President of the Radio Corporation of America, on his return from a visit to Europe. In his statement he gives the total number of television sets in the hands of the general public after a year of the television service as less than 1,000, and states that the total sales of televisors during the period of the Radio Show did not exceed 100.

We think it quite proper that this information should have been given to so important a figure in the radio world as Mr. Sarnoff, but this does not explain why it should have been made available to a visitor to this country but withheld from the public here.

The Questionnaire

Our Thanks Again

WE wish again to express our thanks to readers for the replies to our Questionnaire, which are still reaching us in large quantities and will prove to be of inestimable value when the task of extracting information from them has been completed.

Readers will appreciate that individual acknowledgments of so many thousands of replies cannot be undertaken even in the case of those who have supplied names and addresses, and accept this expression of our sincere thanks.

The Series Phase Aerial Array

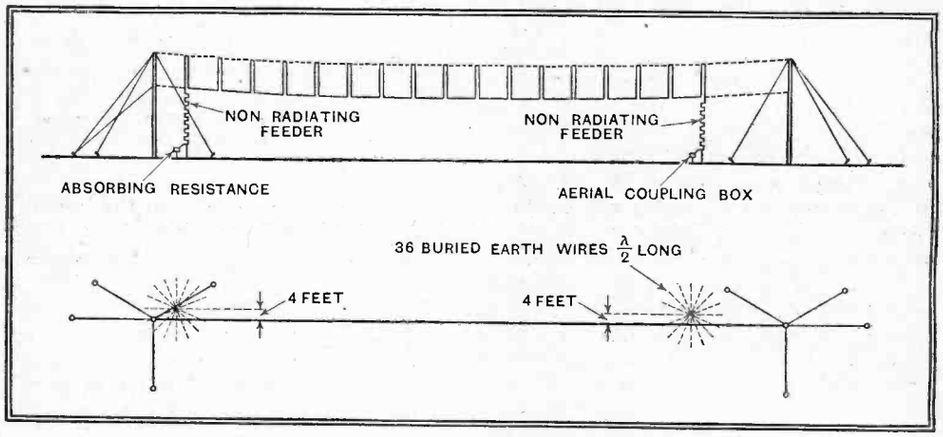
AN ECONOMICAL AND EASILY ERECTED DIRECTIONAL RADIATING SYSTEM OF HIGH EFFICIENCY

By N. WELLS, M.Sc.

THE original Marconi Beam Aerial is well known, and its success has led other investigators to devise many interesting modifications of the original basic features of an active curtain with a reflecting screen. The present article is concerned with the Marconi Series Phase Array, also due to Mr. C. S. Franklin, a form of directive aerial that is neat, simple and of relatively low cost; in fact, a form that is particularly adapted for service equipments where considerations of both efficiency and economy are important. As usually constructed, its main feature is a series of vertical quarter-wave loops spaced approximately one-quarter wave apart, the number of loops being determined by the conditions and nature of the service.

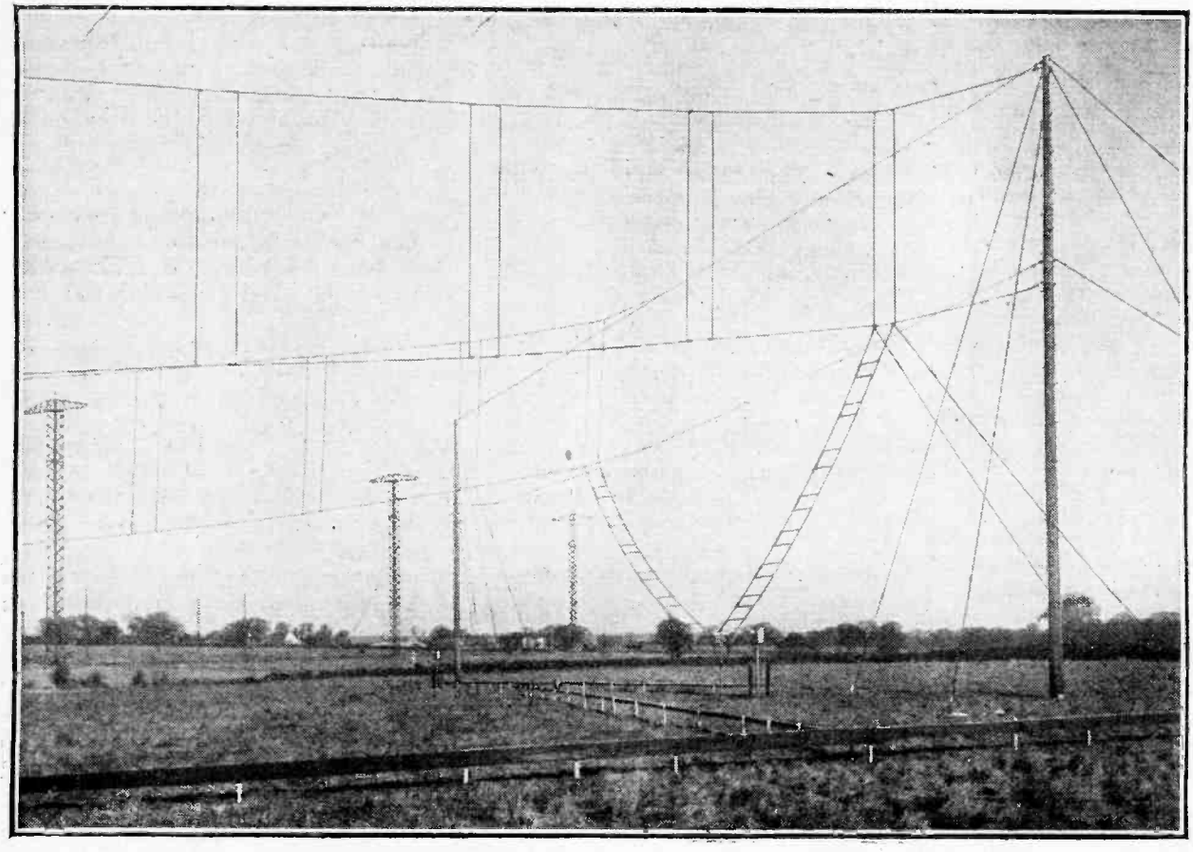
Radiation is an incidental effect of any changing current flow, and may be produced by either stationary waves or travelling waves. In the Series Phase system the wave travels along the conductor; for this reason it is usual to terminate the array with a resistance equivalent to its wave impedance (about 300 ohms) in order to absorb any small amount of non-radiated energy and thus avoid weak reflection effects.

The object of an aerial array is to produce a directional effect; that is, radiation from the active portions must be additive in the required direction—equally, of course, radiation must cancel out in unwanted directions. In principle, the Series Phase Array consists of a series of in-line vertical radiators, with a time phase difference equal to the space phase separating them; it will be shown very briefly that this arrangement fulfils the required conditions, the reader being referred to numerous technical papers for more precise discussions,[1] but first it is necessary to demonstrate that the system does, in effect, constitute a series of radiators spaced one-quarter wavelength apart, differing in phase by 90 deg.; subsequently its merits will be discussed, together with some of the practical implications of design.



Practical arrangement of a single-element 17-loop array.

With the help of Figs. 1, 2 and 3 we will, for the moment, consider only the loops, deferring an investigation of the effect of the horizontal limbs CD, FG, etc., until later. The two vertical limbs of each loop are so close that they may be regarded as a single radiator; that is, the loop may be treated as a single wire one-quarter wavelength high, along which the currents in the two limbs are combined. But current in BC is in opposite direction to current in AB, since BC is turned through 180 deg. relative to AB; hence the addition will be as Fig. 4. It is clear from an inspection of this



[1] For vector and graphical methods of analysis, see articles by E. Green, in *Experimental Wireless*, October, 1925; by A. W. Ladner in *Marconi Review*, No. 33, 1931; also by N. Wells in the *Electrical Review*, May 25 and June 1, 1928.

The Series Phase Aerial Array—

figure that the final result, in respect of ABC, is a quarter-wave radiator, as shown in Fig. 5, and similarly in respect of DEF; this latter figure also establishes that there is always a phase difference of 90 deg. between the two radiators. Thus, the loops act as quarter-wave high radiators, with a phase difference of 90 deg.; that is, a phase difference equal to the distance separating them. Note that the maximum amplitude of the standing wave is twice that of the travelling wave.

Directional Properties

Some idea of the directional effect of the Series Phase Aerial is possible with the aid of Fig. 5, wherein, for convenience, the loop aerial ABC is designated by X, while the loop aerial DEF is designated by Y. To begin with, consider X1, X2, X3, etc., as representing five stages in the time phase change (amplitude and sign) of aerial X over half a cycle, then Y1, Y2, Y3, etc., will represent the phase changes of aerial Y at identical instants. By the time X has changed through 90 deg. it will be as X3; but at this instant the wave front from Y, being at stage Y1, has travelled through 90 deg. of space in direction X, reached it and, being in correct phase, has added to X3; similarly, radiation from stage Y2 adds to X4, stage Y3 to X5 (zero plus zero), etc., etc., for waves travelling in the direction right to left; that is, radiations add in the direction towards the fed end. Again, by the time Y has changed through 90 deg. it will be as Y3; but at this instant the wave front from X at stage X1, travelling in direction Y, reaches it and adds nothing to stage Y3, while the wave front from stage X2, travelling in direction Y, reaches stage Y4 exactly 180 degrees out of phase with Y4 and cancels rediation from Y4; similarly

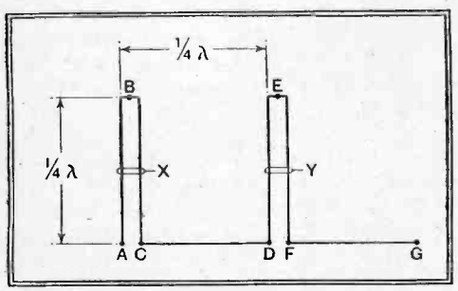


Fig. 1.—Explanatory diagram representing a system of two loops.

radiation from stage X3 cancels radiation from Y5, etc., etc., for waves travelling in the direction away from the fed end, that is, radiation cancels out in this direction.

Fig. 6 indicates the form of theoretical horizontal polar diagram for 2 loops and for 8 loops, while Fig. 7 indicates a measured polar diagram for 17-loop elements, four abreast. One of the features of the SP array is the ease with which single arrays can be duplicated, or quadrupled, thereby gaining any required degree of concentration in the horizontal plane with minimum expenditure of cash and space. Spacing between individual arrays is usually three-quarters of a wavelength. It will be appreciated that such paralleling is most advantageous when the length of the array has been extended to give the best possible vertical diagram for the service in view.

Another important feature of the Series Phase Arrays is that, owing to the cumulative effect being in line, the vertical polar

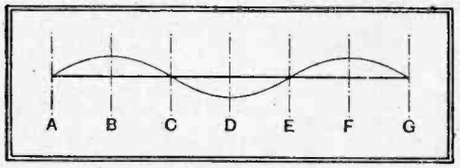


Fig. 2.—Indicating the system of Fig. 1 spread out in line, with current distribution covering the 1½ wavelengths of conductor included from end to end.

diagram is almost similar to the horizontal diagram of one line of loops (see Fig. 8). To obtain an equivalent vertical diagram from a broadside array would involve a very high and costly construction.

The radiation resistance R of a plain vertical quarter-wave aerial is the equivalent circuit resistance referred to I, the maximum current amplitude as measured

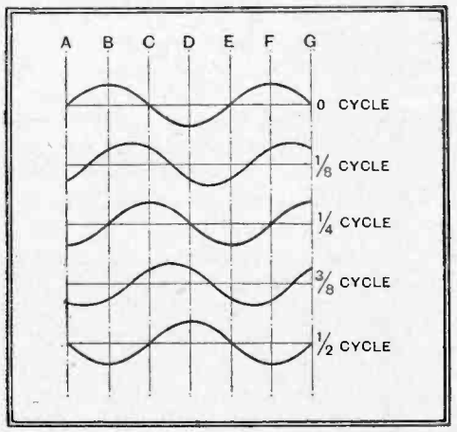


Fig. 3.—Five stages in one half-cycle of a travelling wave.

at the base of the aerial; expressed in the usual form we may write:—

$$I^2.R = \text{Watts}$$

We have seen that the SP loops act as quarter-wave high aerials with, in effect, a stationary wave of amplitude twice that of the current flowing through the loops; therefore, if above current I is flowing through the loops the watts radiated will be $(2\ I)^2R$, or $4\ I^2R$, four times the watts radiated from a plain quarter-wave aerial.

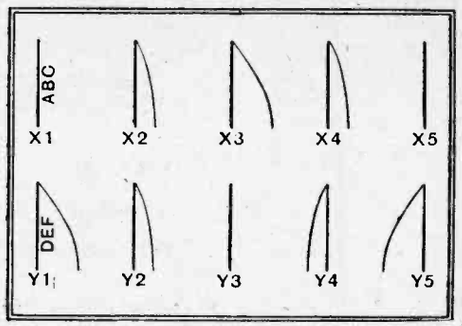


Fig. 5.—Current distribution in two adjacent loops over one half-cycle, divided into five stages.

Put another way, the loops are equivalent to twin in-phase quarter wave aerials each fed with current I; in both cases, loop or twin, the radiation resistance R^1 of the system, reference current I, is such that:—

$$I^2.R^1 = 4.I^2.R, \text{ that is } R^1 = 4R.$$

Thus the radiation resistance of the loops

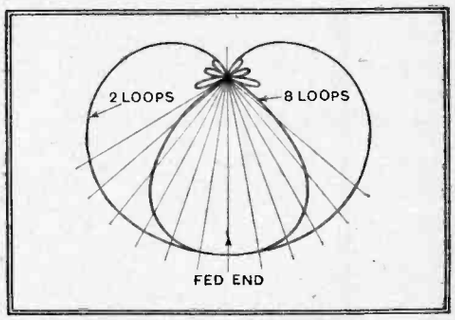


Fig. 6.—Theoretical horizontal polar diagram for two and eight loops.

is four times that of a quarter-wave aerial, and will be of the order of 150 ohms, a very high value. This is one of the outstanding features of the Franklin SP aerial.

A diagram indicating current distribution along the horizontal members may be easily constructed from Fig. 3; since for all practical purposes these members can be treated as joined in line, such a diagram will be as Fig. 9 for six consecutive horizontals. The particular distribution shown corresponds to the instantaneous values over the first stage of the travelling wave starting at A, Figs. 2 and 3. When extended over two or more wavelengths, that is, over sixteen or more horizontals, it is possible to verify by calculation that the radiation from such a system is only slight, and may be ignored as regards any appreciable effect upon the polar diagram. Apart from calculation, however, an inspection of Fig. 9 makes it fairly obvious

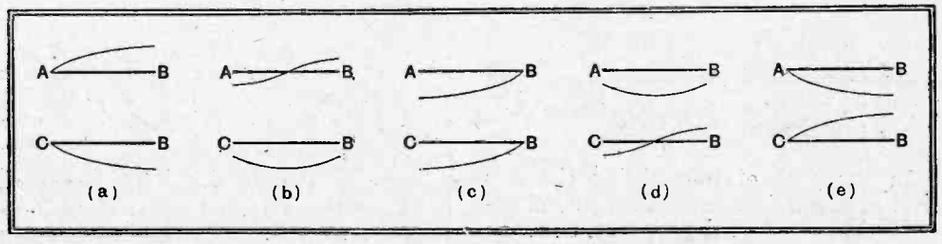


Fig. 4.—Distribution of current in the conductors of a loop.

The Series Phase Aerial Array—

that radiation from the horizontal tends to cancel out when taken over a number of members; in fact, the horizontal members may fairly be regarded as non-radiating feeders.

Such in brief outline is an explanation of the working principle of the Series Phase aerial. It will be realised that in respect of loop phasing and efficiency, also in respect of horizontal single-feeder connection, it represents a system that is altogether unique.

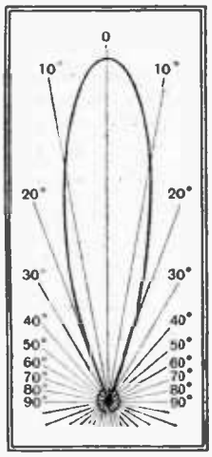


Fig. 7.—Measured polar diagram of four 17-loop arrays in parallel.

Before concluding it may be useful to touch on certain practical aspects. Regarded as a transmitter, it is obvious that phasing is completely under control, and, therefore, advantage may be taken of the concentration or directive property of a series system by extending it through four, or five, and in some cases even six, wavelengths. These lengths correspond to seventeen, twenty-one, and twenty-five loops respectively.

On the other hand, regarded as a receiver where the incident field cannot be controlled, being at the mercy of the erratic E and other space layers, there is a diversity phase effect to combat; because of this effect it is inexpedient to extend the overall length of a complete receiving aerial over such a distance that there may be out-of-phase effects from front to back. Experience has indicated that the best average results are to be obtained by extending the receiving aerials through two to two-and-a-half wavelengths, that is, for nine to eleven loops; this applies to twelve months' working, and it must be obvious that during such a period there are bound to be occasions when conditions are steady, and longer aerials would be beneficial—unfortunately, as mentioned, and as all receiving engineers know, there are other periods when such high gains are much worse than useless.

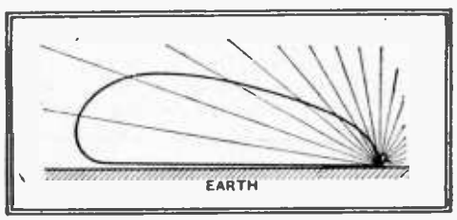


Fig. 8.—Typical vertical polar diagram for a series phase array.

In the case of transmitting elements five, or more, wavelengths long terminating resistances are not necessary, since the loops may be so dimensioned that the last few loops radiate virtually all residual energy.

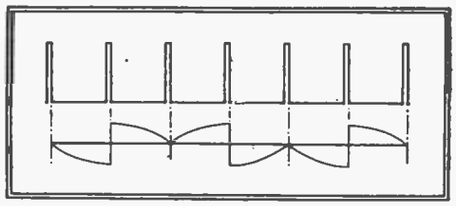


Fig. 9.—Distribution over six horizontal limbs.

Advantage may be taken of the symmetry of the SP aerial to work it in either of two opposite directions; for this type of service the aerial is fed at either end, the feeders being brought to an auto change-over junction box below the centre of the aerial span.

In order to reduce the effects of variable ground conditions, as between wet and dry seasons, and more especially in order to ensure a consistent vertical polar characteristic, there has recently been adopted a ground system of longitudinal earth wires extending beyond the aerial elements and linked up with the aerial terminal ground screen.

The aerial is usually fed through a length of 75-ohm Marconi concentric feeder, this value being transformed to match the aerial terminal impedance via the well-known Marconi reactance transformer. Thus in the case of a single element aerial the transformer series coil would have a reactance of some 130 ohms, and the shunt condenser a reactance of some 170 ohms, actual values being adjusted on site to throw back the requisite 75 ohms into the feeder.

The average gains of the Series Phase Arrays vary considerably with height and location, but conservative estimates are as follows:—

No. of Aerial Elements in Parallel.	Gain over Half Wave Vertical Aerial.
1	6 to 9 dbs.
2	9 to 12 ,,
4	12 to 15 ,,

Theoretical gains are higher, and, as a matter of fact, are often attained in practice.

Finally it will be appreciated that the dimensions of the aerial loops and horizontal members must be such that attenuation along the series of loops is neither too rapid nor yet too slow; for, in the first case the earlier loops will be active while the further loops will tend to be inert, while in the second case energy will be lost by undue dissipation in the terminal resistance. The problem is not difficult in the case of receiving aerials, but in the case of transmitting aerials the dimensions have to be carefully graded according to the frequency and length of complete element.

Notes and News

Police Wireless Development

BIRMINGHAM, Bristol and the South Wales areas are the latest districts to be included in the national scheme for linking up the police forces of the country by wireless. The country is divided into various areas, the largest of which is naturally the Metropolitan police district, and while each area is completely self-contained with regard to its wireless arrangements it will no longer be isolated.

French Wireless Licences

IN spite of prophecies to the contrary, the cost of the French listener's wireless licence will not be increased. The postal administration denies that an increase was ever contemplated, but a section of the French Press is of the opinion that a definite plan for increasing it to 100 francs was drawn up but that it has been quashed as the result of the outburst of indignation which followed the publication of the likelihood of an increase. The cost of a wireless licence is now 50 francs.

Free "Radio Times" for Lithuanian Listeners

THE National Broadcasting Corporation of Lithuania has just been granted permission by the Government department which controls wireless matters to publish a weekly magazine. This journal will contain both foreign and home programmes, and, in addition, will publish general news appertaining to broadcasting throughout the world, and also several pages devoted to technical matters. The most interesting point about this magazine, however, is that, instead of having to pay for it as in the case of the B.B.C. journals, every listener will be entitled to receive it free of charge. There are 40,000 licence-holders in Lithuania.

Wireless Stamps

SPECIAL postage stamps are to be issued in Egypt to commemorate the opening of the Telecommunications Conference on February 1st. One of the new stamps will bear the effigy of Marconi. It has also been suggested that the issue of a special series of stamps should be made in Austria to commemorate the opening of the new broadcasting headquarters next month.

Have You Heard It?

LAST Tuesday (October 12th) the RCA opened a new short-wave station in Guatemala City. The station has a power of 10 kW and will broadcast on four different frequencies, although a regular schedule for their use is not at the moment available. These frequencies are 9,685 kc/s, 11,760 kc/s, 15,170 kc/s and 17,800 kc/s. The station opened at 7 p.m. local time, which corresponds to 1 a.m. (G.M.T.). Those who chanced to hear the opening ceremony are invited to send in a report to RCA Photophone, Ltd., Electra House, Victoria Embankment, W.C.2.

Wireless and War

DURING the bombing of Nanking, the 75 kW station of the Central Committee of the Kuomintang was completely destroyed. Several stations of smaller power in Shanghai suffered a similar fate, thus illustrating the great necessity for special protection for wireless stations.

The True Circuit Diagram

EFFECT ON RECEIVER PERFORMANCE

By W. T. COCKING

BOTH experimenter and designer are often surprised by the failure of some piece of apparatus to function in the expected manner, even when tests show all components and connections to be in thoroughly good condition. The reason for the failure is not always easy to find, but it is often due to the true circuit being rather different from what one fondly imagines it to be. Normally, the circuit diagram shows in symbolic form the components and their connections. The symbol used for a component, however, shows only its main attribute; a tuning coil, for instance, is depicted as an inductance in spite of the fact that it also possesses resistance and capacity.

If all these different subsidiary attributes of a component are included in the diagram, it is often possible to see why the operation is affected, and it is often advisable to draw such a diagram when trying out some new idea. The greater insight into the real conditions pertaining to the circuit may make all the difference between success and failure.

A good example of the unexpected effects which can be brought out by such a diagram is afforded by the negative feed-back detector described in *The Wireless World* for January 1st, 1937. The conventional circuit diagram is shown in Fig. 1; the circuit is that of an anode-bend detector with the load resistance in the cathode circuit. This resistance R2 is by-passed by C2 to radio-frequency currents only, with the result that there is heavy negative feed-back at audio frequencies and the detector becomes extremely linear and capable of handling a large input. Because there is no intentional load impedance in the anode circuit, Miller effect should be absent, and the arrangement has actually been called the infinite input impedance detector.

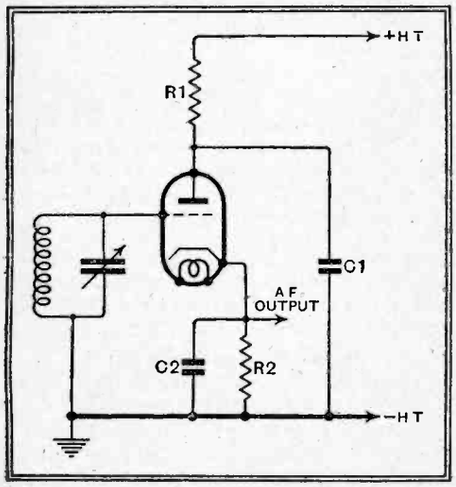


Fig. 1.—The conventional diagram of the negative feed-back detector.

In some experiments carried out by the writer the good points enumerated above were observed, but it was found that so far from the input impedance being infinite it had a *negative* input resistance. In one case the resistance was actually low enough for oscillation to occur! It was obvious that here was a case of a circuit behaving in an unexpected manner.

Now one important factor ignored in the circuit of Fig. 1 is the interelectrode capacities of the valve. Let us redraw the circuit as in Fig. 2(a) to show these. At first glance there is still nothing to cause oscillation, but if we rearrange the circuit as in Fig. 2(b) we can see at once that it is really a form of Colpitt's oscillator! It should be noted that (a) and (b) of Fig. 2 are identical circuit diagrams, but the arrangement of (a) is the conventional one for a detector and that of (b) for an oscillator.

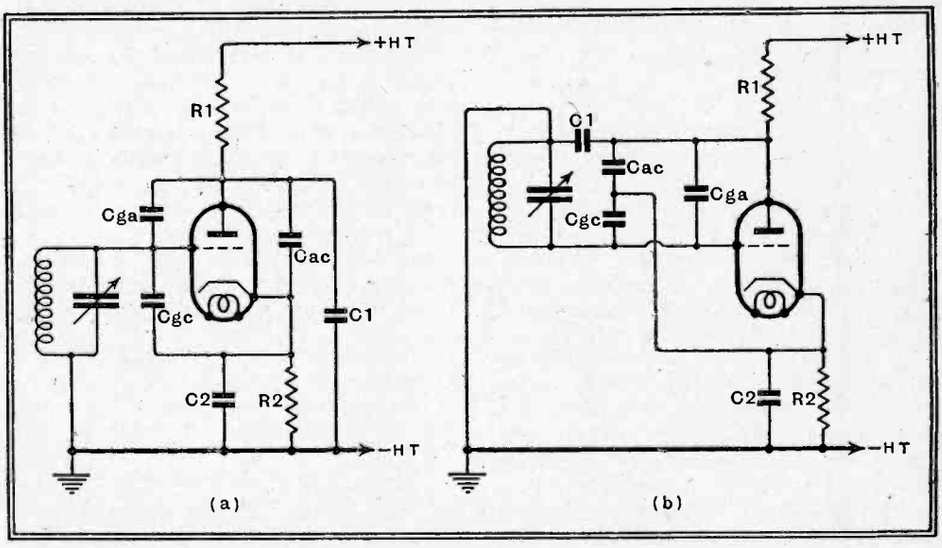


Fig. 2.—The actual circuit diagram of the detector, including the valve capacities, is shown here; at (a) it is drawn in the usual way, and at (b) it is rearranged so that its likeness to an oscillator is clear.

The capacity of C1 is normally so large that we can regard it as a short-circuit to RF currents. When this is so, the anode-grid capacity Cga is virtually in shunt with the tuning condenser, but causes no harmful effect. The anode-cathode capacity and C2 are also virtually in parallel, and the capacity so formed is in series with the grid-cathode capacity across the tuned circuit. The circuit is thus that of a Colpitt's oscillator and will inevitably have a negative input resistance; whether or not it actually oscillates depends upon the coil efficiency and upon the relative values of Cgc and Cac + C2. The smaller the value of Cgc and the larger the value of Cac + C2, the less likely is oscillation to occur; Cac + C2, however, by-passes the AF load resistance R2 and cannot be made very large without reducing the response at the upper modulation frequencies.

We must, therefore, face the fact that with this detector some degree of reaction is inherent. Actually, with normal values of components oscillation is very unlikely on the medium and long wavebands when the detector is used alone. If it is preceded by a high gain amplifier, however, it is quite likely that the reaction effect will be sufficient to promote instability.

The use of a variable condenser for C2 would in theory enable the reaction effects to be controlled. The writer has not tried this, and it is doubtful whether it would prove satisfactory as a reaction system except on short waves.

When it is desired to minimise the effect, it is important to choose a valve with as small a grid-cathode capacity as possible and to adopt the largest value for C2 which is tolerable from other points of view. The resistance R2 is normally about 50,000 ohms in value and C2 should not then exceed some 0.0003 μF. The condenser C1 and a resistance R1 are merely decoupling components and must give effective decoupling at audio frequencies. The resistance, however, forms part of the DC load on the detector and must be low in value if distortion on deep modulation is to be avoided.

Neglecting the shunting effect of the grid leak of the following valve on R2, the AC load resistance is R2 and the DC load resistance is R1 + R2. With R2 = 50,000 ohms, R1 should not be greater than 10,000 ohms and preferably less. For good decoupling, C1 must then be of 8 μF capacity or even more.

UNBIASED

By FREE GRID

Snowed under with replies.

How It Is Done

I MUST confess when I published my query the other week (17.9.37) concerning the manner of working of the various radio robots at our seaside resorts, I never realised that there would be so many people thirsting to take away my ignorance. I have been literally snowed under with replies and I greatly regret that it is quite impossible to find space for them on this page, and I am, therefore, giving a brief résumé of their contents.

Many of you will recollect the radio robot on one of the stands of Radiolympia two or three years ago. It would, on demand, give full constructional details of your domestic life, including the name of your favourite flower. Similar stunts have appeared in many of our seaside resorts, and the average member of the public who does not read *The Wireless World* is gullible enough to believe that it is done by "invisible rays." Even many *Wireless World* readers believed that there was an ultra-short wave link somewhere. Apparently, however, the whole stunt is far cruder than that.

Although the explanations sent to me differ in detail, the majority of them agree on the salient points. It appears that in most cases there is a confederate concealed inside the robot or, more often, in an adjacent structure built of perforated metal and looking like an enormous meat safe. Usually this is marked "Danger. High Voltage."

When the man moving about among the audience takes a coin or any other article from somebody and asks the robot for the date or colour of it, as the case may be, he merely words his question in such a manner as to give a cue to the man or girl inside the meat safe concerning the correct answer to give, a prearranged code being, of course, used. To a certain extent the confederate in the box relies on his power of observation as he can, of course, get a very good view of what is going on by peering through the perforated metal. The reply comes from the robot via a simple PA installation inside it, the hidden confederate speaking into a microphone inside the meat safe.

Two of my correspondents make the base suggestion that if pepper or a stink bomb is let loose just outside the perforations of the high-voltage cabin, it leads to the use of unparliamentary language by the robot; another one makes the same "suggestion," but, for some reason or other, forbids me to say anything about it.

Some readers insist that there is no confederate inside the robot and that it is all done by a very clever form of ventriloquism, but, although I am quite prepared to be corrected, I think that they are labouring under the impression that a ventriloquist can actually throw his voice to a distant part of the room and is not merely a good psychologist; in fact, one correspondent insists that a ventriloquist standing among the audience could actually throw his voice inside the robot so that it came just in front of the microphone therein, and so passed through the PA system in a normal manner! If there really is a man with a skip-distance voice of this kind, I should very much like to meet him.

The only other variation of these suggestions is to the effect that a previously made gramophone record, used inside the robot, also plays a part in the general procedure. Two readers, by the way, tell me that the "confederate" explanation is official as they have it straight from the horse's mouth.

A Delicate Question

I HAVE frequently censured set manufacturers for their lackadaisical attitude towards the question of remote control as a result of which I am compelled to keep jumping up from my seat like a jack-in-the-box to change the programme. At the same time I have always been careful to point out that it is no use attempting to solve the problem by means of the so-called fireside set which is tunable from an armchair, as I strongly dislike having the loud speaker bellowing right in my ear all the time.

Now when voicing these protests I naturally meant them as a gentle hint to manufacturers to provide a proper remote control system in which the receiver at the other end of the rom was operated by a simple tuning unit on the arm of the chair. Although, as I have always said, I thoroughly dislike having the loud speaker shouting close up to me all the time, I do at least like to hear something of it, notwithstanding the appalling nature of the B.B.C. programmes. I am truly aghast, therefore, at the solution of the problem which has been provided by certain set makers.

I am moved to this somewhat forcible expression of opinion as I have just been contemplating some of the new "armchair" sets which have appeared this year. It is quite obvious, of course, that this sort of receiver is not intended for the likes of you and me with our comparatively humble manner of life. As no doubt you will have noticed, the loud speaker of these sets faces away from the occupier of the chair who would thus hear little or nothing, of the programme. I can only think, therefore, that these receivers have been designed for plutocratic people of the old-family-butler type who can afford the luxury of a lofty and supercilious semi-automaton kind of footman to sit in the chair and do the tuning while the set's owner sits on the other side of the hearth and listens to it while enjoying his champagne and Woodbine.

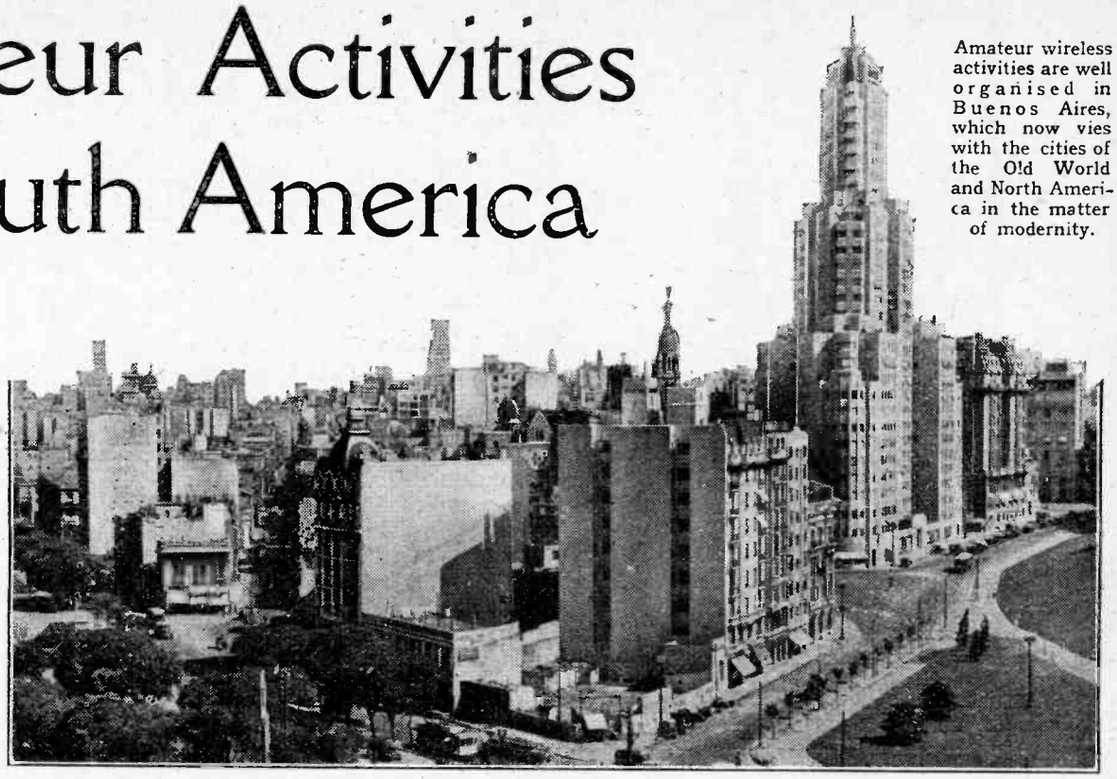
I must say, however, that I am very captivated by this type of receiver which, in other respects, is a first-class design, and I am wondering if, by dint of extreme economy in living, I can manage to save enough to pay the weekly salary—wages would be far too vulgar an expression—of one of these attendant menials. The truth is I don't even know what sort of salary I ought to offer them and am fearful of wounding their sensitive natures as

Lofty and supercilious footman.

I recollect once doing when I pressed a bent threepenny bit into the hand of the head waiter of Manchester's most luxurious hotel. Perhaps some of you fellows who are accustomed to living in the purple can drop me a delicate hint on the subject. It is, I suppose, too much to hope that the manufacturers of these luxury sets supply a specially-trained hireling varlet with it as part of the price.

Amateur Activities in South America

A Visit to the Radio Club del Argentina



Amateur wireless activities are well organised in Buenos Aires, which now vies with the cities of the Old World and North America in the matter of modernity.

DURING a recent visit to Buenos Aires the writer was fortunate enough to be able to pay a visit to the Radio Club of Argentina, and see first-hand how amateur radio is faring in the Argentine and also to make personal contact with some of the club's members.

Calling at the headquarters of the club one evening I found a round dozen or so of the members present and the club's transmitter in operation on 28 Mc/s, using the call sign LU9AA. The gear was being operated by Señor Guerrini (LU9AX), who has the honour to be this year's president of the club.

An active transmitting amateur from England is somewhat of a rare visitor in the Argentine, and as soon as I made myself known I was greeted with that enthusiastic welcome so peculiar to amateur radio.

A Well-equipped Club

The Radio Club del Argentina is fortunate in having a very fine suite of rooms situated on the first floor of a big building in the "West End" of Buenos Aires. One enters by an attractive flight of stairs which brings one up to the entrance hall, cloak-room, information bureau and office. In the entrance hall are several interesting exhibits—the first set to receive signals from the Falkland Isles way back in the nineteen-twenties; a collection of valves; the club's silver trophies, and several pictures and photos of past presidents and other members of the club who have distinguished themselves in various ways.

At my request to see the transmitter I was seized by both arms and conducted into the transmitter room when I was shown with great and justifiable pride on the part of my hosts the transmitter, receiver and associated equipment. The club boasts a very fine commercially built transmitter having a final input to the output value of 500 watts on 'phone or CW. The receiver is a commercially built superhet, tuning down to below 28 Mc/s. The station works chiefly on 28 Mc/s 'phone, and whilst I was there a very pleasant QSO was had with another amateur station in the interior of the country.

The club caters for all aspects of amateur radio. Adjoining the transmitter room is a well-equipped laboratory where facilities are available for building and testing out new gear. Many of the members are at the moment suffering from their first attack of the 56-Mc/s fever, and I saw several 5-metre receivers and transmitters in course of construction. The laboratory includes a very good "junk" store where members can buy, sell and exchange surplus gear.

A special room is set aside for beginners where Morse classes and lectures are held. There is also a lounge, a reading-room and library, while a bathroom contributes materially to the comfort of members after a spell in the workshop.

Congested Wavebands

The club has several hundred members scattered throughout the Argentine, and those in office are very diligent in looking after their interests. It was interesting to learn that the problem which is worrying them most at the moment is the same problem with which the amateur in this country is concerned, namely, the congestion of the amateur bands caused by indiscriminate use of 'phone.

The amateur in the Argentine is licensed for 160, 80, 40, 20, 10 and 5 metres, and, as at home here, can use CW or 'phone as he likes anywhere in these bands. He may use powers up to 100 watts, but the authorities are somewhat tolerant and inputs up to 500 watts are more the rule than exception. Consequently, the interference between stations at times is terrific, so much so that the 40-metre band is useless for any DX or serious experimental work.

Señor Guerrini is in course of getting out a scheme for dividing the bands into 'phone and CW channels along the lines adopted by the American Radio Relay League. It is hoped that the Department of Posts and Telegraphs will approve this scheme and see that it is enforced.

Members whose chief interest is in receiving are also cared for, the club possessing an excellent superheterodyne receiver, and receiving contests are held from time to time. A lot of interest is taken in the short-wave broadcasts from Europe, and Daventry is a popular station. Now that the B.B.C. have a programme directed to that part of the world reception is very good. The Coronation broadcast was well received and listened to with great interest in Buenos Aires.

Germany, Italy and Russia are also received well; the stations in order of their signal strength being first Zeesen, then Daventry, followed by Moscow and Rome. One has to be careful, however, as to which station one listens, as if the police hear a programme containing too much Fascist or Communist propaganda emanating from the loud speaker one is liable to be accused of being an adherent of one or other of these organisations, and that usually means a change of abode to the local prison!

In conclusion, I wish to express my thanks to the members of the club for their hospitality and the very interesting evening they gave me during my visit to their headquarters.

A. C. G.

Large-Screen Television

RECENT CATHODE-RAY DEVELOPMENTS

CRITICISM of television reproduction is now directed mainly against the relative smallness of the received images. This article discusses methods whereby the limitations of picture size set by ordinary "direct" methods of reproduction may be overcome.

THE cathode-ray television receiver is now firmly established and has proved itself capable of handling high-definition pictures. There are other rival systems, still more or less in the development stage, but it is still impossible to say whether the future will produce anything superior, either in speed or flexibility, to the electron stream.

Cathode-ray reproduction has already reached the stage where it compares very favourably with the standard set by the home "movie" projector, so far as clearness in detail and absence of flicker are concerned. But as regards size, the picture is still distinctly on the small side, as judged by the popular idea of what can reasonably be viewed by several people at the same time.

This drawback has not been ignored by those responsible for the development of the cathode-ray tube, and it is proposed to describe some of the lines along which a remedy has been sought.

The fluorescent screen presents the main difficulty. In the first place, the size of the screen sets a limit to the size of the picture which can be traced out by the scanning stream; and in the second place, the fluorescent light it produces is normally so low in intensity that it will not allow of any worthwhile magnification by optical means. Nor is it practicable to construct a CR tube of much larger dimensions than those already in use. The quest for a larger picture therefore appears, at first sight, to lead us round a vicious circle.

One possible way out is to replace the fluorescent screen by one made of very thin metal, on which the picture is reproduced, by the bombardment of the electron stream, in varying degrees of incandescence instead of in fluorescent light.

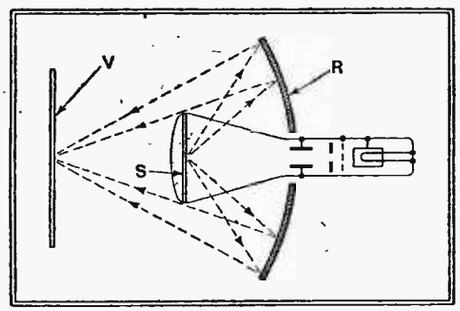


Fig. 1. A projection system which makes use of the brighter face of the fluorescent screen.

Usually the metal screen is pre-heated by an independent current to a temperature just below that at which it gets red hot. The scanning stream from the gun of the cathode-ray tube then does the rest, throwing up the outlines of the picture in shades which vary from red to white heat.

This method of attack has led to the production of small "projection" tubes fitted with metal screens, roughly 2 by 1½ inches in size. The picture so produced is sufficiently brilliant to stand up to very considerable amplification by ordinary lenses. Enlarged to 24 inches by 18, for instance, the picture shows detail equal in every way to that given by a 16 mm. home "movie." It is possible to project much larger pictures, up to 12ft. by 9ft., by further magnification, though at a reduced level of illumination. Provided they are shown in a perfectly darkened room, the definition is, however, still remarkably good.

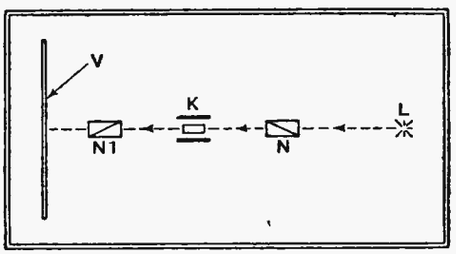


Fig. 2. Illustrating the action of a light valve.

The development of midget CR tubes capable of producing pictures sufficiently bright to stand up to a reasonable amount of optical amplification opens up the prospect of marketing cheaper television sets. For really large-sized pictures it is necessary to use something of the order of 25,000 volts on the anode. But if one were content with a picture equal to the present standard size of 12in. by 9in., the smaller size of tube would represent a considerable all-round saving in initial cost.

There is some room for improvement in making the best use of the light available, even in the case of the ordinary cathode-ray receiver fitted with the usual fluorescent screen. According to present practice we view the picture not from the side of the screen which receives the first impact of the electron stream, but from the opposite side, i.e., the one which faces the bulb end of the tube. In other words, a certain amount of fluorescent light is wasted in passing through the thickness of the screen before it reaches the eye of the observer.

Fig. 1 shows, by contrast, an arrangement in which a reflector R is placed around the back of the bulb so that it collects the light given off from the "brighter" side of the fluorescent screen S, and focuses it directly on to a viewing screen V mounted outside the tube.

A more promising line of attack is to project the picture outside the tube, in the first place, instead of inside it, so as to avoid being handicapped by the dimensions of the tube. In this case the fluorescent screen is replaced by a sensitive electrode which is arranged to act as a "light valve" under the control of the scanning stream of electrons. It is essential, of course, to retain the electron stream for scanning purposes, otherwise the outstanding merit of the cathode-ray tube is lost. But instead of using the stream to create a fluorescent picture inside the tube, it is applied to control the passage of light from a lamp through the tube on to a viewing screen which is located outside the tube.

The principle is illustrated in Fig 2, which shows how an ordinary Kerr cell is used as a light valve. A ray from a lamp L passes first through a Nicol N, next through the Kerr cell K and then through a "reversed" Nicol N1. The intensity of the light which finally reaches the viewing screen V is actually determined by the intensity of the signal voltage applied to the Kerr cell. This rotates the plane of polarisation of the cell, and so in effect "opens" it to allow more or less of the light to pass through.

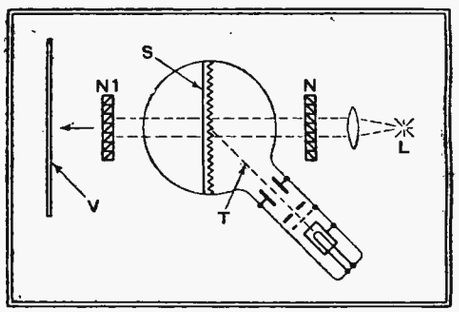


Fig. 3. The principle illustrated in Fig. 2 applied to the projection of television images.

Fig. 3 shows this method of control applied to a cathode-ray receiver in which the picture is projected outside the tube. At the same time the advantage is retained of using the electron stream as a means of scanning.

The place of the fluorescent screen is taken by an electrode S which is built up of a "mosaic" of small quartz crystals. Each crystal acts as an independent "Kerr cell" under the control of the

Large-Screen Television—

electric fields applied by the scanning stream from the cathode of the tube. On one side of the tube is a powerful lamp L flanked by a "bank" of Nicols N. On the opposite side is the external viewing screen V, similarly flanked by a bank of "reversed" Nicols N1. Between them, and inside the tube, is the mosaic screen of light-cells. As the scanning stream T passes over the screen, each cell in turn "opens up" and allows a corresponding ray of light from the lamp L to reach the screen V. In this way the picture is kept free of the usual limitations imposed by the use of a fluorescent screen.

The same effect can be secured by using a light-control screen in which each of the small cells contains a colloidal solution of doubly refracting crystals in cellulose

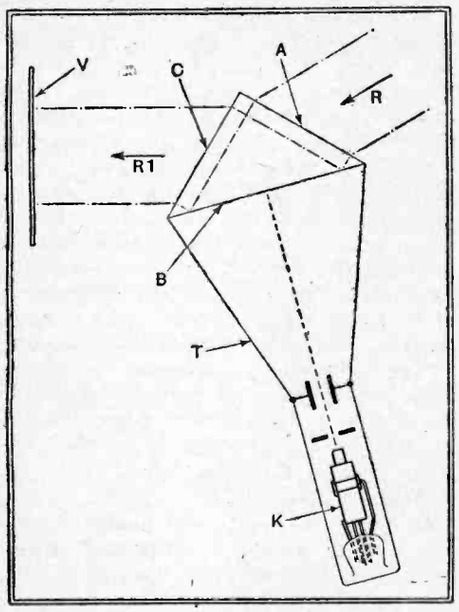


Fig. 4. A system which uses the critical angle of internal reflection.

nitrate. Normally the crystals do not set themselves in any definite formation, but are kept in constant movement by the well-known Brownian forces. In this condition they are opaque to a polarised ray of light.

But under the action of the scanning stream of electrons, the crystals tend to orientate themselves along definite lines, corresponding to the electric lines of force. This makes each cell become more or less transparent, according to the intensity of the scanning stream, and since the latter is, in turn, controlled by the incoming signals, corresponding light-and-shade effects appear, as before, on the external viewing screen.

Fig. 4 shows what appears to be a much simpler method of obtaining the same result. It is based upon the discovery that the impact of a stream of electrons upon the face of a prism will, under certain conditions, vary the degree to which a ray of light is reflected from that face.

When a ray of light, such as R, strikes against the face A of a prism, it is well known that there is a certain angle at which the light reaching the face B will be internally reflected, so that instead of passing through the face B it is turned back on to the face C, and so passes out in the direction of the arrow R1. This so-called "total internal reflection" from the face B only occurs at a definite angle of incidence. For any other angle, some of the light will pass clean through the face B and is therefore lost so far as the reflected ray R1 is concerned.

As applied to the reception of pictures, the usual fluorescent screen is replaced by a prism of glass fitted, as shown, at the "bulb" end of the tube T. The ray of light from a lamp is first carefully adjusted so that it strikes the face B of the prism at the "critical angle" at which it is completely reflected back towards the face C and so on to the external viewing screen V.

The impact of the scanning stream of electrons from the cathode K against the inner face B of the prism then alters the "critical" reflecting angle of that face, so that instead of all the light being reflected back towards the face C, some of it passes clean through the face B, and so is diverted from the viewing screen.

The amount of light so lost depends upon the intensity of the electron stream, or, in other words, upon the strength of the received signals. For maximum signal strength, the ray passes completely through the particular spot on the face B, against which the scanning stream strikes. Since none of it can then reach the viewing screen, the latter will show a "black" spot on the corresponding point of its surface. Similarly, other points on the screen will show varying illumination, according to the value of the incoming signals, and so again a complete picture is built up outside the tube.

In the explanation given, it will be noted that maximum signal strength produces a "black" spot instead of a white spot, on the viewing screen, so that the resulting image is a "negative" of the original picture. In practice, this can readily be converted into a "positive" by reversing the usual phase of the signals applied to the control grid of the CR tube.

Universal Heater Current Supply

By D. P. TAYLOR

AT some time or other most experimenters have been brought to a standstill in their experiments by not having available a supply of alternating current for the heaters of one or more valves. For instance, it may be desired to use an additional valve of different voltage to that available from the power transformer, or in the case of a mains rectifying valve the potential of the heater makes a separate winding necessary. These troubles can be overcome by the construction of a simple tapped transformer which is used to step the available supply up or down as required.

A transformer to satisfy these requirements may easily be built up on the core and bobbin of an old mains transformer or even on those of a large smoothing choke. The data that follows relates to a core having a cross-sectional area of about 1½ square inches.

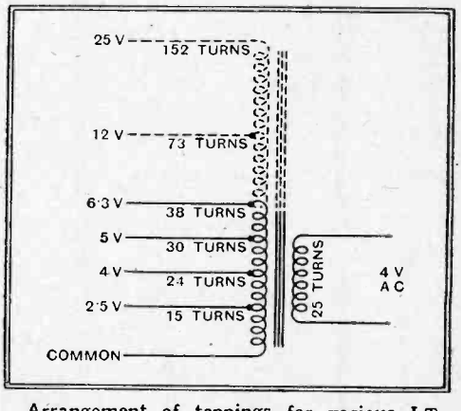
As shown in the accompanying diagram the transformer has two windings, one of these being plain and the other tapped. Both coils are wound with 16 SWG, the primary having 25 turns and the secondary 38 turns tapped at 15, 24 and 30 turns. Care should be taken in the construction of this transformer to ensure low-resistance joints where the taps are made, and several layers of empire cloth should be introduced between the two windings.

If the untapped winding is connected across a 4.0-volt supply from a power transformer, voltages of 2.5, 4.0, 5.0 and 6.3 are available from the tapped winding. The 4.0-volt tap on the output side is to enable the transformer to be used as an insulating transformer when one or more valves are to be operated with their heaters at a different potential than the remainder with respect to earth.

These voltages cover most British and American valves, and, in addition, the non-standard voltages of 1.0, 1.3, 1.5, 2.3 and 3.8, which can be obtained between tappings may prove useful for experimental purposes.

Some readers may care to extend the voltage range of the transformer to cover the 12.0- and 25.0-volt ranges, in which case the additional winding may consist of 114 turns tapped at 35 turns.

This transformer is not limited to use with an input voltage of 4.0; it can be supplied with the correct voltage at any



Arrangement of tappings for various LT voltages. The extra turns shown in dotted lines will seldom be required.

tap in which case 4.0 volts AC will be available from the untapped winding.

The output from the transformer is limited to about 3.0 amperes from all taps. This is usually sufficient for up to two or three additional valves, but there is no reason why a larger model using heavier-gauge wire should not be made up to give a larger output if so desired.

BROADCAST BREVITIES

NEWS FROM PORTLAND PLACE

Is the B.B.C. Poor ?

ONCE more the B.B.C. has dodged the issue in the matter of pre-breakfast broadcasting of physical jerks—this time without any allusions to the probable danger to the lives of hypothetical apoplectic retired colonels. Putting it bluntly, the Corporation pleads poverty.

When we recover from our stupefaction and investigate matters, it looks as if there may be something behind this plea.

Financial Commitments

A glance at the B.B.C.'s commitments for the next two years shows that it will be involved in capital expenditure to the order of a million and a half pounds. Here's how.

Purchase of the site adjoining Broadcasting House, minus buildings, involves £50,000. If the new extension costs as much as Broadcasting House itself, another half million must be spent before the work is completed. Before the end of 1939 at least two provincial television stations will probably be erected, accounting for something like £300,000, and the new station at Start Point will work out at about £140,000. Other major expenses are concerned with the equipment and furnishing of the headquarters' extension and the provision of regional offices and studios at Aberdeen, Swansea and Glasgow, amounting in all to nearly £300,000.

Got a Stamp ?

Thus, the B.B.C. cannot afford physical jerks. If, however, every licensed listener contributed a halfpenny stamp the £16,666 accruing would buy a gymnasium. Has anyone got a stamp?

Relays as Quality Check

SOPHISTICATED listeners are apt to sneer at the B.B.C. relays from foreign stations. Actually these can provide a useful "yard-stick" for reception quality.

Sometimes the private listener, picking up a distant station direct, gets a better signal than that provided by the elaborate land-line system, but not often. Usually the boot is on the other foot, and in any case a comparison between the direct and the relayed signal gives an excellent check on fading and atmospheric distortion.

Special Programmes from Abroad

More and more foreign relays are being arranged for the next few months. During the autumn light orchestral music is to be relayed between 5 and 6 p.m. on Mondays, Tuesdays or Fridays from Holland, France, Denmark, Belgium, Czecho-Slovakia, Austria and Hungary.

Motala will shortly transmit an all-English programme which will be relayed by British stations. It will be interesting to compare the sound quality on Motala's long wave with that coming over the landline direct from the station amplifiers. In fact, frequency readings on two-channel transmissions of this kind should make good material for experiments at club meetings.

Music Critics and Radio

NOW that the "Proms" are over for another year it is worth asking why the music critics invariably wrote their criticisms after listening to the concerts in the Queen's Hall and not on radio sets. This despite the fact that by far the larger audience was never within fifty miles of Langham Place. Criticism, to be useful, should be written from the standpoint of the ordinary listener.

Most of the music critics, by the way, sit in the centre back seats of the Grand Circle. Does this, or does it not, remind one of that French prelate who praised an all-wise Providence for causing the great and refreshing rivers of La Belle France to flow through all the principal towns?

Off to Berlin

H. L. FLETCHER, chief of the B.B.C.'s Mobile Recording Unit, is just off to Berlin with his colleague, R. Dimbleby, to study broadcast recording over there. They will be the guests of the Reichs Rundfunk organisation, which has reduced programme recording to a fine art and placed Germany in the forefront in this sphere.

Recording in the Streets

As ether searchers know, the German stations make extensive use of records, especially for actuality programmes and news bulletins. Almost every day the recording vans roam the Berlin streets picking up interesting trifles which are welded into an artistic whole for transmission in *pot-pourri* form in the evenings.

BERLIN'S DAILY ECHO. The German wandering microphone interviews an important visitor to the city. As a result of Mr. Fletchers' visit mentioned on this page we too may have broadcast recorded echoes of the day's happenings.

Items include interviews with "men-in-the-street" as well as celebrities, fire engine turnouts, accidents, trips through the markets and the general commotion and bustle of the streets.

Editing Records

Mr. Fletcher may learn much from his German hosts, but it is more than likely that he will have something to teach them, especially if he goes into details of his new editing unit which, by an ingenious combination of turntables and movable pick-ups, enables him to select from or combine the outputs of half a dozen discs. Basically, the principle is that of the dramatic control panel.

Scotching Mistakes

The device also makes it possible to smooth out mistakes and delete unnecessary passages while providing a continuous sound record. This proved invaluable recently when a certain public ceremony was recorded for re-broadcasting. The principal actor fumbled badly in the opening sentences of a speech, but corrected himself without repeating the first sentence. Mr. Fletcher transferred the speech from the original record to another, which was stopped during the offending passage and restarted when the correct sentence was reached. The ultimate play-back gave a speech which flowed as smoothly as oil from a spout.

Howling Un-Success

EVERYONE was sorry for Martin Taubman twelve months ago when he brought his "Electronde" to Alexandra Palace for a recital before the television cameras. As *Wireless World* readers are aware, the Electronde produces musical notes by hand-capacity effects on a valve oscillator; but, unfortunately, it is also susceptible to other effects, as was plainly apparent when Mr. Taubman brought the instrument within the wipe-out area of the television transmitter. The Electronde just howled, until a genius suggested recording a performance on the Baird intermediate film system while the transmitter was out of action.

This was done, and when the Electronde went on the air no one could have known that the recital was several hours old.

Three Days' Hard

But Mr. Taubman was far from satisfied. Last week he invited the inventor, M. Theremin, to accompany him to Alexandra Palace, and the two spent three days next door to the control room experimenting with the Electronde. At the end of the third day the B.B.C. engineers pronounced the instrument sufficiently radiation proof to be played in No. 1 studio, so the Electronde will be in the television programmes again on Thursday next.

Television and Denham

SINCE the two failures at Hatfield and King George V Dock, the mobile television unit has regained prestige by its work at Pinewood, 17 miles from the transmitting station, and Crystal Palace, 12 miles away. Everybody hopes and believes that the Denham transmissions, which begin to-day (Friday) will crown these other efforts. The distance is approximately 16 miles but, owing to different geographical contours and some local interference, the initial tests were less successful than the Pinewood transmissions.

At the eleventh hour, as often happens in television, the programme arrangements have been revised. On Saturday evening the transmission will show Zoltan Korda directing a Technicolour film, *The Drum*.

Technicolour will involve "stopping down" the television camera, as over twice the normal studio lighting is used.

Intermodulation

ANOTHER NEGLECTED TYPE OF DISTORTION

By "CATHODE RAY"

FROM time to time I have brought out for inspection certain aspects of distortion that are quite often overlooked when that subject is being argued. Here is another.

I suppose the most commonly considered sort is *frequency distortion*. A dozen years ago, in the Stone Age of Radio, at least one manufacturer was publishing diagrams showing how "flat" over practically the whole audible frequency scale was the amplification obtainable with his wares. And to this day it is customary to be given and to expect just this amount of information about amplifiers, transformers, gramophone pick-ups, and loud speakers. Probably a large proportion of those people who know anything about the technical side of distortion at all think of it exclusively in terms of "peaks" and "cuts" in the frequency scale. Yet this sort of distortion, even when quite appalling on paper, is generally not the worst.

Harmonic distortion has now received so much publicity in technical circles that it must be well known, though actual data on it still seem to be comparatively scarce. At least it ought by now to be familiar that when an amplifier or other appliance is pressed beyond the limits of power that it can comfortably handle the result is the production of spurious tones having 2, 3, 4, etc., times the frequency of the original. The non-technical listener complains that the reproduction is shrill (because of these relatively high-pitched tones that have found their way in).

Other Kinds of Distortion

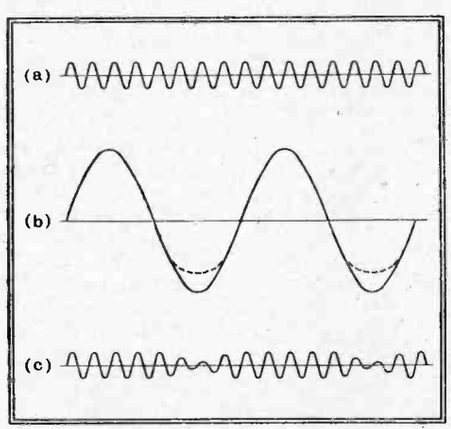
There has been so much discussion in *The Wireless World* correspondence columns on distortion of transients that it may be better known than it once was that there is such a thing as *phase distortion;* though as nobody seems to be able to settle very conclusively how bad it is, or even whether it is noticeably bad at all under ordinary conditions, we shall set it aside just now as not being of major importance.

Then still more recently I have referred to what I have called "*scale*" *distortion* —the distortion that takes place whenever a programme is reproduced at a different level from the original—and have ventured the opinion that this is more serious than the attention it gets (generally none at all) would imply.

All of these distortions are studied and measured on the basis of a single "signal." Now that is done simply because it is easier: not because it bears any close relation to real life, for it doesn't. If all electrically-reproduced programmes consisted of unaccompanied flute solos (dreadful thought!), then our knowledge of distortion would be fairly applicable.

But there is very little similarity between any actual programme (with the exception of the much-criticised tuning note) and the conditions under which amplifiers and things are tested for distortion; and it is surprising that these tests are accepted as adequate. The least that one can do as an approach to working conditions is to test with *two* signals simultaneously. That represents slightly more ambitious programmes than the single signal; for example, organ recitals played with one finger of each hand.

Even such a modest advance in technique enables one to study a form of distortion not listed above. One of the greatest wonders of sound reproduction to those listeners who are thoughtful enough to retain any real sense of wonder is the ability to record the multitudinous sounds of a 100-piece orchestra on a single groove around a disc, or transmit it along a single wire, without the different tones getting jumbled up. If a number of different pigments are shaken up together the result is not a picture in which each colour stands out distinctly; it is a homogeneous mess. But in the output from a perfect amplifier the notes of flute and 'cello have not combined to form something that is neither; the listener can hear and recognise both.



Showing how a weak treble note may be periodically distorted by an over-strong bass note which is being amplified simultaneously.

A perfect amplifier. Of course there is no such thing. In any real amplifier (or microphone, or pick-up or etc.) there *is* a certain amount of damage inflicted on one another by two or more notes passed through simultaneously.

Selecting one possible culprit out of many, consider an amplifying valve. Anybody knows that to avoid distortion it must be worked at such anode and grid voltages as correspond to straight parts of its characteristic "curves." The word "straight" ought really to be in inverted commas, for the curves practically never are *perfectly* straight). Even the best of them become more or less severely bent towards the ends. That means that the amplification of the valve alters considerably. For instance, if the signal is acting at one moment in such a way as to reduce the anode current, the reduction is fairly proportional to the signal voltage for a while; but, if the signal is so strong as to reduce the anode current to nil, at that moment there is no amplification left in the valve at all. The signal is much too strong; it is overloading the valve. But now suppose that at the same time there is a quiet little tune being played up in the treble, and the valve is quite well able to handle this *on its own* without any fuss. At the instant when the powerful bass signal (one can hardly avoid using that silly word "signal," even to describe Beethoven's symphonies) is at its zero, the valve amplifies the treble tone in a perfectly normal manner. But when the bass tone reaches its negative maximum the amplification of the valve is more or less destroyed, and with it the gentle treble. The weak signal has the mark of the strong one brutally and permanently stamped on it.

Graphical Illustration

Perhaps the wave diagrams make this clearer. The piping treble, unaccompanied, is represented by (*a*). The brutal bass, if it could be amplified perfectly, would be shown by the full line (*b*), but we are assuming that the negative peaks are being clipped by "bottom-bending," as indicated by the dotted line. Incidentally, of course, this means harmonic distortion—chiefly second harmonic. During these negative peak periods the amplification of the valve is quenched, so the treble note comes out pinched every so often, as illustrated by (*c*).

If (*b*) is a *very* low note, for all its strength it may not be very audible owing to the insensitiveness of the ear to low notes. Assuming a small table model receiver, with its inadequate baffle area, it may be practically inaudible. But the penetrating tone of the treble stands out clearly, and so, unfortunately, does the mark of the unobtrusive beast or hidden hand.

Intermodulation—

What sort of distortion actually is this, so far as the ordinary listener is concerned? Readers who have worked through any elementary book on radio will have noticed a striking resemblance between all this and the chapter on Transmitters (or perhaps Modulation). (*a*) is the unmodulated high-frequency carrier wave, (*b*) is the "programme," and (*c*) the modulated carrier, radiated from the broadcasting station. The analogy is perfectly sound. The distortion is, in fact, known as *intermodulation*. Now the aforesaid elementary textbook probably goes on to explain that (*c*) is equivalent to (*a*) with the addition of extra frequencies—sidebands—equal to the frequency of (*a*) plus and minus the frequency of (*b*). That is precisely what happens in our music-amplifying valve. Suppose the bass frequency is 40 cycles per second and the treble is 480 c/s. Then the distortion of the former produces a harmonic of 80 c/s, but at least it harmonises with its 40-c/s fundamental, being an exact octave above it; and it also harmonises with the treble, which is a "dominant fifth" in relation to two octaves above the 80-c/s note. So up till now all is harmonious, even if it is not quite what the musician intended. But the effect of intermodulation is to produce tones of 480 ± 40 c/s (actually there is a whole brood of them, but these will serve as representatives). Notes of 440 and 520 c/s definitely do not harmonise with 480, being somewhere between a semitone and a tone flat and sharp respectively. So intermodulation is very likely to produce particularly unpleasant discords, as well as harmonic distortion.

We have been considering a simple case of two tones, one so much stronger than the other that the effect of the weak on the strong is negligible. But if there are a large number present simultaneously (as is usual), and they are of comparable strength (as is usual), so that B not only mutilates A, but A retaliates on B, the final result being dimly imagined. It can also be experienced by listening to any grossly overloaded receiver.

You may say: "I don't make a habit of running my receiver in that deplorable condition, but I do sometimes notice a sort of harshness, particularly when listening to organs and 'bassy' programmes generally."

Some of the conditions that conspire to produce this result have already been mentioned. They are: Enormous relative insensitiveness of the ear to very low notes, and inefficiency of many loud speakers when handling the same. As a result of these, the bass signal required to be heard at all, much more to be heard prominently, is larger than might be supposed, and may overload one or more parts of the equipment unawares. To increase this probability still further it happens that most of the equipment is particularly liable to be overloaded by low notes. Transformers—intervalve and output—that can turn out their designed wattage in the form of medium and high notes, often suffer from saturation of the core and other intermodulation-provoking ailments when handling considerably less power at very low frequencies. My experience has shown that tests for output are not always carried out (as they should be) at all frequencies down to the very lowest. Loud speaker coils, in order to reproduce the "plonk" of the double-bass and big drum, and the pedal note of the organ, are obliged to execute large movements each side of their positions of rest in the magnetic gap; and in other than exceptionally generously designed models they exceed the limits of reasonably uniform magnetic field, and so modulate all the rest of the programme. The same applies to gramophone pick-ups and microphones; even an *equal* signal is much more likely to cause distortion when its frequency is low; *a fortiori*, then, and so forth, is such distortion likely to occur in view of the other facts mentioned.

Theoretically, then, there are many reasons for expecting this particular type of distortion when the apparatus might appear to be working within its rated power. Practically anybody with even a moderately discriminating ear can tell that there is often something badly wrong with an alleged 3½-watt output stage when it is turning out no more than perhaps a watt. If even experienced radio engineers could hear what a *good* 3½ watts sounds like, many of them would get a shock. But that is verging on another subject.

News from the Clubs

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

Next Tuesday will be gramophone pick-up night. Members are asked to bring their pick-ups for comparative tests. On October 26th Mr. L. F. Marshall will talk on "Making Electrical Measurements."

Wirral Amateur Transmitting and Short-wave Club

Headquarters: Beechcroft Settlement, Whetstone Lane, Birkenhead.
Meetings: Second and last Wednesday evening in each month at 7.30 p.m.
Hon. Sec.: Mr. J. R. Williamson, 49, Neville Road, Bromborough, Birkenhead.

The club has decided to hold meetings twice a month during the winter season. At the last meeting a successful junk sale was held, when there was a record attendance.

Dollis Hill Radio Communication Society

Headquarters: Brainteroft Schools, Warren Road, London, N.W.2.
Meetings: Alternate Tuesdays at 8 p.m.
Hon. Sec.: Mr. J. R. Hodgkyns, 102, Crest Road, Cricklewood, N.W.2.

Recently, Dr. Lemon gave a demonstration of amplification and reproduction at his laboratory in Kensington. There were twenty-one members present.

Exeter and District Wireless Society

Headquarters: Y.W.C.A., 3, Dix's Field, Southernhay, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

It has been decided to built an amplifier giving an undistorted output of 10-15 watts, and this is to be obtained by the use of two MHL4 valves followed by a final stage of two PX25 valves in push-pull. This piece of apparatus will be ready for testing in November, and a set of frequency test records is being obtained. At the last meeting a lecture and demonstration was given by Mr. Cholot, of Lissen, Ltd. The lecturer dealt with short-wave apparatus.

Lincoln Short-wave Club

Headquarters: Technical College, Lincoln.
Meetings: Every Tuesday at 7.30 p.m.
Hon. Sec.: Mr. M. Babbs.

This Society was formed recently and has received its first lecture on SW communication. Intending members are asked to get into touch with the Hon. Secretary.

Edgware Short-wave Society

Headquarters: 40, Raeburn Road, Edgware.
Meetings: Sundays at 11 a.m. and Wednesdays at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

All those in the district who are interested in short-wave work or transmitting are requested to 'phone or write to the Hon. Secretary. His 'phone number is Edgware 4917.

Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Vision	Sound
45 Mc/s.	41.5 Mc/s.

FRIDAY, OCTOBER 15th.

3, Round the Film Studios. O.B. from Denham. **3.10,** Dish of the Month—October. Marcel Boulestin will show how to make Khebab. **3.25,** Gaumont-British News. **3.35,** Dancing Time.

9, O.B. from Denham. **9.10,** Dish of the Month. **9.25,** British Movietonews. **9.35,** Contrasts: a mixed programme.

SATURDAY, OCTOBER 16th.

3, O.B. from Denham. **3.15,** C. H. Middleton from the garden in Alexandra Park. **3.30,** British Movietonews. **3.40,** "Love in the Air": twenty minutes of music with Eric Wild and his Tea Timers and Vocalists.

9, O.B. from Denham. **9.10,** "A Fool and his Money"; a wayside comedy by Laurence Housman. **9.30,** Gaumont-British News. **9.40,** The Mizzen Cross-Trees: a revue of nautical songs.

MONDAY, OCTOBER 18th.

3, O.B. from Denham. **3.10,** "Pas Seul" ballet: Pearl Argyle of the Vic-Wells Company. **3.20,** British Movietonews **3.30,** From the West End cabarets.

9, From the West End cabarets. **9.30,** O.B. from Denham. **9.40,** A Pepler Masque of Keats' "The Eve of St. Agnes."

TUESDAY, OCTOBER 19th.

3, O.B. from Denham. **3.10,** Music Makers: Lisa Minghetti (violin). **3.20,** Gaumont-British News. **3.35,** "The Happy Journey to Trenton and Camden": a comedy by Thornton Wilder.

9, British Movietonews. **9.15,** Body-line No. 2. **9.30,** O.B. from Denham. **9.40,** Cabaret.

WEDNESDAY, OCTOBER 20th.

3, Musical item. **3.10,** Richard Hearne in a pantomime sketch: "The Barber's Shop." **3.20,** British Movietonews. **3.30,** Eighty-seventh edition of Picture Page.

9, Queue for Song. **9.25,** Gaumont-British News. **9.35,** Eighty-eighth edition of Picture Page.

THURSDAY, OCTOBER 21st.

3, Music from the Air: Martin Taubman playing his Electronde. **3.10,** Music Makers: Jeanne Dusseau (pianoforte). **3.20,** Gaumont-British News. **3.30,** Esmond Knight in "Night Must Fall": a play by Emlyn Williams.

9, Martin Taubman and his Electronde. **9.10,** Experiments in Science, No. 2: —The Hands of Chimpanzees. **9.20,** British Movietonews. **9.30,** "Night Must Fall."

On the Short Waves

MOST amateurs who operate transmitters in this country, and no doubt those elsewhere, are viewing with some trepidation the forthcoming World Telecommunications Conference at Cairo in 1938.

That a move will be made at this conference to reduce or entirely suppress some of the present amateur bands is without doubt, and it therefore appears that the transmitting amateur must shortly justify his right to a space in the ether or, as the story-books have it, forever hold his peace.

Neglecting the water which has already flowed under the bridge of time, there are basically two ways in which the amateur may serve the radio (and general) community, and these are:—

(1) By the study of propagation conditions on unexplored frequencies.

(2) By his ability to seize upon new ideas and inventions, and develop them.

To take, first, the study of propagation conditions, here it is obvious that little work remains to be done until we reach the region of the ultra-high frequencies, where the ground is still relatively uncharted; and, whilst we are now reasonably familiar with the world performance of a 28 Mc/s transmitter, much remains to be accomplished on 56 Mc/s and higher. It is perhaps too much to expect that long-distance communication will ever be possible on 56 Mc/s,* but we do know that these frequencies are not always quasi-optical in their characteristics. Any "looker-in" to Alexandra Palace on the South Coast will tell you that, but what is not so certain is the reason for the variations in the signal strength of an ultra-short wave transmitter at distances between 20 and 100 miles.

At times one finds a correlation with atmospheric humidity or with a temperature inversion at perhaps a thousand feet; on another occasion, however, the ionosphere itself seems to enter into the picture.

On that very disturbed day, Friday, October 1st, my 28 Mc/s signals were fading rapidly at a point a mere 10 miles away.

Incidentally, there was a very bad Dellinger fade-out between 16.05-16.22 G.M.T. on September 30th, which extended in its effect right down to the ultra-short waves, but, most remarkably, at the same time produced abnormally strong signals (approx. 1,000 microvolts per metre) from DJB Zeesen on 15.21 Mc/s. This is the first time one has been able to record the "D" layer ionisation to be so greatly enhanced during one of these bright hydrogen eruptions that it replaced the upper regions as a bending medium.

Scope for the Amateur

To take now the second point in the amateur's case. As the larger radio authorities develop more and more inertia it is becoming impossible for them to react quickly to new ideas or take the responsibility for developing new inventions. Here lies a vast field for the amateur worker, who by the very smallness of his equipment can rebuild it often overnight in order to test a new form of noise suppressor, a new system of modulation, a new directive aerial system or a new type of valve.

It is no exaggeration to say that of the first 1,000 crystal-controlled transmitters in the world probably 950 or more were amateur owned.

Push-to-talk 7 Mc/s 'phone may be very amusing, but what about a crystal-controlled un-neutralised inverted-amplifier 100-watt 'phone job on 56 Mc/s, complete with rotating beam? Here's scope for ingenuity, and don't forget British valves, a DET5 (a hard-pumped PX25) will easily out-perform the dearer American T55 on 10 metres at 600 volts HT; in fact, it can easily be made to give three times the output of the T55 under these conditions owing to much better mutual conductance and lower plate impedance. On 5 metres this kind of valve, however, demands a special circuit. I, personally, regret that the G.P.O. cannot see its way clear to grant unlimited 10-watt licences, whilst retaining an efficiency bar for higher powers on special frequency bands.

To start the listening report one can give W2XE's new schedule, effective from October 1st:

Monday to Friday:—			
21.52 Mc/s.	1230–1500 GMT	}	Europe
15.27 ,,	1800–2300 ,,	}	
17.76 ,,	2330–0100 ,,	}	S. America
15.27 ,,	0100–0500 ,,	}	
Saturdays and Sundays:—			
21.52 Mc/s.	1300–1800 GMT	}	Europe
1527 ,,	1950–2300 ,,	}	
17.76 ,,	2330–0100 ,,	}	S. America
15.27 ,,	0100–0500 ,,	}	

The long period during which the 13-metre wave (21.52 Mc/s) is in use on Saturdays and Sundays should be particularly noted.

Conditions were very good at 10.30 p.m. (B.S.T.) on Friday, September 24th, in contrast with the previous evening, and both W3XAL and W2XAD were excellent. Even EAR (EDZ) on 9.49 Mc/s was a strong well-modulated signal on this occasion.

Conditions remained fairly good up to 28 Mc/s or higher on Saturday and Sunday, September 25th-26th, but W3XAL disappeared into the noise by 11 p.m., leaving W2XAD again excellent.

Very amusing signals were intercepted from LSY, 18.115 Mc/s, Buenos Aires, at 10.30 p.m. on Tuesday, September 28th, when this very well received transmitter was radiating a recording (in French) of speech "spoken" at many times the normal rate, the speed of talking being progressively reduced to normal as the record was played. The record itself was probably played at 78 r.p.m. throughout. Ordinary recorded commercial speech could, of course, be played-back over a broad-band transmitter at something like four times the normal rate of speaking, re-recorded and replayed at normal speed, with a considerable saving in time. The problem is equivalent to making a good record of 30 to 50 line television.

Owing to very bad conditions the last ten minutes of the last "Five Hours' Back" programme on Saturday, October 2nd, was abandoned by the B.B.C., but by 10.30 p.m. conditions had improved wonderfully and Guy Lombardo and his orchestra were well heard over W2XE, 15.27 Mc/s, until 11 p.m. B.S.T.

* Beyond a few rare contacts.

NOTES FROM A LISTENER'S LOG

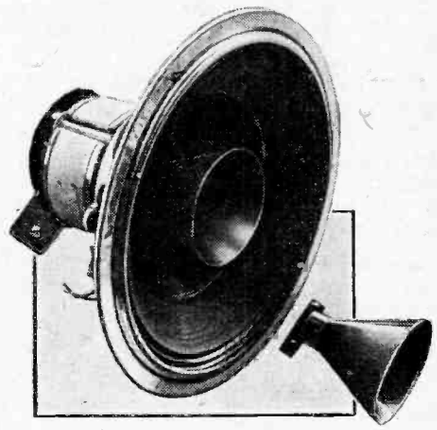
No U.S. 10 metres signals were heard on Saturday, but VU2CQ was quite good at times.

Finally, I should like to report reception of ZTJ Johannesburg on 6.135 Mc/s (measured) at 4.42 p.m. G.M.T. September 22nd, speech in English and Afrikaans. In the evening of Wednesday, October 6th, the sunspot positive (?) corpuscular radiation (the unwanted variety responsible for magnetic storms) appeared to have ceased, and very good conditions prevailed, both W2XE on 17.76 Mc/s and W3XAL, 17.78 Mc/s, on their South American beams were producing excellent signals of good entertainment value until well after midnight.

ETHACOMBER.

NOT A "TWEETER"

IN the loud speakers fitted to many of the new Philips receivers will be found a central cone of hard-moulded material. This



does not form part of the diaphragm system but is a reflector fixed to the centre pole piece and designed to give more even distribution of high frequencies.

The Radio Industry

THE firm of Norman Rose (Electrical), Ltd., has moved to Waveband House, 43, Lambs Conduit Street, London, W.C.1.

A reader wishes to obtain some of the woven metallic material used for the loud-speaker grille in certain receivers. Will any firm able to supply please communicate with us?

"Radio Interference Bulletins," which have been issued periodically by Belling and Lee, Ltd., have been reprinted in book form. Engineers and others professionally interested in interference suppression may obtain copies, post free, by sending 1s. 2d. to the firm's works, Cambridge Arterial Road, Enfield, Middlesex.

Negative Feed-back

NOTES ON OPERATING CONDITIONS

By P. K. TURNER, M.I.E.E.

AFTER discussing some of the advantages which have led to the wide adoption of the negative feed-back principle, the author goes on to describe the graphical determination of operating conditions.

DEGENERATION, inverse feed-back, or negative feed-back, as it is variously called, is becoming quite widely used in audio-frequency amplifiers. Actually there are two kinds of negative feed-back—one which tends to maintain a constant output voltage and one which tends to maintain a constant output current. The former results in a reduction and the latter in an increase in the effective output impedance of the amplifier.

Full design details of amplifiers embodying either type of feed-back were given in an earlier article in *The Wireless World*[1] for the case when the feed-back is applied over a single stage. The system usually adopted is the one giving voltage stabilisation and so tending to reduce the output resistance, and this is the one which will be considered here.

The circuit is shown in skeleton form in Fig. 1, in which R1 is the load circuit resistance; in the case of an output stage this resistance is the speech coil impedance multiplied by the square of the output transformer ratio and is not physically present as a component. Assuming that C1 and C2 are so large that they can be neglected and that R2 and R3 are so much greater than R1 that they can be ignored, then $e_a/e_1 = A/(1+AB)$ where A is the amplification without feed-back and $B = R2/(R2+R3)$ = the amount of feed-back.

The first effect of feed-back is thus to reduce the gain by $(1+AB)$, and this is a disadvantage. The second effect is to reduce the effective AC resistance of the valve in the ratio $(1+B\mu)$, and this is a distinct advantage when using a pentode,

[1] *The Wireless World*, November 6th, 1936.

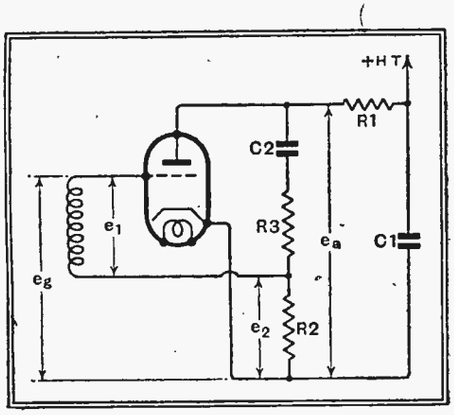


Fig. 1.—Skeleton diagram illustrating the principle of negative feed-back.

since the resistance can easily be reduced to the same order as that of a triode and the loud speaker can be properly damped. This property is also of value when a valve forms the terminating resistance of a filter.[2] Variations in the HT supply voltage or in valves and components have a much smaller effect on the amplification than they do when feed-back is absent.

The effect of feed-back on distortion is less readily expressed, but if we imagine that e_1 is a pure sine wave of frequency f and that there is distortion in the valve, then the output will contain frequencies f, 2f, 3f, etc. These will be fed back in reverse phase as part of the grid voltage e_g; being amplified, they will appear in the output and, being in opposite phase,

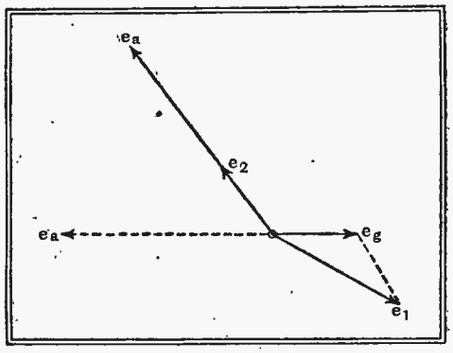


Fig. 2.—Vector diagram to show the effect of negative feed-back in reducing phase shift.

they will decrease the harmonic output.

In the case of harmonics the order of which is a prime number the effect is simple and the percentage of harmonic in the output is reduced by $(1+AB)$. Other harmonics, however, may actually be increased. The prime harmonics are the 2nd, 3rd, 5th, 7th, 11th, 13th, 17th, 19th, etc., while the others are all the even harmonics except the 2nd, and the 9th and 15th harmonics, ignoring those higher than the 20th.

The use of push-pull itself balances out the even harmonics, so that when negative feed-back is applied to such a stage the only possibility of trouble lies in the 9th and 15th harmonics. In practice, there is rarely, if ever, any trouble from these. The most important practical advantage lies in the reduction of the 3rd and 5th harmonics.

Negative feed-back also reduces phase-shift in an amplifier, and this is most easily shown by the vector diagram of Fig. 2. The grid voltage e_g is shown, and owing to the impedance of the load circuit not being purely resistive the voltage across it is not exactly opposite to the grid

[2] *The Wireless World*, December 25th, 1936.

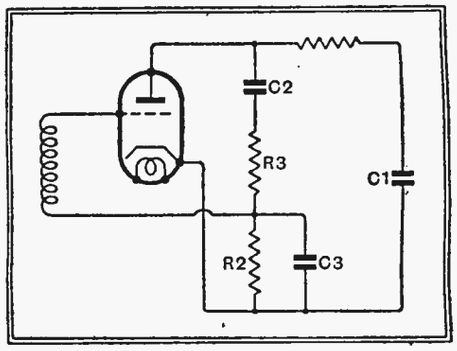


Fig. 3.—Tone correction applied to a negative feed-back circuit.

voltage (as $\acute{e}_a$ dotted), but is out of phase as at e_a. Then the feed-back voltage will be out of phase as at e_2. Now e_1 has to overcome e_2 as well as provide e_g, and it is consequently of the magnitude and angle shown on the diagram. It is obvious that e_a is much more nearly in exact opposition to e_1 than e_g, so it is clear that the feed-back has reduced the phase-shift.

"Lifting" Bass and Treble

Tone correction is readily possible by arranging the circuit so that the amount of feed-back varies with frequency. Thus in Fig. 3, if C2 is made small its reactance at low frequencies will become comparable with R2. The feed-back at such frequencies will then be reduced and the bass response will rise. Similarly, a shunt condenser C3 to R2 will reduce the feed-back at high frequencies and lift the response curve. One valuable feature of this method of correcting for earlier defects in the amplifier is that it reduces the phase-shift instead of making it worse, as do many other methods.

For push-pull operation, the circuit of Fig. 1 is duplicated in the manner shown in Fig. 5. One effect of the feed-back applied in this manner is to minimise any mismatching of the valves.

When it is desired to investigate the operating conditions of the valves some difficulty is often experienced because of the feed-back. It is, however, possible to do it graphically by a modification of the usual process with the anode volts-anode current valve curves.

For the purpose of curve-sheet drawing, let us imagine the whole feed-back circuit adapted to DC. It becomes as in Fig. 6, where there is no condenser in the feed-

Negative Feed-back—

back circuit, and the input voltage e_1 is supplied by a battery. Now consider point A on the valve-curves, Fig. 7. For this point $e_a = 100$ V, $e_g = -20$. But if e_a is 100 V, and there is 20 per cent. feed-back, e_2 must be +20 volts.

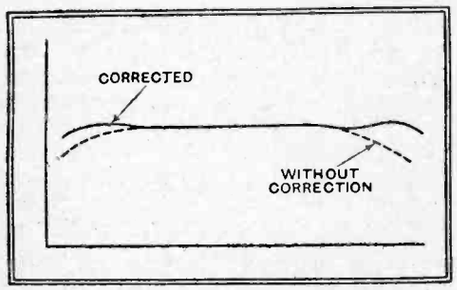


Fig. 4.—Effect of using a small value of C2 and a shunt condenser C3 in the circuit of Fig. 3.

If then 2_g must be −20 volts while e_2 is +20 volts, e_1 must be −40 volts. So that A is a point on the curve for $e_1 = -40$ V.

Let us find another point on this curve. Suppose that $e_g = O$. If $e_g = O$ while $e_1 = -40$, then e_2 must be +40 volts; and if there is 40 volts across R2 with 20 per cent. feed-back, then e_a must be 40×5 or 200 V. So that point B on the curve sheet, for $e_g = O$, $e_a = 200$, is also a point on the curve for $e_1 = -40$.

The *general* way of finding all such points is quite easy. First, of course, one must fix the feed-back; say 20 per cent., or 1 in 5. Then settle some value of e_1 for which we want the curve—say $e_1 = -40$, as above. Multiply the two together, changing the sign of e_1; this gives 200.

Now, for each value of e_g for which there is a curve, multiply that e_g by the feed-back factor, and subtract the result from the product already found. The result is the value of e_a at which the e_1 curve crosses the e_g curve.

Thus, for $e_g =$ 0 10 20 30 40
we have $5 \times e_g =$ 0 50 100 150 200
and $200 - 5e_g =$ 200 150 100 50 0
giving points B, C, A, D on the curve-sheet. Thus the curve for $e_1 = -40$ can be drawn.

Similarly for $e_1 = -60$, the first product is 300 V.,
so for $e_g =$ 5 10 15 20 30 40
we have $5e_g =$ 25 50 75 100 150 200
and $300 - 5e_g =$ 275 250 225 200 150 100
giving points E, F, G, H, K, L, and the curve for $e_1 = -60$ is drawn through these.

These curves can be used for all purposes connected with the normal use of the valve, since the insulating condenser in the feed-back circuit does not affect AC.

For example, if we adopt point H as a working-point—200 V anode, 20 V bias, 47 mA. current, we find that for the same bias 218 V gives 60 mA., and 172 V gives 30 mA., a difference of 46 V for 30 mA., or just over 1,500 ohms effective anode impedance.

Also, for 200 V anode, 50 V e_1 gives 70 mA., and 70 V e_1 gives 24 mA., a difference of 46 mA. for 20 V of e_1, i.e., an effective mutual conductance of 2.3 mA/V.

Multiplying the impedance by the conductance, we have an effective μ of 1.5×2.3, or 3.5 approx.

Again, the choice of working point and the laying-down of a load-line is done in exactly the usual manner, just as if the dynamic curves were of the ordinary type. But there are just two points to remember.

First, having decided on one's working point, the actual DC bias to be applied is got from the e_a curve, not the e_1. In Fig. 7, for example, if point H is selected, the *bias* must be 20 V, not 60.

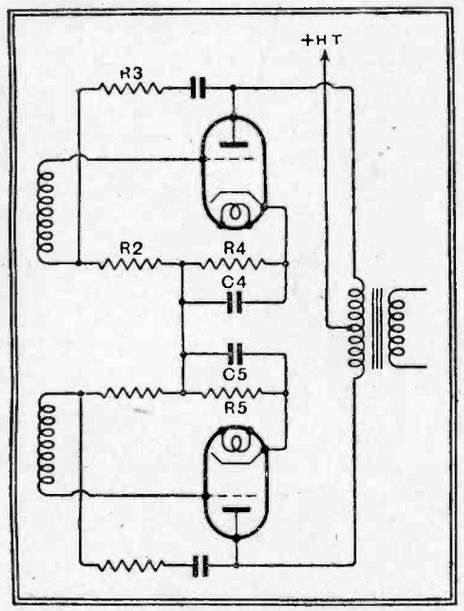


Fig. 5.—Negative feed-back applied to a push-pull circuit.

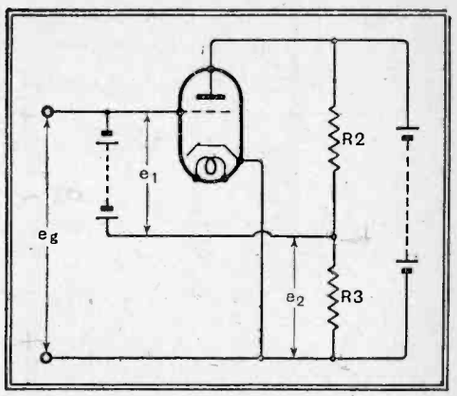


Fig. 6.—Negative feed-back adapted to DC conditions.

working point 50 mA. at 300 V on the anode, we find that 20 V bias is called for, with $e_1 = -80$. To get maximum power, we shall have to swing the grid up to the knee of the dotted curve for $e_g = O$. This gives $e_1 = -14$ approximately, so that the input amplitude must be 80 − 14 = 66 V, or 132 V swing of e_1. Without feed-back we should have a swing (of e_g) of twice the bias, or 40 V.

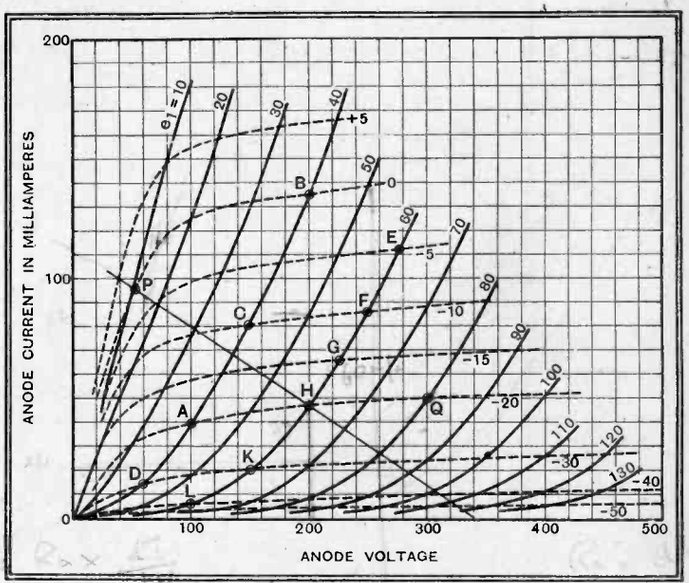


Fig. 7.—Curves for graphical investigation of operating conditions.

Avoiding Grid Current

Secondly, if grid current is to be avoided, the swing along the load line must stop at the dotted (e_g) curve for $e_g = O$, even if this still shows negative e_1. For example, for the load-line shown (3,000 ohms) there would be grid current beyond point P, for although this shows $e_1 = -11$, it is also on the line for $e_g = O$.

The whole dynamic curve sheet is, of course, valid for only the chosen feed-back value. Hence, to avoid waste of time, it is important to choose a feed-back which will do what we want.

In Fig. 7, the value 0.2 for this was selected. If we happen to choose as

In actual practice, we usually have to solve the inverse problem. If our chosen working point has 20 V bias, and our earlier stages can give 132 V swing, what must the feed-back be?

The formula for this is feed-back

$$\text{ratio} = \frac{e_1 \text{ amplitude} - e_g \text{ amplitude}}{e_a \text{ amplitude}}$$

For example, if in Fig. 7 we take the working point Q at $e_a = 300$, $e_g = 20$, $e_1 = 80$.

For the "knee" of the $e_g = O$ curve we have $e_a = 70$, $e_g = O$, $e_1 = 14$, so

$$\text{feed-back} = \frac{(80\text{-}14) - (20\text{-}0)}{300 - 70} = \frac{46}{230} = 0.2 =$$

20 per cent.

Usually, of course, the feed-back will come to some odd fraction, and we take a round number near it.

"BROADWAY MATINÉE" is the title given to a series of variety programmes which we shall hear from New York during the Autumn months. The photo was taken from Times Square, looking towards Broadway.

Listeners' Gu

Outstanding Broadcasts at

A FEATURE of the arrangements for the coming months' programmes is the extensive use of material from the Continent and the U.S.A. Miss Isa Benzie, B.B.C. Foreign Director, has prepared a very varied list of proposed Continental relays for the autumn months. She writes in an article in last Friday's *Radio Times*: "There is a genuine pleasure in listening to the programmes of another country . . ." and "to have heard a programme as it is being broadcast to another people is to have shared for a moment their life." From a cursory glance at the schedule we should, by the end of the year, have shared in the life of most of our Continental cousins. Some of the broadcasts are quite ordinary, but others are really ambitious.

This week we shall hear dance music from Holland on Tuesday at 5 (Nat.), variety from Vienna on Wednesday at 8.15 (Reg.), as well as the European concert provided by Italy to be broadcast from Turin, which will be relayed by the Regional transmitter on Monday at 8.

From the New World we are to hear a weekly series of variety programmes which have been arranged by Felix Greene, B.B.C. North American representative, in collaboration with and by courtesy of the Columbia Broadcasting System. This weekly half-hour of American variety, which has been given the title "Broadway Matinée," will bring to listeners the outstanding talent in musical comedy, variety shows, and night clubs on Broadway. The first of these, all of which will be on Mondays, will be given this week at 8.30 (Nat.). This series of programmes is just one of many which, as Felix Greene says, is planned to give listeners a balanced picture of American life.

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FOR THE NORTH

TUESDAY will be a red-letter day for listeners in the North, for it will see the opening of the new high-power transmitting station at Stagshaw. The opening ceremony by the Duchess of Northumberland will be broadcast in the Regional programme at 3. During this ceremony Sir Noel Ashbridge, the Chief Engineer, and Mr. Cecil Graves, Controller of Programmes, will also be heard.

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FOLK LORE

ERIC MASCHWITZ, who relinquished his post as Director of Variety in June this year, on Sunday makes his first contribution to the programmes since his departure. He said, when leaving, that he would from time to time contribute to British broadcasting, and in collaboration with Gipsy Petulengro he has written "Gipsy Melody," which you will hear on Sunday at 9.5 (Nat.). It is a programme of music and folk-lore from the Hungarian plain in which Gipsy Petulengro will himself take part. It will probably be some time before another programme by Eric Maschwitz will be heard, for he is now in America, where he is to write film scenarios and produce his play "Balalaika" in which his wife Hermione Gingold will take part.

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A GALAXY OF STARS

WHEN each month's edition of Harold Ramsay's "Radio Rodeo" from the Union Cinema, Kingston, is presented to listeners, one can be certain of a galaxy of broadcasting stars. The October edition, which Regional listeners will hear on Wednesday at 9, is certainly no exception, for it brings Harry Richman, with his American wisecracks and songs; Scott and Whaley, the coloured comedians; Jeanne de Casalis in another "Mrs. Feather" episode; Issy Bonn; Bennett and Williams; Gaby Vallé; the Eight Step Sisters; and Fred Hudson. As usual, three well-known organists will also take part: Harold Ramsay, H. Robinson Cleaver and Phil Park.

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WORLD THEATRE

THE first play in the new series "World Theatre," which is designed to enable listeners to hear the permanent classics of the drama, was to have been Humbert Wolff's translation of "Cyrano de Bergerac." Owing to casting difficulties this play has been postponed, and in its place Barbara Burnham will produce Bernard Shaw's "Candida" on Sunday at 6 (Nat.). The scene for this is set in St. Dominic's Parsonage, Victoria Park, London, in the autumn of 1900.

The producer is casting the play with actors who have seldom or never before appeared in it, her intention being to add freshness to the broadcast interpretation.

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"I WAS THERE"

OWING to a subsequent rearrangement of programmes, of which I was not notified, the broadcast in the series "I Was There," by Mr. Blyth, on the Valparaiso Earthquake of 1906, which was given for Tuesday, October 12th, in our last issue, will be heard on Tuesday (19th) at 9.20 (Nat.).

ITALY provides the next European concert, which will be broadcast from Turin on Monday at 8 and will be relayed by many Continental stations as well as our Regional at 8. This photo is of Toti dal Monte, the celebrated soprano, often heard from Rome, who will take part in the concert.

The rearrangement was doubtless due to the fact that the talk in this series scheduled for this Tuesday, and ultimately given last week, was on the Fitzsimmons-Corbett fight and would have clashed with the programme which would have followed it at 9.35. This will be a running commentary on the match between Maurice Strickland and Walter Neusel for the International Heavyweight Championship, which will be given by Howard Marshall from Wembley.

de for the Week

me and Abroad

"THE LILAC DOMINO"

THE recently formed Music Productions Section of the B.B.C. makes its first contribution to the programmes with the operetta "The Lilac Domino," which was such a hit at the Empire when produced there in 1918 and when broadcast in 1934. The broadcast version, which Gordon McConnel will again produce on Tuesday at 8.30 (Reg.) and Wednesday at 7 (Nat.), contains the main original plot, but the story has been considerably simplified to conform to the microphone's limitations. Like all McConnel's radio productions, the music will predominate, dialogue being cut to a short concise framework of the plot.

The chief parts will be taken by Dennis Noble and Maria Elsner, the charming Viennese singer, who will play Georgine, the Lilac Domino herself. Others in the cast include Bernard Ansell, Barbara Couper, and Helen Crerar.

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MOVIE MUSIC

LOUIS LEVY and his Symphony return to the microphone in the third edition of their popular programme, "Music from the Movies" tonight (Friday) at 6.45 (Nat.). The vocalists will be Eve Becke and Gerry FitzGerald, both well known to listeners, although they will be making their first appearance in this particular series.

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MRS. GRUNDY

THAT most prolific of radio dramatists, L. du Garde Peach, has brought to life that well-known if much disliked character "Mrs. Grundy" in a comedy, specially written for radio, "Mrs. Grundy Comes to Tea." This will be heard this evening (Friday) at 8.10 (Nat.) and again Regionally on Saturday at 6.30 produced by Lance Sieveking with Doris Gilmore as Phœbe (maid) and Beatrice Gilbert as Mrs. Grundy. The period of the play is 1860, and the most influential ladies of a small provincial town have been invited to a tea-party at which Mrs. Grundy has promised to attend.

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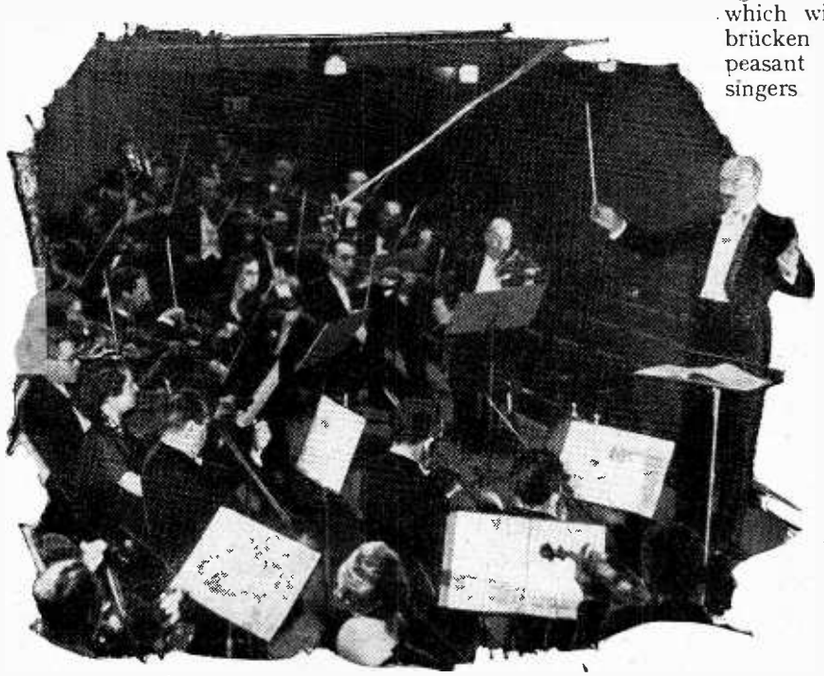
NATIONAL WINE WEEK

GERMANY celebrates its National Wine Week in the broadcast programmes on Sunday. These celebrations should have taken place earlier in the month, but were postponed owing to the various festivities associated with the Italian visit and the Harvest Festival.

Most of the evening programmes have some link with the vintage festival. At 7 Frankfurt broadcasts a musical programme entitled "My Son, when you go to drink wine . . .," whilst at the same hour Deutschlandsender relays a variety concert for the opening of the Neustadt Vintage Festival from Saarbrücken which will include the Saarbrücken station orchestra, peasant bands and village singers

THE AUDITOR.

JAN KIEPURA, the world-famous Polish singer, who will be heard during Warsaw's relay of a concert from Paris on Saturday at 8, is here seen singing to a crowd from the roof of the Polskie Radio O.B. van.



SIR ADRIAN BOULT conducting the B.B.C. Symphony Orchestra in the Queen's Hall, where he will conduct the first of the 1937/8 season's concerts on Wednesday, which will be broadcast Nationally. Owing to the postponement of the first world performance of Schumann's violin concerto in Germany, this will not be included in Wednesday's programme as was advertised, but will be heard during the concert on February 16th, 1938.

HIGHLIGHTS OF THE WEEK

FRIDAY, OCTOBER 15th.

Nat., 6.45, Music from the Movies. 8.10, "Mrs. Grundy Comes to Tea." 9.20 Talk: "What More do You Want from the Scientist?"

Reg., 6, Hanwell Silver Band. 6.35, Pianoforte Recital: Hilda Bor. 9, "I Remember."

Abroad.

Warsaw, 8, Concert of Polish Music from the Théâtre des Champs-Elysées, Paris.

SATURDAY, OCTOBER 16th.

Nat., 2.30, The National Covered Courts Lawn Tennis Championships. 3.30, The Brooklands Mountain Championship. 5, Henry Hall and his dance orchestra. 8, "Palace of Varieties."

Reg., 2.30, Acts I and II of "La Bohème" from Sadler's Wells. 6.30, "Mrs. Grundy Comes to Tea." 8, Prison Reform: a discussion on the British system.

Abroad.

Rome, 8, Lehár's operetta "Gypsy Love."

SUNDAY, OCTOBER 17th.

Nat., 6, World Theatre No. 1: Bernard Shaw's "Candida." 9.5, Gypsy Melody: a programme of Hungarian music and folk-lore.

Reg., 5, The Alphas. 9.5, Sunday Orchestral Concert—1; Soloist Lauri Kennedy ('cello).

Abroad.

Deutschlandsender, 6.30, Puccini's "Tosca."

MONDAY, OCTOBER 18th.

Nat., 7, Monday at Seven. 8, Design in everyday things—3. 8.30, Broadway Melody: American variety.

Reg., 6, The Richard Crean Orchestra. 8, Italian-European Concert from Turin.

Abroad.

Bordeaux-Lafayette, 9, Ste. Cécile Concert Society's concert with Thibaud (violin).

TUESDAY, OCTOBER 19th.

Nat., 8.30, Violin recital: Zimbalist. 9.20, I Was There. 9.35, Commentary on Strickland-Neusel boxing match.

Reg., 3, Opening of the Stagshaw Transmitting Station. 8.30, Operetta: "The Lilac Domino." 9.45, Julian Huxley on Wild Life.

Abroad.

Leipzig, 8, Sibelius Concert by the Leipzig Symphony Orchestra.

WEDNESDAY, OCTOBER 20th.

Nat., 7, Operetta "The Lilac Domino." 8.15, and 9.30, Symphony Concert.

Reg., 6.20, Maurice Winnick and his orchestra. 8.15, Variety from Vienna. 9, Radio Rodeo from the Union Cinema, Kingston.

Abroad.

Saarbrücken, 8.25, Schubert's Unfinished Symphony, by the Saarbrücken Station Orchestra.

THURSDAY, OCTOBER 21st.

Nat., 7.40, Eight Bells (6th edition). 10.20, Light music through the ages—2: Orchestre Raymonde.

Reg., 7.50, Midland Parliament: discussion on Higher Wages and Shorter Hours. 8.40, Herman Darewski and his new Melody Rhythm Band.

Abroad.

Königsberg, 7, Studio production of Jan Brandts-Buys' opera, "The Tailors of Schönau."

Letters to the Editor

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

Transient Response

MR. VOIGT REPLIES

FROM the many letters referring to my article (*The Wireless World*, July 30th, 1937) on "Transient Response," it would seem that the subject is of considerable interest.

As my reply is being published as a letter, it must necessarily be condensed. First, however, I wish to correct some errors: Page 90, first column, six lines above the diagram, for "pressure" read "velocity," and page 92, second column, for "Fig. 3" read "Fig. 4." Also at the end of the description of the simple transient in the velocity diagram, Fig. 4, the article states, "This transient, by avoiding sharp corners, avoids high accelerating forces." This statement is too general. To be accurate, I should have said: "This transient, by avoiding anything nearly vertical, i.e., roughly at right-angles to the base line, avoids high accelerating forces."

In my article, I stated on page 91, "From considerations and experiments such as these I am convinced that although very sharp transients undoubtedly require reproduction of high frequencies, there are many simple transients in which this is not the case."

Mr. Turner mis-states my case when he thinks I am trying to prove that good frequency response is not so important as good damping. I think, as he does, that both are necessary in a perfect system, but at the same time I do feel that damping has been overlooked far too much, especially in view of its importance in the case of simple transients, which depend upon damping rather than extreme frequency range for their correct reproduction.

Mr. Davis and Mr. Bradshaw discuss the questions involved in the reproduction of steep-fronted transients, and it is pointed out that the steepness increases with increasing frequency and amplitude. It is quite correct that increased amplitude increases the steepness, but it also provides the compensating factor of increased energy. In practice, therefore, it is the increased steepness due to higher frequency content which presents the difficulty with that class of transient.

With such transients, inductance, and particularly inertia, are usually the main causes of delay at starting. Back EMF only occurs when motion is taking place, and is therefore a damping factor to be thankful for.

If my special transient is plotted out on a large scale, it will be found that even at its steepest part (representing maximum acceleration) the slope is slightly less than that of the sine wave corresponding to its "fastest" component (600 cycles). Yet according to Mr. Baggally, and confirmed by Mr. Turner's analysis, the transient contains frequencies of a much higher order.

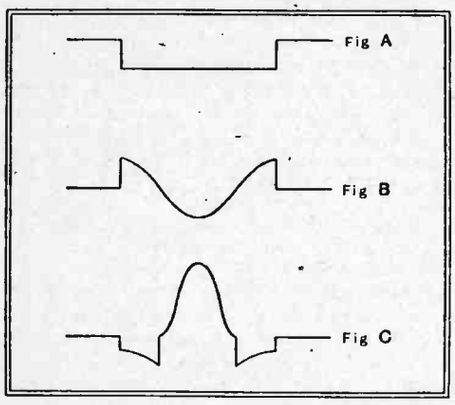
Mr. Baggally in his letter quotes the formula:—

$$y = a \sin (pt + \phi_1) + b \sin (2pt + \phi_2),$$

and states that it cannot be anything but periodic no matter what values we assign to a, b, ϕ_1 and ϕ_2. This is probably quite true, but as we are dealing with a non-periodic transient, it would seem to my non-mathematical mind that the formula $y = a \sin (pt +$, etc.) was *not* the right one to use. Further, that the drawing of any conclusions therefrom might be ill-advised.

But, Mr. Baggally, please, my transient does not start and stop with a jerk. To jerk is the one thing above all others which a simple transient must not do. As soon as it jerks, it becomes complex and gets away from the simple case I am discussing. It was in order to avoid even the resemblance to a jerk that the displaced cosine curve, instead of the customary sine curve, was selected.

In thinking that my transient contains sudden jumps in acceleration when the two component curves meet the axis, Mr. Baggally has, I believe, made a slip. He was probably thinking of the step introduced at the beginning and end of each cosine wave by the process of displacement (Fig. A), but I would like to point out that a cosine wave when $\theta = 0$ starts at a finite value, and therefore *also has a step* (Fig. B). By making the two sets of steps equal and opposite, I have not only concealed the Heaviside functions, as Mr. Baggally suggests, but have cancelled them and their attendant spectra of frequencies. This also eliminates sudden jumps in acceleration.



This cancellation effect also seems to have been overlooked by Mr. Scowen. He expresses the commencement of the curve and gets the formula:—

$$[1] \times (-1 + \cos \omega t).$$

Now at the commencement t is near to 0, therefore $\cos \omega t = 1$ (see cosine tables). The formula therefore becomes:—

$$[1] \times (-1 + 1) = [1] \times 0 = 0.$$

If we go further and take Mr. Scowen's expansion the result is the same, i.e., the unit function cancels out.

It should be noted that this applies not only to particular transient of my Fig. 4 in the original article, but to any transient free from steps, and therefore includes *all* transients to be expected in the reproduction of normal sounds. Had the displacements not cancelled, then our transient might have taken a form such as Fig. C, and would certainly have included frequencies to infinity at each step.

Fortunately, there is no instrument in the orchestra which can produce a stepped wave. Nature never supplies the infinite accelerating force which this requires. (Sparks and explosions get somewhere near.) We need not, therefore, worry any further about the analysis of any transient containing an uncancelled step, at least not in acoustics, as Nature will always see to it that the necessary cancellation takes place. Mr. Bradshaw's mention of the violin string released for one cycle only may be recalled here, even though the true behaviour of such a string is not as simple as might be expected.

I think I have said enough to show that the frequency content of the unit function has no real bearing on the contents of a simple transient, also my special transient contains nothing steeper than the corresponding 600-cycle sine wave, and yet Mr. Turner's analysis plots frequencies up to 5,000 cycles, and indicates that there are more higher up. Independently, Dr. N. W. Lewis has worked out the analysis for me privately, and as he gets substantially the same result, I cannot doubt its accuracy. Can the results of the analysis be reconciled with the absence of anything visible which would lead one to expect high frequencies? I think the attempt should be made.

Let us imagine that we have a 600-cycle electrically maintained tuning fork inside a soundproof box provided with a small sound opening. Imagine further that a shutter similar to those on cinema projectors and silent in action is so placed as to cut off during a part of its revolution the sound emerging from the box. Let the speed of the shutter be such that the fork emits a whole cycle during the cutting off period, i.e., the wave is "modulated" to zero in one cycle. By having the hole suitably shaped the rate of cut-off can be so graded as to avoid abrupt changes and consequent introduction of spurious frequencies. An oscillogram (using an aperiodic microphone) would show a 600-cycle note suddenly collapse during one cycle. No spurious frequencies would be visible (regardless of magnification) or any irregularities. But what would the analysis be?

Mr. W. B. Lewis gives the basis of the mathematician's point of view when he says: "If a sharply tuned resonator responds to a pulse, then the frequency of that resonator is present in the pulse." Undoubtedly the sudden change from the sustained note would be treated by the mathematicians as a pulse. It is easy to show on squared paper how, by adding for 1/600th sec. only and at the correct point, a 450-cycle pulse mixed in the correct phase with a 750-cycle pulse, to the existing 600-cycle note; this can be made to collapse smoothly in one cycle. The mathematician's method of extinguishing the note by adding other frequencies therefore seems logical. The duration time of these pulses is so short that a tuned resonator would not be able to determine the true frequency—nor, it seems from Dr. Hughes' letter, would the ear be able to do so. The mathematician would therefore consider a band of frequencies to have existed during the period of this pulse, the ear presumably receiving a similar impression.

Does this, however, also apply to a loud speaker which is reproducing such a sound? Remember that the current fed to it was a 600-cycle note sustained and then collapsing

Letters to the Editor—

during one cycle. Such a collapsing wave could not be reproduced by a loud speaker which was resonant at that frequency. The energy stored in the resonating part would preclude a sudden cessation of the wave. To secure aperiodic working it would be necessary to increase the damping, and I have no doubt that when this has been sufficiently increased, it would be found that the loud speaker resonance was so flat as to include 450 and 750 cycles and, in fact, the whole band of frequencies found by the mathematicians to have been present in the pulse.

We have therefore the case that whether we look at the problem from the practical point of view of adequate damping at a specific frequency, or from the mathematician's aspect of a frequency band, we get identical answers; his method is therefore justified. There is, however, one important point. The necessary frequency band was obtained by means of adequate damping on the part reproducing the sound. I am not satisfied that the same result is obtainable by omitting the damping and widening the band by including additional resonances, even though this method is the usual one for augmenting the frequency scale of loud speakers at present. (Note that this method tends to be directional and to ignore phase.)

As regards my own transient, evidently I was misled by the smooth appearance obtainable from the curve into hoping that it was quite free from higher frequencies. Mr. Turner's analysis proves me wrong, but I am pleased to say I did get fairly near my objective with such a simple function as the two displaced cosine curves. Examination of the vestigial high frequencies found by Mr. Turner shows their magnitude in the peak region near 1,400 to be as much as 28:1 down compared with that at 600 cycles, while the peak regions higher up become progressively smaller. That around 5,600 cycles, calculated from Mr. Turner's formula, being about 1,000:1 down. My contention that critical damping rather than a tweeter speaker would be required when reproducing this transient is, therefore, abundantly justified.

This has also been confirmed with the experimental apparatus of Beale and Denman. As soon as I learnt of the practical tests they had made, I communicated with them, and wish to place on record my gratitude for their kind co-operation in enabling me to examine the apparatus and make additional tests.

From their letter I rather feared that they had been able to hear frequencies in the tweeter region from my transient. This, however, was not the case. The application of the top attenuating circuit audibly altered the sound, but the change was similar to that obtained when harmonics of a low order are reduced. Tests were then made to determine the frequency region actually concerned, and it was found that a circuit having a fairly sharp cut-off at about 1,200 cycles caused a distinct difference (i.e., softening) in the sound. The difference produced by a similar circuit cutting off at about 1,800 cycles, however, could not be distinguished, it being so slight as to be completely masked by the change in the background noise. This result fits in very well with that to be expected from Mr. Turner's analysis.

Messrs. Beale and Denman's experiments are further of very great importance in connection with their tests on the sine wave decaying after a sudden start or vice versa. The current in their tests was produced by modifying the light falling on a photocell by means of a rotating cam. The transient, therefore, consisted of a sudden start, subsequent decay, and a silent period of about eight times the length of the transient. I found it quite impossible to dissect the sound mentally into its separate components and plot it on a time base in the manner that would have been easy if the cam had run much slower. This confirms Dr. Hughes' mention of a time constant of the ear of about 150 millisecs. The interesting thing, however, is that there was no difficulty in hearing (i.e., not attempting consciously to analyse), whether the transient was running forwards or backwards. In one case it sounded exactly like a motor cycle exhaust, in the other, although the frequency content was the same, the sound was sufficiently different to be identified without hesitation.

As the transient time was 5 millisecs, this shows definitely that with a transient of this kind the ear takes notice of the relative timing of the several parts of the wave to an accuracy certainly closer than 10 millisecs.

Mr. Bell's letter I found most interesting. The idea that an hour's television transmission is just one long transient is, of course, perfectly correct. His suggestion that a practical transient would be repeated after a period of rest, so that the analysis would be a Fourier series instead of a Fourier integral, the series being then treated as a short-term series, strikes me as being eminently practical. Actually, in the tests made by Beale and Denman the transient was continually repeated once per rev. of the cam, i.e., about ten times per second.

Mr. Bell points out that the lowest frequency to emerge from the Fourier series is in such cases settled by the spacing of the repeated transient. The only limitation is that the loud speaker, etc., shall come to rest before the arrival of the next one. This means that if the damping is adequate, so that the transient is not elongated, a series of my suggested "simple" transients (Fig. 4 of the original article) could be spaced at any frequency up to 300, with the corresponding frequency as the fundamental in the analysis. In the case of the reception of spark telegraphy from a transmitter having a particularly low spark note, each spark produces an isolated train of waves which the receiver detects and passes on to the loud speaker. This radiates one transient for each spark, but the shape of this transient will be quite independent of whether the spark is the first, middle or last of the series, or what the spark frequency is, providing there is no overlap.

Turning now to the hypothetical speaker-cum-echo chamber arrangement, one correspondent thinks that delay in building up the sound precludes a level frequency response. This is, however, not the case if the mechanism introducing the delay is free from losses. The interference pattern and internal resonances visualised by Mr. Lewis would certainly occur, but as he states, they need not appear externally in the overall characteristic. It is understood, of course, that the total output from the mouth is being considered. The output at any one point of the opening might not be constant, but so long as the echo chamber does not absorb energy, the total from the speaker must necessarily emerge from the mouth, where the measuring microphone(s) would award full marks without even considering either reverberation or phase.

The only part of Mr. Bell's letter with

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which I do not agree is where he suggests that if the loud speaker originating the transient in the echo chamber had a frequency response really down to zero, then the whole of the transient would emerge 1 sec. late. The simplest way of visualising such a perfect loud speaker is to assume the original performer, i.e., the tin whistle player, to be situated in the echo chamber, it will then be obvious how blurred the change from one note to the other is bound to be. If, however, anything is done to preserve the correct phase relation, for example, by passing the sound through an imaginary pipe which does not modify the velocity of propagation and which is 1,130ft. long, then the reverberant effect which I have pictured is also eliminated.

Normal calibrating gear does not measure phase. It is a good thing, therefore, that Mr. Baggally has pointed out that a phase/frequency curve should be included in order to tell the whole story. I quite agree with Mr. Baggally that the phase relation in the case of my hypothetical loud speaker would be extremely complicated. I can well imagine any automatic phase-recording apparatus jumping off its bearings in the attempt. Mr. Baggally's ideal of zero phase shift is certainly excellent, but I think it is unduly severe and not realisable until someone invents the infinitely rigid, weightless material of the loud speaker designer's dreams. However, to get near zero phase shift, damping will have to be greatly increased, so I am "all for it."

My paragraph on page 92, column 2, read: "No perhaps not, but more than 99.99 per cent. of loud speakers ever made have moving parts which, in relation to their damping, are much too heavy not to store energy and do something of this kind in one or more points in the scale."

Evidently Mr. Turner missed the five vital words, "in relation to their damping," as he suggested that I was unintentionally misleading in not mentioning damping, and then devotes several paragraphs to stressing its importance.

Mr. Bell confirms the necessity for damping in the case of transients, and points out that practical acoustic transients rarely have a frequency spread which is both up and down.

I would like to point out here that almost anything which increases damping, whether by increasing the loading on the part concerned, or by reducing its mass so that existing damping becomes more effective, generally has the automatic effect of increasing the frequency scale. This is, however, no proof that other methods of increasing the frequency scale will necessarily have the required effect.

Dr. Hughes considers that absorption of energy during times of increasing amplitude and its restoration during decay will necessarily show on the response curve. This will depend rather upon the losses accompanying the storing of the energy. But so long as it is customary to ignore effects of less than 3 db. in a speaker curve on the assumption that this difference is inaudible, such cases of energy storage are liable to continue unobserved.

Analysis of the behaviour of a microphone ribbon under transient conditions when supported at each end and considered as a stretched string capable of vibrating at a fundamental, and all odd harmonics will, for example, reveal peculiar effects which might escape detection owing to the relative smoothness of the steady state response. The phase characteristic, however, should disclose the trouble.

Unfortunately, it is very difficult to obtain the phase characteristics in the case of an ordinary speaker; not only does it vary with direction, but there is a complication due to the time taken for the sound to travel from the diaphragm to the microphone.

SUMMARY

(1) There is some evidence that the ear takes notice of the relative timing of the separate parts of a transient.

(2) The frequency content of the Heaviside unit function has no direct bearing on that of simple practical transients.

(3) Owing to the "modulation" effect transients not having steep portions behave as if higher frequencies were present than are to be expected from the steepness alone.

(4) While the author failed in his displaced cosine transient to produce one made up of two frequencies only (reason above) he has, nevertheless, succeeded in producing one which, by analysis (and confirmed by experiment), is so poor in high frequencies that a tweeter would be of no value in reproducing it. Transients substantially free from high frequencies therefore can exist.

(5) Everyone is agreed as to the importance of damping.

(6) The echo-chamber loud speaker, in spite of an infinite frequency scale, will spoil any transient.

(7) A phase/frequency curve or its equivalent would immediately show up the faults of the echo-chamber speaker although the overall response curve does not do so.

(8) In the absence of the phase/frequency curve (or equivalent) the response curve does *not* tell the whole story.

Therefore, something which is distinct from frequency response and can be called transient response *does* exist.

P. G. A. H. VOIGT.

London, S.E.19.

"Direct Current" or "Zero Frequency"

MR. SCROGGIE'S letter in your issue of September 24th indicates that he feels very strongly about the use of such an unscientific term as "direct current," and particularly to the use of the abbreviation DC followed by the word "current" or "voltage."

Probably many of us have given a little thought to this question at times, but the convenience of such terms and the knowledge that we shall certainly be completely understood has caused us to continue to use them.

I do not think there is any similarity between the suggested change of a term such as DC to ZF and a change from the present British systems of weights and measures to the metric system. The first is a mere change of words or symbols, but the latter is a change of actual units. The advantages of the metric system of units are very obvious, but the advantages of using ZF to replace DC are not so obvious.

Is ZF really such a good substitute? Mr. Scroggie says that what is known as a "direct" current can be regarded as a particular case of alternating—namely, zero frequency. But as it is then not alternating at all, is this any clearer than calling it "direct"? And how are we to deal with pulsating DC, which has a definite frequency of pulsation? Is the unsmoothed output from a rectifier to be called ZF? Personally I favour the term "unidirectional" if one wishes to be precise.

Further, it is questionable whether the term "current" is correct as applied to an alternating quantity. Consider an AC generator supplying "current" to a supply system. Actually the generator merely causes a vibration of electrons in the system, and the electrons in the generator never leave the machine, but simply oscillate to and fro over an extremely small distance. In the case of a DC generator we have an actual current flow which is, however, quite slow. The speed may be as little as half an inch per hour in a cable carrying some hundreds of amperes.

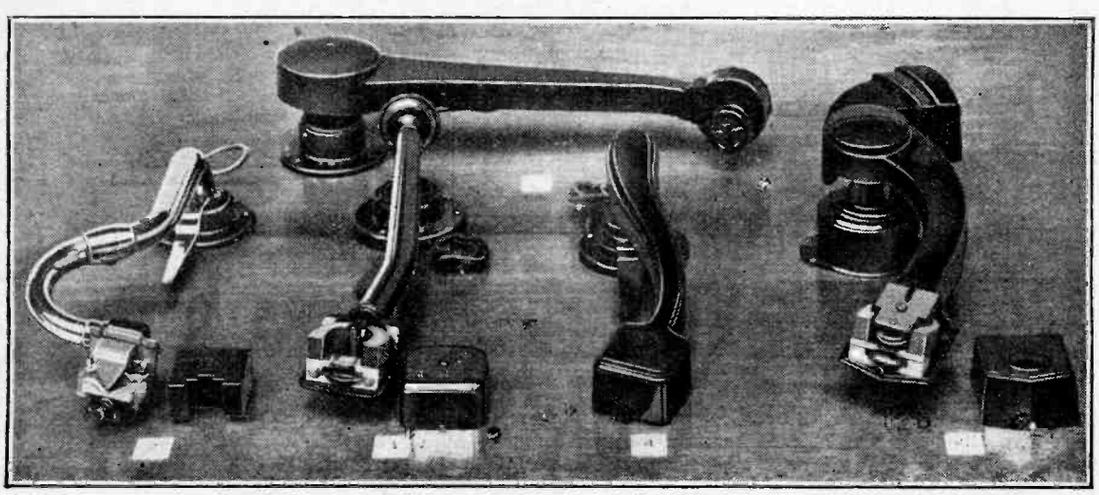
In the case of DC we have, therefore, an electrical current, but in the case of AC we have electrical vibrations.

On the whole, I think that AC and DC may be considered as useful symbols established by usage to indicate definite ideas, and no confusion is likely to result from their use.

The idea of "zero frequency" has its definite uses for mathematical purposes.

T. A. LEDWARD.

Huyton, Liverpool.



ON RECORD

Stages in the development of the H.M.V. gramophone pick-up—an exhibit arranged for the Science Museum, South Kensington. At the back is the original oil-damped model fitted to the first H.M.V. electrical gramophone and on the extreme right the latest high-fidelity type incorporated in this year's Model 801 radio gramophone.

Television

COMPARATIVE STATUS IN ENGLAND AND THE U.S.A.

David Sarnoff.

N.B.C. Photo

A Statement made in New York by David Sarnoff, President of the Radio Corporation of America, on his return from a European tour on September 25th.

DURING my five weeks' stay abroad I studied the latest developments of television in Europe. While interest is shown everywhere in this new branch of the radio art, greater progress has been made in England than elsewhere in Europe.

Nevertheless, the experience to date with television in England has only served to emphasise the formidable nature of the problems which must be solved before a satisfactory service of television to the public can be rendered and a new industry soundly established.

The question is often asked: "Is England ahead of the United States in television?" I shall try to answer this question by stating the facts as I have now observed them on both sides of the Atlantic.

The B.B.C. has been operating its television transmitter, located at Alexandra Palace in London, for about a year. The range of this transmitter is more than 25 miles, and covers all of London and its immediate vicinity. The system employed is known abroad as the Marconi-E.M.I. Television System, which is fundamentally based on the R.C.A. Television System first developed in the R.C.A. Laboratories in the United States. Under an exchange of patent licences, this British company may use R.C.A. patents in England and, in turn, R.C.A. and its American licensees may use British patents in the United States.

Each side is therefore in a position to benefit from developments and improvements made by the other.

For nearly one year the B.B.C. has been broadcasting television programmes to the public on a regular daily schedule of one hour in the afternoon and one hour in the evening.

Some fifteen British radio manufacturers have been offering television receiving sets to the public at prices ranging between $200 and $500 each. At the Olympia Radio Show, which I visited while in London, all the manufacturers exhibited their latest television sets, and the B.B.C. arranged special programmes so that the public could view the actual operations of television while visiting the Radio Show. From a technical standpoint the results were highly satisfactory. The public filled the television booths and showed great interest. But while hundreds of thousands of ordinary broadcast receivers were sold during the Show the public bought less than one hundred television receivers in total.

During one year's operation of a public television service in England fewer than 2,000 receivers in all have been sold to the trade, and fewer than 1,000 are actually in the hands of the public. There is but one television transmitter in London, and I was informed that it will probably be two years more before a second transmitter is erected in any other part of England.

The foregoing represents the present status of television in England, despite the fact that geographically its problem is simple compared with the vast area to be served by a television service in the United States. Also, it is to be noted that in England the costs of erecting a television station, the establishment of a special organisation, and the furnishing of television programmes, have been paid by the Government out of licence fees paid by the public annually for the privilege of listening or seeing by radio.

The range of the R.C.A. television transmitter atop the Empire State Building now operated by the N.B.C. from its television studios in the R.C.A. building in New York City, is approximately the same as that of the B.B.C. station in London. The television receivers installed in the homes of our experts, who have been carrying on field tests during the past year, are likewise of the same order of performance as those in use in England.

Problem of Programmes and Stations

The major problem of television, in both countries, is to provide a programme for the home that will meet public requirements and maintain public interest.

To place television on a commercial basis in the United States it is necessary to establish a sufficient number of sending stations that must be interconnected and able to furnish a regular service at least to the population residing within the principal market areas of our country. The erection of such stations, the provision of necessary interconnecting facilities, and the establishment of a regular programme service that would meet public requirements and hold public interest, call for vast financial expenditures before any returns can be reasonably expected.

I firmly believe in the American system of private enterprise rather than Government subsidy; of free radio to the home rather than licence fees paid to the Government by owners of receiving sets; and I have no doubt that in due time we shall find practical answers to the practical problems that now beset the difficult road of the pioneer in television. The road calls for faith and perseverance as well as ingenuity and enterprise; but it is a road that holds great promise for the public, for artists and performers, and for the radio industry.

Random Radiations

By "DIALLIST"

This "National" Nonsense

IT is good to see that some of the lay papers are hammering at the B.B.C. over their preposterous policy in closing down the London and North Nationals until 5 o'clock in the evening on five days each week. Until you come to examine the programmes in detail you don't appreciate just how absurd the whole business is. Did you, for example, realise that on Mondays and Wednesdays the morning broadcast to the schools lasts just a quarter of an hour, from 11.30 to 11.45, or that on Tuesdays and Thursdays it occupies only 20 minutes, between 11.25 and 11.45? Did you know that the special afternoon broadcasts for Scottish schools occupy just 55 minutes on Tuesdays, and 1 hour and 25 minutes on Thursdays? Or, again, have you discovered that during the whole week barely 10 hours is actually devoted to school broadcasts? Possibly you haven't, but these are facts which you can readily verify for yourself. Then where in the name of fortune is the justification for completely disorganising the broadcast service by keeping the London and North Nationals silent six hours and three-quarters every day from Monday to Friday, inclusive?

Is There a Reason ?

One imagines that there must be some reason for this drastic step, though here, as so often, it is exceedingly difficult to follow the workings of the B.B.C.'s collective mind. Is it possible that whoever gave authority for the stations to remain silent until 5 p.m. didn't know how short were the hours actually devoted to school broadcasts? On the face of it it doesn't seem unlikely, for otherwise it might surely have been appreciated that a slight rearrangement of the hours given to schools, so as to prevent them from straying over the programmes at odd times between 11 a.m. and 4 p.m., would have made such lengthy silences quite unnecessary. But there is another fearsome possibility which must not be overlooked: Is the B.B.C. contemplating a vast extension of its broadcasts to schools? Is it to make room for a much more complete educational schedule that this clean sweep of six hours and three-quarters daily has been made? Whatever the reason may be, there is no question that thousands of listeners in London and in the big towns served by the North National are being quite needlessly deprived each week of a large number of programme hours.

A School-Broadcasts Suggestion

It was suggested in a leading article in *The Wireless World* a week or two ago that the use of ultra-short wave transmissions might eventually provide a way out of the difficulties created by the inclusion of educational broadcasts intended specially for schools in the National programmes. I am one of those who believe, rightly or wrongly, that eventually the great bulk of broadcasting will be done on such wavelengths, although it may be some time before this happens. But it does occur to me that transmissions not on ultra-short but on a short wavelength might possibly provide a way out of the present difficulty. I don't mean that these transmissions should be for the whole country; my idea is that only the special Scottish school broadcasts should be given in this way. It is, after all, these that are causing the trouble, and if Scotland could be served without making use of the medium-wave stations for the purpose all would be well. Some experiments from Daventry might be worth trying. One would think that most parts of Scotland should be sufficiently distant to be outside the skip area if a suitable wavelength were chosen. Perhaps Scottish readers will tell us how they receive the Empire programmes from one or other of the "GS" stations? The schools might, of course, object promptly that they haven't got short-wave receivers —but if the educational broadcasts are worth having they'd very soon get them, or have their existing sets adapted.

Television Costs

SOME people are rather appalled by the statement published recently that it costs £250,000 a year to give a satisfactory service of television from a single station. Assessing the number of televisors in use in the London area at eight thousand, they argue that this means that the owner of each of them is receiving thirty pounds' worth of entertainment a year at the B.B.C.'s expense.* That's not quite the way to look at it, I feel. A television service is bound to be costly, because any kind of show must be so thoroughly rehearsed beforehand. We must give television every possible chance to develop for it is clearly the broadcasting of the future. The B.B.C. couldn't possibly say: "Show us 20,000 televiewers first and then we'll provide a service." The only way is to make the service as good as possible, even if it is far from paying its way at first. What worries me, and many others as well, is that the B.B.C. had to find this quarter of a million pounds out of its existing revenue. It has also to pay, without any additional grant, for the Empire service.

And Now Stagshaw

NEXT Tuesday, the 19th, the Duchess of Northumberland opens the North-East Regional Station at Stagshaw. Its coming will be a boon and a blessing for dwellers in large parts of the five northern counties, Northumberland, Cumberland, Durham, Westmorland and Yorkshire. The Newcastle station has long since ceased to be of much use except in quite a small area, and a considerable portion of the North of England has been badly served, so far as the Regional programmes go, for a long time now. As soon as the Start Point transmitter gets to work East Anglia will be about the only region of Great Britain in which the Regional programmes don't come in too well. I hope that the project for the 5-kilowatt relay station in East Anglia hasn't been dropped, for during the last few years I've paid a good many visits to those parts, and I know how indifferent Regional reception is, even with a largish set.

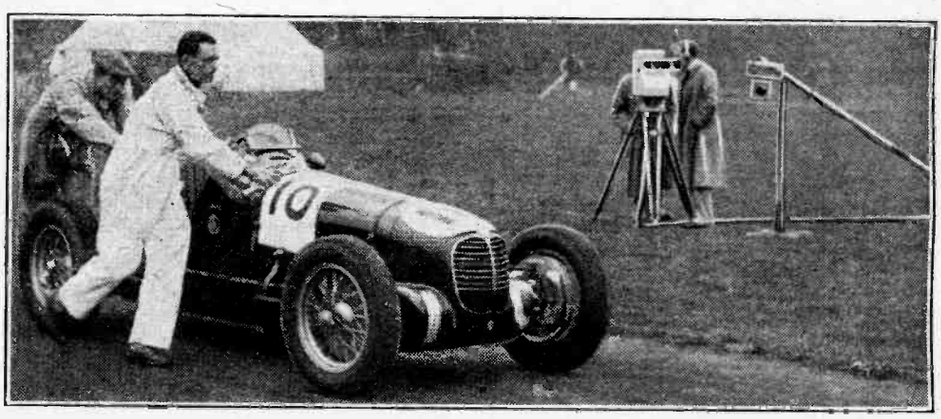
Exit the Bugler !

I KNOW that PA equipment and loud speakers have been used to replace church bells, and even that the voice of the muezzin calling the faithful to prayer from the minarets of the East is in some places now supplied by a gramophone record. But I hardly expected, somehow, despite all the mechanisation that is going on in the world's armed forces, that the duties of the bugler who bids the troops arise from their couches in the morning would be taken over by the disc and the PA amplifier. Nevertheless, this revolution is already in being in America at the Army Air Base at Mitchell Field. When the hands of the guard-room clock point to the unwelcome hour, the sergeant of the guard merely presses a button and instantly reveille rings out loud and clear from loud speakers in every barrack room.

What Next ?

Well, it's an age of progress and I expect that the radio valve will in time take over more duties than those of the early morning bugler. How long will it be before mechanised battalions march past (rumble past? trundle past?) the inspecting Brass-Hat with what Americans call a sound-truck blaring forth the regimental march from loud speakers mounted on its roof? Even that glory of armies, the voice of the sergeant-major, may issue in years to come not from brazen lungs, but from a metal horn!

* A statement on the total number of televisors in London is given elsewhere in this issue.—ED.



The B.B.C.'s Mobile Television Unit once again demonstrated its adaptability when on Saturday last excerpts from the road race for the Imperial Trophy were televised from the racing circuit at the Crystal Palace.

Television in the States

ONE of the surprises provided by the Alexandra Park high-definition plant was that the range of its transmissions turned out to be so much greater than had been expected. They are finding just the same thing now in New York, where experimental programmes have been going out for some time from the tower of the Empire State Building. Good reception is obtained in many places a long way outside a 30-mile radius, and it is stated that a receiver is operating consistently and well at one place 69 miles from the transmitter. The Empire State Building is the tallest in New York, which is saying a good deal. I don't quite know how it compares for height above sea level, or above the surrounding country, with the aerial at Alexandra Park. We are still rather in the dark about the possible range of television transmitters working on the ultra-short waves, for so few experiments have been made with receivers at distances much beyond 70 miles. Personally, I am inclined to look upon these instances of reception at distances much over 40 or 50 miles rather as freaks, and I believe that the true service area for genuinely good reception has a radius not more than double the 25 miles originally estimated, and probably rather less than this.

Starving the B.B.C.

The Ullswater Committee recommended, though they didn't put it exactly in these words, that the B.B.C. should be granted as much of the licence fee receipts as it genuinely needed. At present it is getting something like one and a quarter million pounds less than the licence fees bring in and its financial needs are very large. There's Broadcasting House part two to be built, and the Stagshaw and Start Point stations to be paid for. The London and other of the older Regional stations are just about due for reconstruction, for they all ought to be brought up to 100 kilowatts. And then there's the development of the television service. The B.B.C. people have a very strong case for pressing now for a bigger grant.

Wireless and Fish

NOT long ago I mentioned that your wireless set could be a pretty good indicator of whether you were likely to be successful on setting out for a day's fishing for salmon or trout, or might have, on your return, to score bad marks from the recording angel by excusing your failure with tales of the big ones that were lost. My point was that if you switched on before faring forth and found atmospherics bad it was more than probable that you would have a poor day. A reader from Hayes tells me that he has scored big successes with fish in general on days when atmospherics were poisonous, and even when thunder could be heard rumbling in the distance. Most of us, without descending to anglying, could tell of similar experiences. But these, I think, are just the exceptions that go to prove the rule. Generally speaking, if your loud speaker is full of crackles, bangs and frying noises, it isn't much use going out with rod and landing net. But anglers and angliars are equally queer creatures, for if they are bent upon that "fysshinge with an angle," of which Dame Juliana Berners wrote centuries ago, nothing will convince them that prospects are not hopeful, even if they know that they aren't. And sometimes fish break all the rules by coming madly on to feed at times when they should by every precedent be glued firmly to the bottom of river, lake or pond. Still, in the ordinary way, I back my wireless receiver as a pretty fair indicator of angling prospects.

Television's Birthday

VERY soon now we shall come to the first birthday of our high-definition television service. There certainly has not been the rush to buy televisors that was anticipated just before the service started; but I believe that television is catching on slowly and that it won't be so very long before it becomes a great deal more popular than it is now. I have asked a lot of people lately who could well afford television sets, but hadn't got them, why they didn't take the plunge. An answer that I have had from several non-technical folk is to the effect that television in its present form seems too much bother. If, they say, there was a large, well-lighted screen it would be simple enough; but we don't like the idea of having to get up out of our armchairs and to switch off the lights before we can look-in. You may condemn that as a mere confession of laziness, but hobbies of this kind have to be made to suit lazy people. Don't forget that ordinary wireless received a tremendous fillip when the introduction of the wave-change switch did away with the need for pulling out one lot of coils and sticking in a second before you could go from one waveband to another.

A Manual of Public Address

LIKE its predecessor, the new edition of the Partridge PA Manual will prove a valuable source of information to all who are concerned with the technical aspects of Public Address. Incidentally, the new publication has been entirely re-written and the scope is now more general.

A summary of the chapter headings gives a good idea of the ground covered: Electro-Acoustics, Power Amplifiers, Elimination of Hum, Input Circuits, Output Circuits, Pre-Amplifiers, with a concluding section dealing with the Partridge Technical Service. Sources of supply and applications of PA form the subject of appendices.

The special problems of the PA engineer in the matters of power requirements, frequency range and, above all, of balance, are treated from a very practical aspect in the opening section, while in the Amplifier chapter the three main classes are discussed, and a useful table of valve-operating conditions is given.

Copies may be obtained for 2s. 6d. from N. Partridge, B.Sc., King's Buildings, Dean Stanley Street, London, S.W.1.

Short-wave "Radiochron" Receivers

THE "Radiochron" clock-receiver reviewed in our issue of June 4th, 1937, is now to be produced as an all-wave set. There will be two models, both at 15 guineas, one of which will cover a short-wave range of 16-31 metres, and has also a long-wave range in addition to the medium-wave range, which was the only one provided in the original model. The other receiver is a special Colonial model in which the long-wave band is replaced by a second short-wave range giving a total coverage of 13-50 metres; the medium-wave range is, of course, retained.

Recent Inventions

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

TELEVISION RECEIVERS

IN a set designed to receive either one or the other of two picture transmission systems, such as the Marconi or Baird, which operate with different scanning frequencies, means are provided to facilitate the necessary adjustments.

The handle of the "selecting" device moves in a T-shaped slot, and when placed at the lower or stem end of the slot the set is switched off. When the handle is moved to the upper end of the stem, the set is switched on, and an automatic indication is given as to whether it should be moved over to the right to receive one type of signal, or to the left to receive another. Simultaneously, the size of the scanning spot is controlled.

The selection of a particular programme is effected by means of two branch circuits which are tuned respectively to the two different scanning frequencies used. The circuits energise one or other of two tuning forks, and the one that is set in motion allows the light from a lamp to shine through, in order to indicate the direction in which the control handle of the set should be moved.

Marconi's Wireless Telegraph Co., Ltd., and A. A. Linsell. Application date December 3rd, 1935. No. 466866.

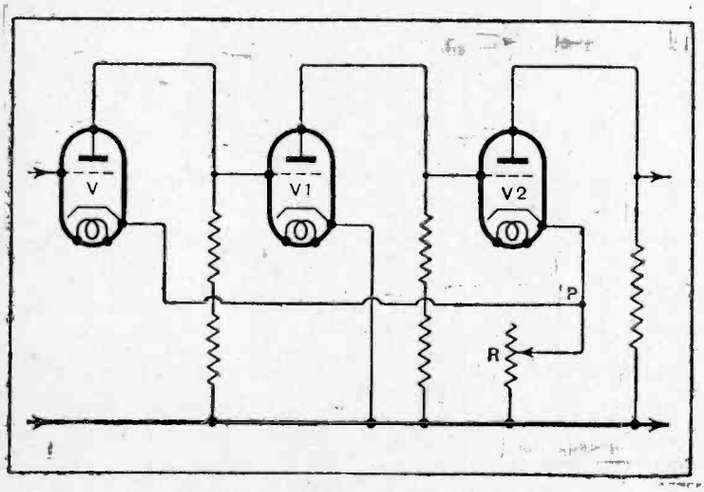
o o o o

AUTOMATIC VOLUME CONTROL

THE usual method of applying automatic volume control by using a variable-Mu valve tends to cause distortion, since it depends for its operation upon the curvature of the valve characteristic. It is also liable to produce cross-modulation, particularly when receiving weak signals.

According to the invention, AVC voltages are derived by a method of reaction which does not involve any valve curvature. The Figure shows a skeleton circuit in which the cathodes of the valves V and V2 are connected together at P, the circuit being completed through a variable feed-back impedance R. With this arrangement the feed-back is negative so that an increase in the value of R will decrease the "gain" and increase the rectilinearity of response. On the other hand, if the feed-back is positive, an increase of R will increase the gain, but decrease the straight-line factor. The reactive link may include a diode valve which is associated with resistances in parallel or in series, in order to straighten out the working characteristic.

Marconi's Wireless Telegraph Co., Ltd., and N. M. Rust. Application date December 16th, 1935. No. 467430.



Method of applying AVC without distortion.

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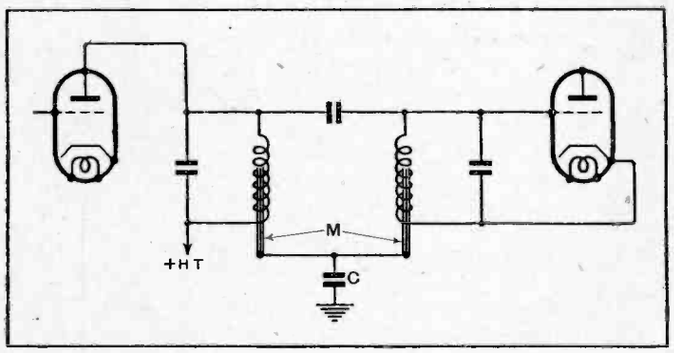
PERMEABILITY TUNING

FOR constant selectivity, the coupling coefficient between the high-frequency circuits of a wireless receiver should vary inversely with the signal frequency. With this object in view, advantage is taken of the fact that a small but useful capacity effect exists between each magnetic core M and the winding into which it is inserted, and that this capacity varies as the core is moved in and out of the winding.

The two circuits shown in the figure are ganged together, so that, as the cores are moved inwards to tune to a lower frequency, the capacity coupling between the circuits is increased. The cores M are connected together and earthed through a condenser C. The condenser may be replaced by a parallel or series circuit, tuned so as to emphasise any desired part of the total frequency range. This allows variations in the inductance-to-resistance ratio of the coils to be compensated.

Johnson Laboratories Inc. (Assignees of W. A. Schaper). Convention date (U.S.A.) June 26th, 1935. No. 467637.



Permeability tuning system giving uniform selectivity.

o o o o

PREVENTING INTERFERENCE

RELATES to means for protecting a wireless or television receiver from transient disturbances, such as those due to the ignition system of an internal combustion engine. The high-frequency circuits consist of a main channel which is highly selective, and a parallel channel of lower selectivity, the latter being arranged to reduce the amplification factor of the former during the persistence of the interfering impulses.

The branch channel is provided with an AVC system responsive to the amplitude of the received signals. A delay network is provided to allow the main amplifier to be disabled before the interfering impulses can reach it and to keep it out of action during their persistence.

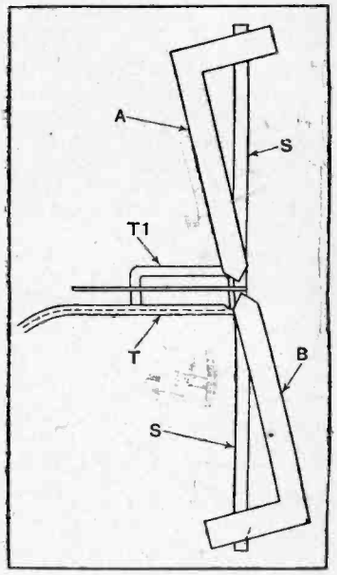
W. S. Percival. Application date November 8th, 1935. No. 467263.

o o o o

TELEVISION AERIALS

IF there is insufficient room to install a full-length half-wave dipole, any attempt to "load" a shorter aerial up to the required electrical length necessarily sharpens the tuning, and so leads to a falling-off in its response to the full range of side-bands used in television.

The difficulty is overcome by bending each of the "limbs" A, B of the dipole into the L-shape shown in the Figure, and at the same time increasing the surface area of the aerial so as to offset the increased selectivity due to the deformation. The limbs are mounted on a vertical support S, and are fed through a "branched" transmission line T, T1. The branched part of the line acts as a rejector circuit to prevent the flow of signal currents along the external sheath.



Construction of a television aerial.

E. C. Cork. Application date November 30th, 1935. No. 466516.

o o o o

LOUD SPEAKERS

INSTEAD of applying the drive at the centre as usual, it is applied to a point on the periphery of the cone, and in a direction along its wall towards the apex. The arrangement is stated both to favour the production of the higher frequencies, and to restrict undesirable resonance effects.

W. Ditsche. Convention date (Germany) December 19th, 1934. No. 467516.

o o o o

PHASE DISTORTION

PHASE distortion of the "linear" type occurs when the phase-angles of the sidebands, relative to the phase-angle of the carrier, cease to be proportional over a working range of frequencies. Phase-intercept distortion also recurs when the frequency of the modulating signal is zero, but the phase-angle has a value other than zero (or a multiple of π).

Both types of distortion are eliminated, according to the invention, by using a double-beat system of heterodyne reception in which the signal frequencies are first inverted and afterwards restored to their correct phase-relation.

Ferranti, Ltd.; M. K. Taylor; and S. Atkinson. Application date September 10th, 1935. No. 467332.

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CONTENTS

EDITORIAL COMMENT

Something Better

Trend of Demand in Sets

THERE has been much talk of saturation point in the number of wireless licences in this country having been nearly reached, and as we approach closer to this situation it is natural to expect that there will be fewer and fewer people buying a wireless receiver for the first time. This will mean that the manufacturer, and particularly the salesman, will have to readjust ideas on salesmanship, for in the future it will no longer be a case of selling sets on the old argument that if you do not use a set you are missing the entertainment which broadcasting provides. Instead, it will be necessary to impress the public with reasons why the set already in use should be changed for another.

The very cheap sets have undoubtedly made their contribution towards bringing wireless into thousands of homes which might otherwise have been denied this benefit, but it seems to us that it is in the cheap set market that a slowing up in demand will be felt first. Those who have not much money to spend may be expected to hold on to their sets for several years, and, where they are acquiring a set on an instalment-payment basis, there is still less inclination to change the set than if it had been bought outright.

It seems, therefore, that it is in the more expensive market that sets will be changed most frequently, and this brings us to the point that existing sets will not be readily changed unless the manufacturer, and the salesman in particular, are able to show that the technical improvements effected year by year are sufficiently attractive to prospective buyers.

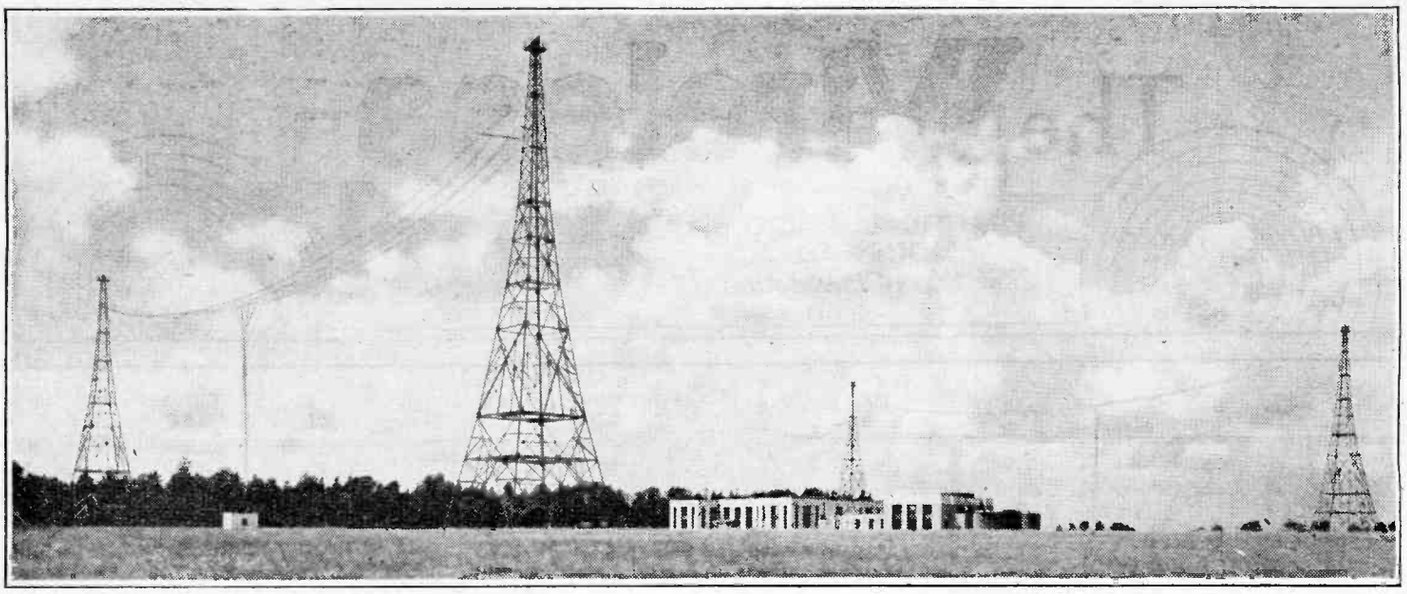
Two or three American firms specialising in big sets of the more expensive type have recently announced their intention to start production here and we believe that it is sets of this kind which will tempt owners of less ambitious receivers to make a change. The nearer we get to saturation point in the licence figures, the more demand, it seems to us, will there be for more ambitious sets with new technical features offering a marked improvement in performance over less expensive types already in use, and still giving excellent service except on the basis of comparison with "something better."

Daventry's Future

Foreign Office Influence

THE future of Empire broadcasting seems at the moment to lie largely in the hands of a Foreign Office committee which has been appointed to investigate the question of how to make the best use of overseas broadcasting potentialities. It will be remembered that the committee which sat on broadcasting prior to the renewal of the B.B.C.'s Charter recommended that in the interest of British prestige and influence in world affairs the appropriate use of languages other than English should be encouraged in connection with the Empire service.

If the Empire station at Daventry becomes a world propaganda service, which seems a very likely move, it will not be used, we may feel certain, as a weapon against any other nation, but to spread honest news, the object of which will be to counteract the influence of misleading or directly untruthful propaganda distributed by some other countries.



Atmospheric Cross-Modulation

EFFECT OF THE WEATHER ON "GHOST" SIGNALS FROM BROOKMANS PARK

By W. L. HAFEKOST

IN the vicinity of powerful twin-wave transmitters cases have been observed where new frequencies, differing from those of either station, have been detectable. The production of these spurious frequencies has often been traced to the presence of a partial rectifier in waterpipes, electrical wiring, metallic conduit, etc. But similar effects have been noticed in circumstances where all possibilities of local rectification seem to be entirely precluded. The author of this article, in dealing with effects of this nature, describes his observations on the influence of the weather on "secondary-beat radiations" from the Brookmans Park transmitters, and suggests a theory to explain the effect, assuming that the cross-modulation takes place in the atmosphere. Observations were carried out on a re-radiated "spurious" signal of a frequency equal to twice the frequency of one station plus the fundamental frequency of the other.

INSTANCES of cross-modulation due to causes external to the receiver and detectable at short distances from transmitting stations have already been reported and discussed in this journal.* Another kind of interaction discussed by the present writer in *The Wireless Engineer* of June, 1936, is not so local, some of its effects having been observed within a daylight radius of approximately thirty to forty miles from the twin broadcasting transmitters at Brookmans Park.

The receiver used in investigating these effects can be regarded as beyond suspicion, while in all three different aerials were utilised. One was permanently fixed in the roof of the car, another was a simple loop giving directive results, while the third aerial consisted of a length of covered wire slung into the outer branches of the most convenient tree. By the separate use of all three aerials, information was obtained enabling the writer to steer clear of any local rectification effects.

It should be said that observations were only made in sparsely populated areas. The writer agrees that it is sometimes possible to produce beats by means of faulty aerial contacts. The influence of telephone or supply wires was also known, and was discussed in the first paper on this subject. After several weeks it was thought that there was cause to suspect the point, or points, of interaction as being in the vicinity of Brookmans Park itself, and daily measurements were then undertaken of the 2903-kc/s "secondary beat" radiation, this being chosen because of its strength and freedom from interference. An amazingly consistent series of measurements were obtained which reflected the influence of weather conditions upon this particular radiation in most sensitive manner. To the writer it is incredible that any partial contact should give such remarkably consistent results over a period exceeding 16 months. Even should the source of interaction eventually be traced to some earthly point, the manner in which the interaction varies with differing weather conditions will surely be worthy of investigation.

Here, perhaps, it would be appropriate to summarise the observations and deductions made after comparison of the carrier measurements with weather charts and local weather observations. It has been noticed that from late autumn until early spring, when day temperatures usually average below 50 deg. F., the highest mean carrier strengths were obtained, maximum strengths being noted when the barometric isobars were about parallel to the signal route (Brentwood-Brookmans Park). With the advent of rain, hail or snowstorms, strengths invariably fell to about 30 db. below this maximum, attenuation being greatest during calm conditions. Recovery from these low carrier levels was found to be dependent upon temperature and wind velocity. Incidentally, the frequent abrupt strength variations, described in the *Wireless Engineer* article, have now been found to synchronise more closely with winds above a certain critical value, which varies according to temperature, than with pressure changes, as previously stated. Coinciding with a sustained rise in temperatures above 55 deg. F., the beat strength shows increasing deterioration, and the influence of isobar direction

* *The Wireless World*, June 4th, 1937.

Atmospheric Cross-Modulation—

upon signal strength becomes almost unnoticeable. The abrupt variations become less significant in frequency and magnitude.

Only upon a certain amount of air disturbance are high strength measurements again observed, these being terminated either by a period of calm weather—the length of the period depending upon prevailing temperatures—or by the occurrence of rain or thunderstorms. With the latter occasionally synchronise some of the most severe and prolonged attenuation, this being of inverse ratio to prevailing wind velocities. Attenuation is also observed to increase with the severity, duration and precipitation of the storm. As in the case of steady rain, the weak strengths persist for several days, depending chiefly upon wind force and temperature. A short list of monthly average values for 1936 of signal attenuation, temperature, wind "run," and rainfall has been set out in Table A. The varying influence of the latter three factors upon signal strength is clearly marked.

In addition to the carrier measurements, observations have also been made upon the modulation, and this has shown that there were very few days when distortion, in one form or another, was not present. Perhaps the most outstanding type has been where only one programme was affected. This, most frequently, was the London Regional programme, although there have been some occasions when the London National alone showed distortion. To the writer it was extremely fascinating to hear one programme creating a rasping or grumbling background, often scarcely audible, and frequently to a varying accompaniment of crackles and mush, while in the meantime the other programme was audible with practically all the brilliance of the fundamental transmission. There also appeared to be selective forms of distortion, where only certain frequencies, or bands of frequencies, were affected. Some days there were vibratory resonances in the lower audio frequencies, these fluctuating chiefly between 100-400 cycles. During severe distortion of this type the higher frequencies were very noticeably attenuated. Contrarily, there were occasions when the lower frequencies showed bad splitting or breaking up. The boom of a drum would be almost obliterated, a feeble crackling noise only being heard. It was noticed that resonances on one programme occasionally affected the modulation of the other, and, at times, the carrier strength.

Although both programmes frequently suffered during periods of selective distortion, the Regional transmission has so far been the greatest sufferer. Severe distortion has not necessarily coincided with wide variations of carrier strength, although these were sometimes preceded, or followed, by heavy mush and scratching. During thundery conditions, in addition to surges and fades of the carrier following some atmospherics, there were also observed three or four rhythmic variation in the depth of modulation of the signal.

Up to the present it has not been possible to obtain definite correllation between the varying types of distortion and any weather phenomena. This may be owing to the lack of meteorological information for the neighbourhoods of Brookmans Park and Brentwood. It has been noted, however, that during several occasions when distortion was absent, there were stable conditions of humidity and temperature over a fairly wide area of Southern England. All the evidence, however, is as yet incomplete.

TABLE A.

Month.	Mean Values.			
	Signal attenuation.	Temperature*.	Wind "run."*	Rain*.
	db.	°F.	miles.	mm.
March	18.4	46.1	5,205	25
April	18.6	45.1	6,514	40
May	20.1	54.7	6,454	13
June	25.4	61.7	4,567	90
August ...	23.7	62.7	4,085	12
September ...	29.3	59.9	5,153	71
October ... (12 days only)	20.2	49.7	6,354	45

*Meteorological Office figures for Kew.

Now to anyone with knowledge of the more recent discoveries in wireless research, some of the observations must undoubtedly give considerable food for thought. It will, however, undoubtedly be suggested that heat expansion at a poor electrical joint would impair the rectifying properties of that part of a wireless circuit, and thus account for the reduced strengths noted. Also, that vibration, however slight, caused by the wind, would account for the wide variations of strength. That rain at such a point open to the atmosphere would also impair any rectifying properties. How, though, will the incidence of isobar direction be accounted for? How will the surges and fades caused by distant thunderstorms be explained? Or the rhythmic variations in the depth of modulation? Why do not the strengths follow temperature changes more closely instead of showing a distinct lag, sometimes for several days?

When one compares the beat measurements with measurements of the fundamental transmissions, certain similarities are noticeable. With rain, or in periods of high winds, the fundamentals also show variations, although not to the same degree. With measurements of local short-wave stations the variations are also noted, although still much less than the beat variations. The influence of isobar direction on short-wave reception has been previously reported by other observers. Thunderstorms have been reported to replenish reflecting regions in the middle atmosphere, and perturbation of these layers has been found to coincide with high winds. Thus it is evident that the variations of the beat effects have some similarity to the variations caused by reflecting layers to normal transmissions. There is, however, this difference: the variations of the beat effects are very much more intense than those of normal transmissions. Naturally, the cause of these extreme changes has been attributed to a varying coefficient of interaction, and from this point a fairly comprehensive theory has been built up, assuming the cross-modulation to take place in the atmosphere.

Referring to the observations, it was noted that a large decrease of strength occurred upon a certain amount of precipitation. The attenuation, although abnormal, nevertheless remains susceptible to temperature and wind velocity. It seems conceivable that any oscillatory motion of electrons in the atmosphere, created by either of the fundamental transmissions, may be reduced by the presence of water molecules. With a reduction of electron density following upon increased temperatures, it is also feasible that the damping effect would be greater. While, with an increase of air disturbance, it is plausible to suggest that assistance may thus be rendered in overcoming inertia, or reluctance to displacement, of electrons. That there is an inertia effect seems fairly evident from careful consideration of the measurements.

With thunderstorms the excessive attenuation noted may be attributed to a number of circumstances. First, perhaps, to the improved reflective properties of the newly discovered low-level layers, and also to the high temperatures which usually accompany the storms, reducing electron density, and also to the presence of water molecules. The rapid surges and fades accompanying thunderstorms could be attributed to rapid variations of the amount of interaction created by the destruction, or liberation, of electrons following lightning discharges, creating a shock effect upon the surrounding atmosphere. This may account for the several rhythmic variations of modulation observed to follow upon "lightning" atmospherics.

Referring to the influence of isobar direction upon the beat strengths, it is thought that this also indicates variations in the degree of interaction. Changes of strength of nearby short-wave transmissions, due to isobar variations, rarely exceed 4 db., yet the strength variations of the beat under similar circumstances extend perhaps to 20 db. It is known that in the higher atmospheres the wind blows along the isobars, and it has been shown that wind velocity greatly influences the strength of interaction. What then more improbable than that the direction of the wind should also be of importance? It is thought that the increased beat strengths illustrate the ability of wind direction to assist in the oscillatory motion, or exchange of electrons, between adjacent air molecules, thus facilitating interaction along the direction of the wind. When the velocity of the wind is greater than the critical value, the ensuing perturbation then creates extensive variations in the coefficient of interaction.

Radio and Art

IDEAS ON THE OUTWARD FORM OF THE RECEIVER

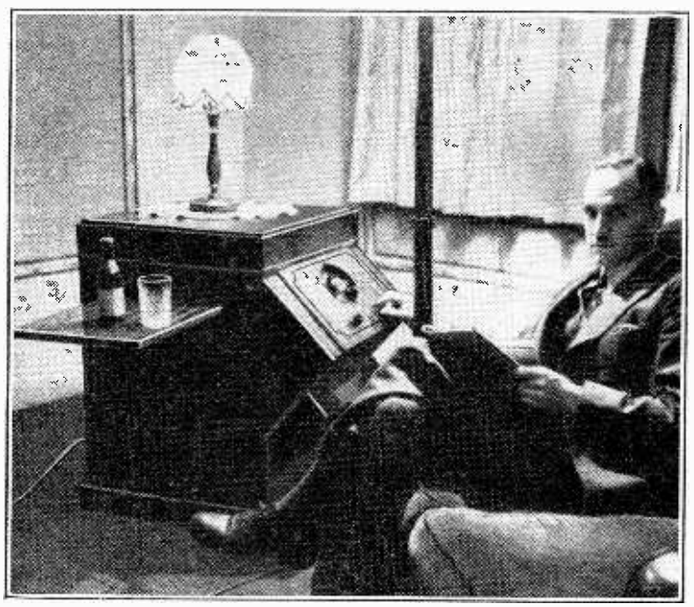
By "CATHODE RAY"

"Controls for the most part ludicrously ill-adapted to the comfortable use of anybody but a circus contortionist."

WHAT should Radio look like? The question has been argued time and again. Meanwhile, pending its indefinitely deferred answer, the manufacturers keep on turning out a stereotyped form of receiver whose disadvantages have so often been announced in *The Wireless World*. Fifteen years' discussions of the question seem to have achieved no general agreement on whether the domestic receiver should look like itself, like something else, or like nothing at all—i.e., to be heard and not seen. Except, perhaps, that the middle alternative seems to be losing ground, if it hasn't already lost it. Lay reporters of the annual Show in its early years used to find plenty of welcome stories in the sets made to look like umbrellas, Chinese pagodas, grandfather clocks, and Etruscan vases. Even now many people, particularly those who delight to live in antique or historic surroundings but are not bigoted enough about it to do without radio altogether, disguise their sets in old chests and other "pieces" of the appropriate period; but my own feeling is that they are really aiming at the third choice—concealment — rather than the creation of a radio art form.

Of course, looking at radio from the artistic standpoint (and everybody does, whether they admit it or not —or why do they go to Radiolympia?) the whole trend of modern opinion backs the first idea—that art is best realised in perfect adaptation to purpose. Judged by this standard, the present-day radio set fails to qualify. Disregarding such special types as portables and motor sets—which with all their shortcomings are at least designed primarily for their jobs—we have the table and the console types. Table models are bad acoustically and the controls involve more or less awkward hand positions and often much peering. Console models, which include most radiogramophones, *can* be better acoustically, but sometimes are even worse, and controls are for the most part ludicrously ill-adapted to the comfortable use of anybody but a circus contortionist. And both inflict on their users the choice of having to get up and cross the room every time an adjustment even of volume is wanted, or else of sitting in the jaws of the loud speaker.

One can buy receivers with control and reproducer portions separated, but only at great cost and with grim determination. The dealer probably "has never heard of such a thing!" Why the cost? It can be understood that sets ordered with non-standard features such as a push-pull output or a special control must cost much more than standard prices or even be rejected by the manufacturer altogether, because the low prices of standard models are possible only by making many thousands of them exactly alike. But as long as a manufacturer can turn out thousands of chassis and thousands of loud speakers he is quite happy, and whether he or somebody else has to assemble them together or separately ought not to make a vast difference to the selling price.



"The only arrangement I have seen that displays real intelligence." The cabinet that thus arouses "Cathode Ray's" enthusiasm was designed by a reader, Mr. W. Ewart Puddicombe, to house a Single Span receiver and Quality Amplifier.

The chief obstacles, apparently, are that it is easier to pack, transport, distribute, stock, sell, and install a set in one unit instead of two; and the customer is always inclined to jib at the prospect of any more wires trailing about the place. Yet it has been demonstrated recently—and by a Government department too—that it is possible to popularise equipment labouring under these disadvantages, if such they be. What happens when you get a telephone? A helpful man comes on request and takes a note of what sort of service you want, whether you like a green, blue, pink, or white instrument, or merely the ordinary black. You sign your name; the installation consists of several units which you can have together or separately in the most convenient positions; the wiremen come and put everything in without bothering you with technical problems; and you do not complain about trailing wires.

A more substantial difficulty in the way of designing radio to serve its purpose best is that, if a high standard of reproduction is aimed at, the acoustic requirements are rather awkward. The speaker mustn't be boxed in, for fear of bass resonance; yet it mustn't be left open, or the bass disappears altogether. The alternatives are an infinitely large—well, say four or five feet square—non-resonant flat baffle, or a horn half as large as the house. At least one enthusiast did actually make his listening room the mouth of an enormous horn, but the practice would have drastic effects on domestic architecture as now understood if it were adopted widely. And the large flat baffle is the interior designer's despair.

Built-in Equipment

Yet the complaint that a loud speaker to do its job really well is impossibly cumbersome, heavy, and costly, does not seem to stop a large proportion of the population from finding room for a piano, which is still heavier, costlier, and more cumbersome, and in 999 homes out of 1,000 far less entertaining.

Personally I incline strongly in the direction of built-in equipment. We live in a transitional age of domestic construction. The mechanisation of homes is developing so rapidly that the architecture of them, which in the nature of things moves more slowly, never has time to catch up. Even the ultra-modern flats wired for television will probably be technically out of date in a few years. At the present time it is the exception

Radio and Art—

rather than the rule for a new house to be adequately wired even for electricity, and the hope of finding an intelligently planned broadcast wiring system is remote indeed. But it is bound to come in time, if some new invention doesn't supersede broadcasting before the speculative builder has had time to become aware of its existence.

The control unit may be installed in some inconspicuous cupboard like an electricity meter, and worked by remote control if the family are not interested in station-searching and only want to switch on the locals. If so, its form is purely utilitarian like that of any other piece of electrical equipment such as a fuse box, and need be no less artistic for that. If the control unit is to be in a living-room, and available for constant use, it obviously must harmonise with the surroundings, and a different treatment is called for; but a thoroughly practical one. Some years ago *Wireless World* readers were invited to send in their ideas about this. I wasn't very much impressed with most of them, but more recently some pictures showing an idea actually in use were published, and are brought out again here for further inspection. I am sorry not to be acquainted with the designer, for his arrangement is the only one I have seen that displays real intelligence. I hope the radio industry will please copy, and reward him handsomely.

"Cathode Ray's" ideal receiver is just as convenient for gramophone as for radio reproduction. A separate loud speaker is, of course, used.

That still doesn't solve the loud-speaker problem. Of course, in the less important rooms some acoustical imperfection can be tolerated, and the ordinary cabinet extension speaker will do. It is too soon yet, no doubt, to expect to have it built-in. And the builder would probably make a mess of it through failing to realise that free space is required behind as well as in front. If it is to serve two adjoining rooms there is no difficulty, except that it must be heard in both or neither.

I have an idea. You remember the acoustic labyrinth I described a few months ago, in which the backward wave is prevented from resonating in the cabinet by being led into a long folded passage lined with absorbent material? Now that chimneys are, or ought to be, becoming disused, why not line them with slag wool (if they are not already thickly lined with soot!) and build the loud speakers into the fireplaces? Perhaps the new houses will have acoustic passages built in.

But that is getting away from the subject. I had intended to discuss something that seems to be entirely unknown in this country, although it has been practised in America for a number of years. It is called Dynamic Symmetry, and its application to artistic radio design was dealt with by Van Dyck (appropriately enough!) in the *Proc. I.R.E.* of September, 1932. Just lately a series of articles on it has been running through *Radio Engineering*. Art is generally considered to be outside the province of the technical man, but as the editor of the last-named journal says—"Put it so that it can be doped out on a 'slip-stick' and art will immediately attract the engineer."

Translated into English a "slip-stick" is a slide-rule, and, from what I have gathered of the subject, practisers of Dynamic Symmetry would find it useful to have the constant 1.618. . . marked on theirs, along with π and $\frac{1}{2\pi}$. This number; which, incidentally, is $\frac{1+\sqrt{5}}{2}$, seems to have a fundamental significance in nature, mathematics, and art. For example, the numbers of seeds in a pair of sunflower pods are invariably found to be in this ratio, as nearly as whole numbers allow. Then take any two numbers and form a series by making each term equal the sum of the preceding two, such as 1, 2, 3, 5, 8, 13, etc., or 2, 9, 11, 20, 31, etc.; and, whatever the original two numbers, the ratio between adjacent terms invariably tends towards 1.618. Lastly, and more relevantly, it seems that forms proportioned on the basis of this same magic number are more pleasing to the eye than those that are not. Whether it is genuine art or merely quackery, it makes very interesting reading.

In my own experience of radio cabinet design the leading dimensions are decided by what will get everything in without too obviously unsaleable a resulting external appearance; and the latter question invariably provokes heated arguments between engineers, sales managers, and directors, every one of whom has an irreconcilably different conviction of what looks right. Whether there is anything in this 1.618 theory or not, it would be worth while if it could get some sort of systematic reckoning of cabinet and control layout accepted by all.

Components and Accessories

AS a source of information on specialised components and accessories of the kind that appeal particularly to the amateur enthusiast, the 1938 catalogue just issued by Premier Supply Stores is especially useful. In this comprehensive 90-page book much space is given to short-wave apparatus, including complete "communication" receivers, but the other wavebands have not been neglected.

Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Vision	Sound
45 Mc/s.	41.5 Mc/s.

FRIDAY, OCTOBER 22nd.

3, "Queue for Song." **3.25,** British Movietonews. **3.35,** Preview: highlights of next week's programme. **3.40,** "The Eve of St. Agnes": a Pepler masque of Keats'.

9, "100% Broadway." **9.25,** Portrait of an eminent Victorian, described by W. E. Williams. **9.35,** Preview. **9.40,** Gaumont-British News. **9.50,** "Pas Seul" ballet.

SATURDAY, OCTOBER 23rd.

3, In Our Garden: C. H. Middleton. **3.15,** Puppet Parade: a demonstration by the British Puppet Guild. **3.30,** Gaumont-British News. **3.40,** Cabaret.

9, Television Follies. **9.20,** British Movietonews. **9.30,** "The Happy Journey to Trenton and Camden": a comedy by Thornton Wilder. **9.55,** Cartoon film.

MONDAY, OCTOBER 25th.

3, Songs from "Balalaika." **3.20,** Gaumont-British News. **3.30,** "Cradle Song," by Gregorio Martinez Sierra.

9, Comedy Act. **9.10,** Music Makers: Marita Farrell. **9.20,** British Movietonews. **9.30,** "Full Moon": a revue for television.

TUESDAY, OCTOBER 26th.

3, Comedy Act. **3.10,** British Movietonews. **3.20,** "The Immortal Hour," a musical drama by Rutland Boughton.

9, Speaking Personally—4: The Hon. Harold Nicolson. **9.10,** Gaumont-British News. **9.20,** "The Immortal Hour."

WEDNESDAY, OCTOBER 27th.

3, Television Follies. **3.20,** Gaumont-British News. **3.30,** Eighty-ninth edition of Picture Page.

9, A Little Show. **9.20,** British Movietonews. **9.30,** Ninetieth edition of Picture Page.

THURSDAY, OCTOBER 28th.

3, Cabaret. **3.25,** British Movietonews. **3.35,** Theatre Parade.

9, Starlight: Steve Geray and Magda Kun **9.15,** Clothes-Line—3: Fossilised Clothes **9.30,** Gaumont-British News. **9.40,** Ballet.

The Future of Daventry

UPHEAVALS at Daventry may follow present deliberations of a Foreign Office Committee which is discussing the whole question of the future of Empire broadcasting. Readers of *The Wireless World,* which ten years ago published the first suggestion of an Imperial broadcasting service, will watch the trend of events with uncommon interest.

Money . . . and More Money

Empire broadcasting is faced with financial crisis. The writing first appeared on the wall when the B.B.C. pleaded poverty as an excuse for not spending a few thousands for "physical jerks" broadcasts before breakfast.

Very soon a campaign will be started for financial assistance from the Dominions and Colonies. The alternative will be considerable curtailment of activity at Daventry.

Mr. Thomas's Hope

The supporters of the campaign will presently point out that British broadcasting did not originally envisage anything like an Empire service, and they will recall a speech of Mr. Thomas when he was at the Dominions Office. Mr. Thomas said that he fully realised the desirability of obtaining more contributions to the service from the Dominions and Colonies *when the service was fully established.*

Dominions Won't Pay

What is desirable and what is obtainable are two different entities, as the landlady said to the lodger.

The Dominions are now well equipped with broadcasting services of their own. Why, they argue, should they pay for a supplementary service from Britain? If the home country wishes to maintain a spate of broadcast programmes for world consumption, let her own Government pay.

Position of the Colonies

The Colonies and smaller dependencies adopt a different attitude. Many of them, having no broadcast service of their own, would gladly contribute to the Empire programmes, but any sums they could raise would hardly pay the wages of the night watchman at Daventry.

Daventry to Go International ?

Faced with this problem, the Foreign Office may act in several ways. A probable course would be to constitute Daventry as a world propaganda station, keeping pace with its opposite numbers in Germany, America, Holland and France.

Multi-lingual transmissions would follow, despite the recent curious remark of Mr. J. B. Clark, Chief of the B.B.C.'s Empire Service, that Daventry will stick to English. That Daventry will become polyglot in the near future is almost certain.

BROADCAST BREVITIES

NEWS FROM PORTLAND PLACE

Televising from St. George's Hall

THE first composite sound-cum-television show from St. George's Hall—a Saturday night Music Hall in December—is now being discussed, but no definite arrangements have been completed. Difficulties are largely technical. The television cable from Alexandra Palace ends inside Broadcasting House, and means will have to be found for bridging the gap between there and St. George's Hall.

Forging a Link

That the cable will be extended across Langham Place is unlikely. More probably the scanning van would be parked next door to St. George's Hall, with the normal trailing cable forming the link with amplifier racks in Scott's Hotel, about 200 yards away, in Langham Street.

This is one of the buildings included in the site purchased for the extension of B.H. and is being converted for temporary occupation by some of the staff previously accommodated in adjoining buildings.

Under the Southern Cross

SEVERAL of the more important members of the B.B.C.'s engineering staff are each hoping inwardly—and fervently—that in a certain eventuality he may be the favoured one chosen to represent the Corporation at the World Radio Convention which is to be held in Sydney next year.

That "certain eventuality" is that the Chief Engineer may not be able to make the trip and absent himself for so considerable a period from important moves in the radio world nearer home. The Cairo Conference is an inescapable liability for Sir Noel Ashbridge, who will, no doubt, be presented with sufficient resulting problems for a long time afterwards. But the B.B.C. should not be left out of the Sydney Convention. The question is, who can be spared for three or four months?

Truth About Stagshaw

NOW that the Stagshaw transmitter is working, the oldest inhabitant of Bewclay should have a hearing. He would tell you that the station is masquerading under a wrong name. Actually, it is a good mile from Stagshaw Bank, the station site actually being at Bewclay, near the Roman Wall which stretches from Solway to Tyne.

Bewclavians say they have had a raw deal; even the Stagshavians feel a bit sheepish about it.

Do Modern Mikes Terrify ?

COMPTON MACKENZIE, in a television talk last week, referred to the frightening aspect of the modern microphone as compared with the dear old "meat safe" type at Savoy Hill. "You felt," he said, "that you could caress those early microphones, but these modern microphones are terrifying."

Funny part is that the ribbon mike of to-day is much kinder to the speaker than the old low cut-off type.

Wanted—An Artist

But technical efficiency is not the only consideration. An artist should now be engaged to design a microphone as æsthetically satisfying as the modern telephone. It could be done.

Without Comment

THE other day the B.B.C. advertised for a sub-editor for the News Department, stating that journalistic experience, though desirable, *would not be necessary.* On the same day the result of the most important horse race of the season was omitted from the news bulletin.

"B.H." in Air Raids

GREAT amusement has been caused at Broadcasting House by the announcement "splashed" in a national paper that in the event of air raids in war time Broadcasting House would be closed down; this in order to prevent enemy aircraft from using broadcast transmissions for direction-finding.

Carrying On

No; B.H. would still function, though with an attenuated staff and not with its control room on the seventh floor as in normal times. Although undoubtedly the transmissions would form an excellent means of guidance for hostile aircraft, this fact would be well outweighed by the service which it would be imperative for B.H. to carry on during a time of war.

Col. Stafford

COLONEL R. S. STAFFORD, who, it will be remembered, recently carried out an investigation regarding the mobilisation of broadcasting resources in time of war, has just been appointed B.B.C. Talks Executive. He replaces Mr. S. D. Spicer, who has joined the staff training college.

A Ticklish Problem

DESPITE the fact that television shows must have at least five or six rehearsals, only during the final run-through before transmission is it possible to use the Emitron cameras which are heavily in demand all the time.

This is a real problem for producers who want to know as early as possible what sort of picture is created by various groupings of actors and how near players should come to the lens to get certain dramatic effects.

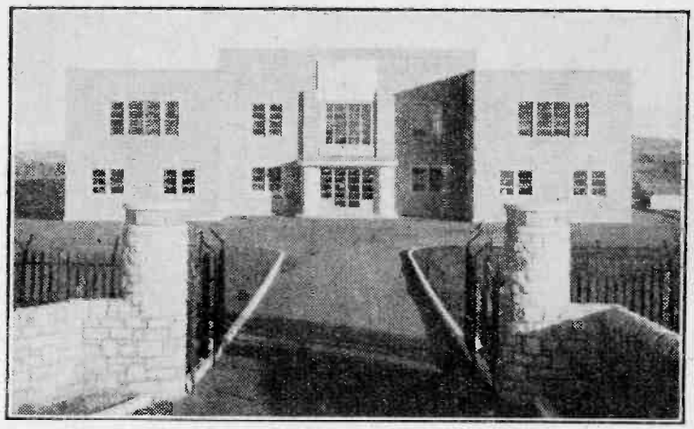
The problem has been solved by one producer so far as his own shows are concerned. Jan Bussell, a comparative newcomer to Alexandra Palace, has constructed a gadget consisting of an eyepiece and frame of tinted glass which looks like a miniature telescope. It tells him at a glance just how much of any scene or close-up comes into the television screen—a portable view finder, in fact. During rehearsals he can be seen scanning the studio horizon.

Sweet Are the Uses of a Relay

READERS who wish to check their direct reception of Berlin against a relay could not do better than experiment with the National relay of Lortzing's opera, "Zar und Zimmerman," from the Berlin State Opera House at 7 p.m. on November 5th. Full orchestra, stars and chorus will be conducted by Robert Heger.

Stagshaw

THE NEW NORTH-EAST REGIONAL

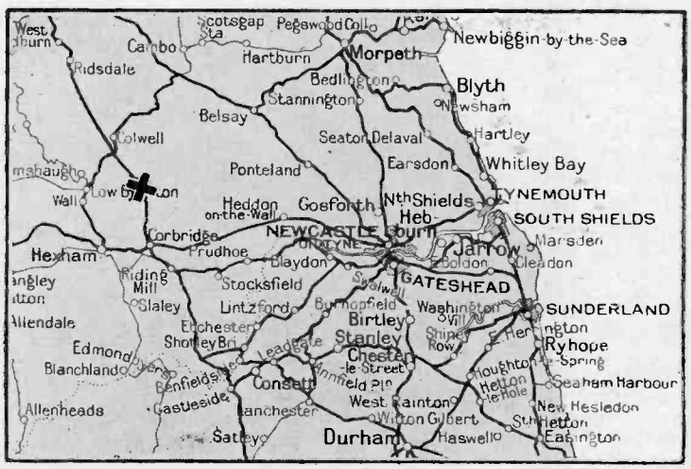


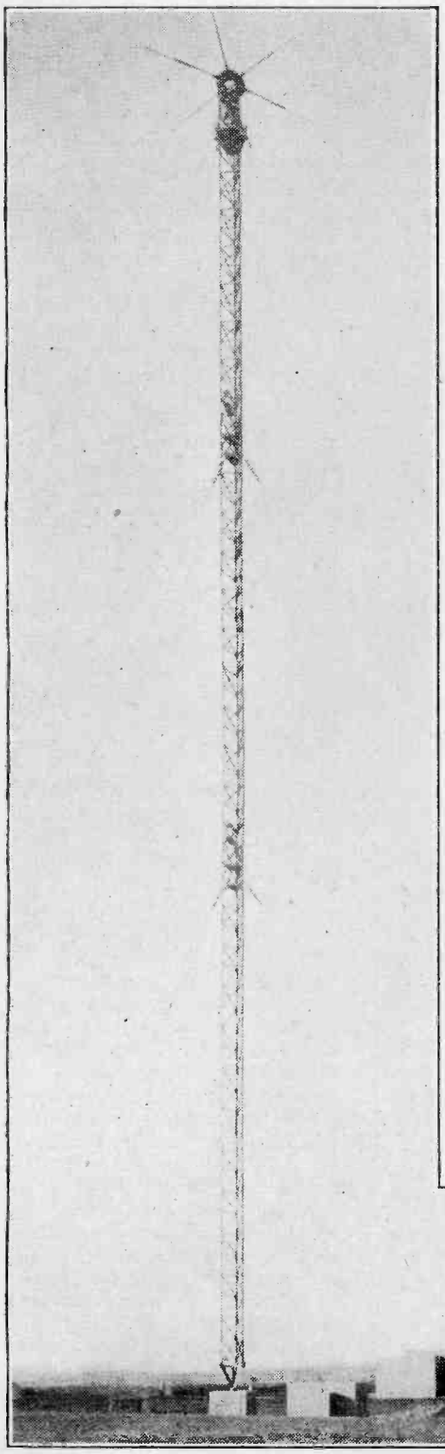
WITH the opening of the new transmitting station at Stagshaw by Her Grace the Duchess of Northumberland last Tuesday, another link in the chain of high-powered Regional stations is forged. This transmitter, which replaces the old 1-kW station at Newcastle-on-Tyne, has a power of 60 kW and will work on the same wavelength, namely, 267.4 metres.

The function of this station, some sixteen miles from Newcastle, is to provide an improved programme service in the region comprising the counties of Northumberland and Durham and the eastern parts of Cumberland and Westmorland.

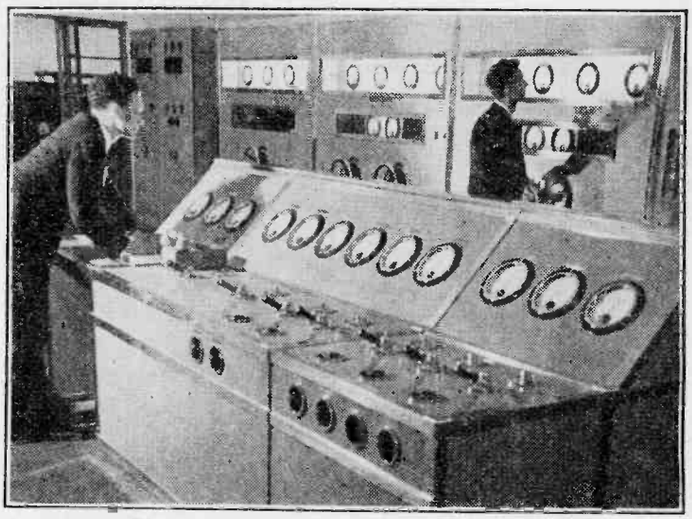
IN CHOOSING the site it was clear that it had to be reasonably near Newcastle, since about one-half of the population of Northumberland and Durham is in and around that city. An idea of the position of the transmitter is given by a cross on the accompanying map. The studios, with the exception of one provided in the station building in case of emergency, are at Broadcasting House, Newcastle.

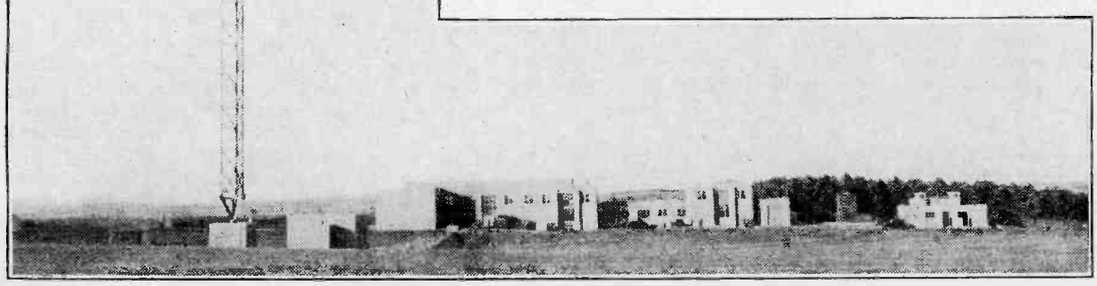
In the photograph below engineers are seen checking operating conditions in the control room. Every precaution has been taken to minimise breakdowns, and a spare of any valve can immediately be brought into operation by means of a switch.





TOWERING 485 feet above the ground the mast-radiator aerial is surmounted by six equally spaced arms forming a capacity-ring. These arms are hinged so that the effective diameter of the ring can be adjusted to obtain the correct electrical constants for the wavelength used. As the mast is completely insulated, the circuits supplying the power for the aircraft warning lights which surmount it incorporate HF filters.





HIGH-POWERED Class B modulation is employed in the transmitter, the use of which is interesting as it is a reversion to the system used in earlier designs of stations. This results in a considerable saving of input energy for the output of 60 kW, which is the maximum allowed by international agreement for the wavelength to be used by Stagshaw.

Current Topics

EVENTS OF THE WEEK IN BRIEF REVIEW

New SW Stations

THE British Malayan Broadcasting Corporation has started to build a new short-wave station which, it is hoped, will commence its first transmissions in March. At present, apart from foreign stations, amateur transmitters are the mainstay of Malayan listeners.

Broadcasting in Hyderabad

THE erection of the new broadcasting station at Saroornagar, near Hyderabad City, is now complete. The station has a power of 5 kW, but can easily have its output doubled when required. It will broadcast on 411 metres. A second station of ½ kW power is being erected at Aurangabad, and plans have been made to build extensive studios in Hyderabad City.

America and Television

ON his return to the U.S.A. after his European tour, Mr. William S. Paley, the President of the Columbia Broadcasting System, announced that tentative plans for non-commercial television programmes were in course of preparation. Transmission will take place from the top of the Chrysler Building, which is New York's second highest sky-scraper. The development of television as a source of entertainment is to be made very slowly and cautiously, and it is emphasised that the American public must not expect the same rapid progress as was the case with sound broadcasting.

The League of Nations Broadcasting Headquarters

THE new broadcasting studios in the Geneva headquarters of the League of Nations are now practically completed. The main hall and the smaller apartments in which the General Assembly and various subsidiary bodies meet are, of course, equipped so that any proceedings therein may be broadcast if desired. In addition there is a special studio from which any member of the League can address the world at large through the two short-wave transmitters at Prangins.

Another room is devoted to recording work, so that broadcasts of speeches can be made at an hour which may be more convenient than that at which they are actually delivered. Records made in this studio will also be despatched to various parts of the world for broadcasting through local stations.

An Interesting Legal Decision

RECENTLY a listener in Grenoble successfully sued a neighbour for damages, it being alleged that the interference from the defendant's electric bell ruined the plaintiff's wireless reception. The defendant appealed, but the decision of the Lower Court was upheld. He then carried his case to the Court of Cassation, which has just granted his appeal and ordered a re-trial. The Court of Cassation granted the appeal on the grounds that any person using electrical apparatus in a lawful and normal manner, as was the case with the defendant, could not be sued for damages in respect of such use.

French Broadcasting Reorganisation

IT has long been felt that the various departments of French broadcasting lacked co-ordination, and M. Lebas, the French Minister controlling radio, has decided to seek Government sanction to create a permanent director-general of broadcasting who will have supreme authority over the technical, artistic, and administrative departments. Pending Government sanction, M. Perin, of the Postal Department, has been appointed temporary director.

Aeroarchics in America

THE hobby of model aeroplane construction is far more popular in America than is the case over here, and the latest development is in connection with controlling a model plane by means of wireless. According to *QST*, the well-known American journal, a considerable amount of experimental work is at present being carried out in controlling the flight of a 13-ft. span machine. The 'plane is fitted with a 3-valve receiver and the total weight is only 10 lb. At present attention is being concentrated on rudder control. Readers will remember that eleven years ago *The Wireless World* experimented with the control of a model boat by wireless, and constructional details of it were given.

BACK-SEAT CAR RADIO. With this mechanically operated remote-control attachment, passengers in the rear seats can control the usual type of dashboard-mounted car radio set. The receiver can be operated at will from either the normal or remote control points; both indicating dials register the same reading. The unit, developed in America, is applicable to most makes of set.

Talking Books

THE scheme whereby a book is recorded on discs for use on specially-adapted gramophones which will give 25 minutes' playing time on each side of a 12-inch disc is making considerable headway. The records are reproduced either via a pick-up and wireless receiver or with an ordinary acoustic sound-box. An average novel can be recorded on ten double-sided 12-inch discs. The idea is, of course, mainly for the use of the blind, and has been developed by the Sound Recording Committee of the National Institute for the Blind, in co-operation with St. Dunstan's.

I.E.E. Wireless Section

DURING the 1937-38 session, meetings will be held on the following dates at 6 p.m.: Nov. 3rd, Dec. 1st, Jan. 5th, Feb. 2nd, Mar. 2nd, Apr. 6th, May 4th. Informal meetings will also be held at 6.30 p.m. on Nov. 23rd, Jan. 25th and Mar. 15th.

On November 3rd the Chairman of the Wireless Section, Mr. T. Wadsworth, M.Sc., will give the inaugural address. On December 1st Mr. A. E. Barrett, M.A., and Mr. C. J. F. Tweed will lecture on "Some Aspects of Magnetic Recording and Its Application to Broadcasting." Subjects for the other dates have not yet been announced.

Measuring Instruments: Revised Standards

IN the recently issued revision of British Standard Specification No. 89, which deals with Ammeters, Voltmeters, Wattmeters, Frequency and Power-factor Meters, second-grade instruments have been excluded, while the limits of error for sub-standard and first-grade instruments have been reduced wherever possible. More specific provision than that appearing in the 1929 edition has now been made for the thermo-couple, electrostatic, and rectifier types of instrument.

Copies of this specification can be obtained from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. 2d. each, post free.

Earth Resistance

METHODS OF MEASURING AND OVERCOMING IT

ALTHOUGH the earth connection has often an important bearing on the operation of a receiver, this part of the installation is frequently neglected. The author of this article describes a method of measuring earth resistance and also discusses ways of improving the effectiveness of the connection.

By "MAINSMAN"

THE provision of a low resistance path to earth for radio frequency currents is, as everyone knows, a matter of the utmost importance, yet many well-informed amateurs and even some advanced experimenters rest content with a single earth electrode, very often buried a foot or so beneath the surface of the soil and then left to look after itself—out of sight, out of mind!

The ideal earth electrode is that which makes the most intimate contact with the surrounding earth and has an extremely low resistance to it. In writing of an earth electrode it is not necessarily meant to imply one plate or rod; it all depends on the resistance of the surrounding earth and may mean an installation of two or more plates or rods.

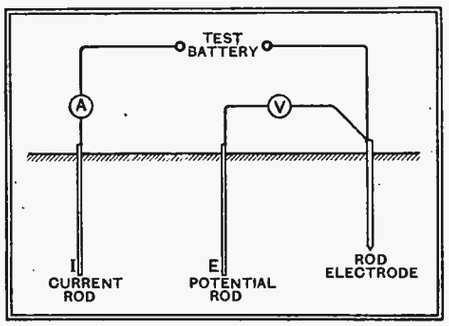


Fig. 1.—Method of measuring the earth resistance of the rod electrode with the help of two temporary earth connections.

After the British "Grid" system came into operation the matter of earthing the pylons began to receive special attention, since it was of the utmost importance that a low-resistance path to earth should be available for lightning strokes and line faults.

Stray Earth Currents

At first curious and unreliable results were obtained from the usual methods employed for resistance measurements, and after some very careful investigations it was found that stray currents were very often present in the soil; these currents were sometimes of such magnitude as to interfere seriously with any reading obtained on the instruments, and to render the tests unreliable and practically useless. It was also found that the earth resistance was not a simple resistance in the way it is usually understood, but that it was actually electrolytic in character, and so a back-EMF could be expected. A further difficulty arose when it was discovered that even the resistance of the temporary earth connections could very easily be greater than that of the earth plate under test.

A method was finally evolved by a firm of instrument makers in which an alternating current was passed through the soil while a direct current was passed through the instruments, the alternating current being made uni-directional by a current reversing device. A very simple testing set has been put on the market embodying the above ideas so that very accurate tests can be made, but the set is too costly for even the serious experimenter and is only used by such bodies as the Central Electricity Board or other electric supply authorities.

There is, however, a simple test that can be carried out by anyone possessing an accurate voltmeter and ammeter which will give some guide as to the value of the earth electrode, and for those who are interested the method is briefly described below, but it must be clearly understood that the tests are liable to be influenced by stray currents to some degree, but it is not possible to say by how much.

It is a Fall of Potential test, requiring two temporary earth rods or plates—rods are better, as they can be driven in very easily—placed at some distance from the electrode to be tested and from each other. This distance between the temporary and permanent electrodes varies according to the size of the latter, but if it is of the familiar copper-tube type then the first rod should be forty to sixty feet away from the earth to be tested, and the second rod should be eighty to one hundred and twenty feet distant. Referring to Fig. 1, a known steady current is passed through the rod electrode to the current rod I via the earth, and the difference of potential between the rod electrode and potential rod E is then measured, the resistance of the rod electrode is then given by the quotient of the PD and current, which is simply Ohm's Law.

The result is only slightly affected by the resistance of the temporary earth electrodes, but this can be practically obviated if the soil round these two electrodes is well soaked with water once a day for several days prior to making the test. The voltmeter should be a high-resistance one to nullify any variation of resistance at E.

An experimental earth electrode which has given very good results and consistent low-resistance readings consists of a six-foot length of one inch galvanised iron pipe with one end drawn out to a spike but not completely closed, a hole being left through which is passed a copper rod, which is seven feet long. A dozen or so three-sixteenth holes were drilled near the spiked end of the iron tube to allow water to soak through round the copper rod which projected approximately one foot from the spike. This copper rod is the actual earth electrode, but of course the iron tube also forms part of the connection.

An earth electrode of this type must be driven at the very least five feet to be effective as it has been noted that at less than that depth the resistance is high but falls rapidly between five and ten feet, the best conditions being reached between fifteen and twenty feet. From this it will be gathered that the hemispherical earth electrode buried a foot or two under the soil, with the bowl uppermost "to hold the moisture," is of little use.

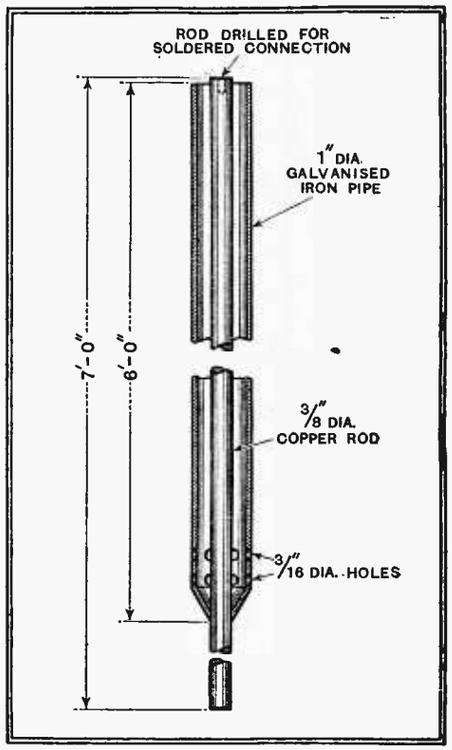


Fig. 2.—Type of earthing rod suggested by the author.

Earth Resistance—

Some tests have been carried out on plates buried upright at a depth of six feet in clay and loam and it was found that the earth resistances of the plates in clay were from 3.5 ohms to 15 ohms, while plates in loam were all below one ohm, and in some cases only 0.1 ohm, so that it became apparent that a clay soil is not such a good earthing medium as it is popularly supposed to be. Even finely broken coke surrounding a plate will not reduce the resistance and in connection with this the writer buried two earth plates each four feet square, seven feet below the surface, surrounded by broken coke in a clay soil. They had to be twenty feet apart and, to comply with Board of Trade regulations for traction systems, it was compulsory to be able to pass a current of at least two amperes between the plates with an EMF not exceeding four volts, and it was not until many gallons of salt water had been poured into the coke that this reading was obtained.

It is now considered that coke as a means of maintaining a damp area in the immediate vicinity of an earth plate does more harm than good, and even a plate does not give such an intimate contact with earth as does a driven rod of reasonable length.

DISTANT RECEPTION NOTES

IN my last notes I mentioned that the reception of medium-wave American stations was pretty good just now if one cared to try for them a little after midnight. Since then I have tried an experiment which I shall certainly repeat if the cause arises again.

The other day I found myself so wide awake at four o'clock in the morning that getting off to sleep again soon was out of the question. My own remedy for this kind of thing is to get up, go down stairs and spend half an hour or so smoking and reading. As I came into my den my eye was caught by the wireless receiver.

Inspiration! Why not see what the American medium-wave stations were doing? Many of them carry on until 1.30 a.m. by their time, which is 6.30 by ours.

I hadn't moved the tuning knob far before I made my first bag. Within the next hour (any resolutions that I had made about limiting myself to half-an-hour went by the board) I had logged half-a-dozen U.S.A. stations coming in with fine strength and hardly any fading. Conditions were distinctly good, for there was no atmospheric interference worth speaking of.

The most interesting station that I logged was WLW of Cincinnati, Ohio. This is the most powerful station in the United States, being rated at 500 kilowatts. But, strangely enough, it is seldom heard in this country in the very small hours.

I remember getting up to try for it at about 6 o'clock one morning shortly after it had been opened. It was coming in then at remarkably good strength, and before long reports of pre-breakfast reception of WLW were received from many different places.

I have tried for the station again and again between midnight and 2 o'clock in the morning, but usually without success.

Probably you have noticed that the majority of the U.S.A. stations that one logs in the hour or two after midnight work on wavelengths between 250 and 400 metres. WOR on 422.3 metres sometimes comes in well, but that seems to be almost the upper limit for good reception at these times. Certainly the stations above 400 metres are better heard between 4 o'clock and 6 o'clock than at earlier times.

It is reported in an American paper that the Canadian Government is to erect 50-kilowatt stations at Montreal and Toronto. The opening date is given as October 1st, 1937, but this must be, I think, a misprint for 1938. At any rate, I have neither seen nor heard any reports of the reception of these stations so far. 50-kilowatt stations in Canada should be well received here under favourable conditions.

I have not yet been able to try for the new Bulgarian station at Vakarel, near Sofia, which was opened a few days ago, the reason being that the medium-wave range of my receiver is out of action at the moment owing to one of those little defects that occur just when you least want them to do so.

The station is, I understand, working on 352.9 metres, a wavelength shared with three Norwegian relays and Valencia. In the original Lucerne Plan this wavelength was assigned to Bulgaria, though no power rating was laid down for the projected station. There was, however, a proviso that it should use an aerial directed towards the east. If this is being done the station may not be easy to receive well.

Bulgaria has two other wavelengths, 235.1 metres, shared with Radio-Mediterranée, and 214 metres, which is an individual channel. These are at present occupied by the 2-kilowatt Varna and the 2-kilowatt Stara-Zagora respectively. In time their power will be considerably increased, though it is probable that they will continue to work, as they now do, as relays for the programmes of the Vakarel station.

D. EXER.

New Osram Frequency Changer

A NEW frequency-changer is now made by Osram and forms a welcome addition to their International range. It is a triode-hexode with the octal base and a 6.3-volt 0.3-amp. heater. Known as the X65, it is claimed to have an exceptionally high input impedance at 20 Mc/s, to be free from "pulling," and to have as good a conversion conductance on short waves as on the medium and long. The price is 15s.

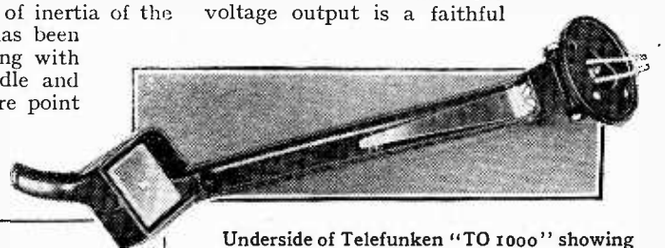
The rating of the well-known PX4 valve has also been changed and it can now be operated at 300 volts with 42 volts grid bias and 50 mA. anode current. Under the new rating it has an output of 3.5 watts.

TELEFUNKEN "TO 1000" PICK-UP

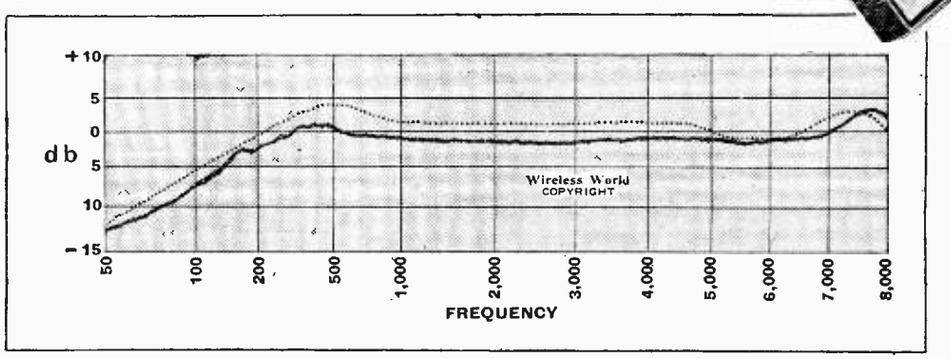
SUPPLIES of this pick-up are now obtainable in this country through Keith Prowse, Ltd., 159, New Bond Street, London, W.1, the price being 5 guineas.

The secret of the remarkably uniform response is undoubtedly to be found in the lightness and low moment of inertia of the armature system. This has been brought about by dispensing with the conventional steel needle and fitting a permanent sapphire point directly to the armature. It is stated that this needle will play at least 5,000 sides of 30 cm. (12 inch) records. The weight on the record is only 25 grams and the restoring force on the armature is very small; it is provided by phosphor bronze springs and not by rubber, as is usual.

It will be seen that the voltage output is a faithful replica of the velocity characteristic of the record, so that correction for restriction of amplitude in the bass must be made subsequently in the amplifier or in the coupling transformer. The output impedance is 100 ohms, and with a straight 1:15 transformer an output of 1 volt RMS is obtained. We understand that suitable transformers of both the "straight" and tone-correction type have been developed for this pick-up by Pamphonic Reproducers, Ltd., 45, Kings Road, Camden Town, London, N.W.1.



Underside of Telefunken "TO 1000" showing pressure control spring which is adjusted to carry part of the weight of the tone arm leaving only 25 grams at the needle point.



Output curve of Telefunken pick-up through 1 : 15 transformer. Zero db is equivalent to 1 volt RMS and the dotted curve shows the characteristic of the test record.

Radio Installation in the Home

A SYSTEM PROVIDING TWO ALTERNATIVE PROGRAMMES WITH COMPLETE REMOTE CONTROL

The loud speaker is seen built into the wall of a room in which is a corner fireplace. The control panel is similarly disposed of and all wiring is concealed.

A RECEIVING installation having many novel and interesting features has been evolved by Correx Amplifiers, Peckford Place, London, S.W.9. Basically the idea is to provide wireless in every room, or in as many as may be required in the house, and it also allows for independent remote control and choice of programme.

In the installation we examined was a two-channel receiver, actually two entirely separate sets operated from a common supply unit and fitted with a remote control relay for switching on and off. As this relay is operated from any room the location of the receiver is quite immaterial, and it can be fitted up anywhere in the house or in the garage, the only requirement being that it be situated in a place convenient for bringing in the aerial lead.

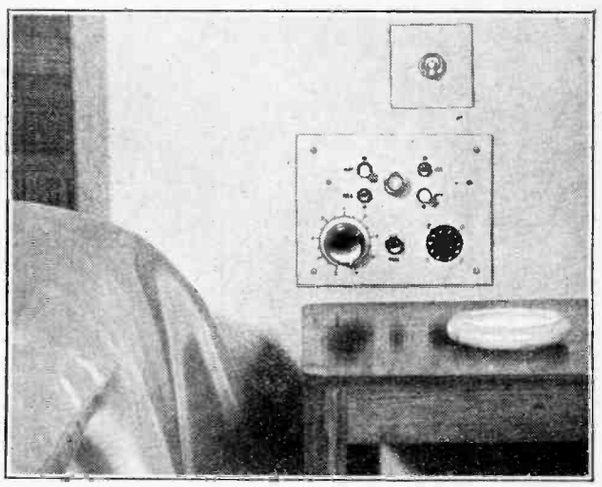
Separate receiving channels are used so that two programmes shall always be available, but if required either channel can be utilised for gramophone reproduction, leaving the other available for radio.

The sets are of the pretuned kind, and a high-fidelity audio amplifier is used with each. The radio-to-gramophone switches are embodied in the receiving equipment.

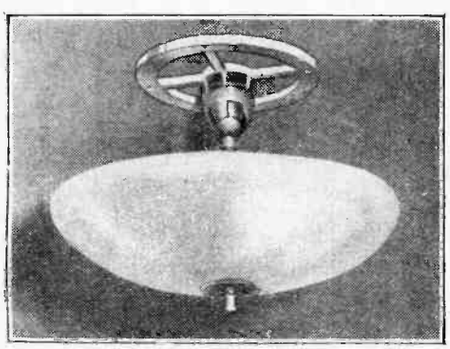
Each room where radio is required is fitted with a loud speaker and a small control panel containing three push-button switches, a volume control, a signal lamp and a 10-point socket. Two of the switches are for programme selection and the third is an on-off switch.

Switching off in any room does not close down the receiver, for this remains in operation as long as the switch is "on" in any other room and this fact is indicated by the signal lamps remaining alight on all control panels. The last switch to be put to the "off" position closes down the equipment and then all signal lamps go out.

If, now, one channel is providing radio and the other is set for gramophone, a portable gramophone unit can be used in any room and plugged into the 10-point socket on the control panel. This will provide gramophone reproduction anywhere on that circuit, so that the one gramophone unit will serve for all rooms. This leaves one channel for radio, which can be either the National or the Regional programme channel, assuming these are the two stations usually received.



The arrangement of the controls are clearly seen in this view which shows the panel mounted in the wall by the bedside.



A novel method of disposing of the loud speaker; it is mounted in the ceiling above the electric light bowl fitting.

Installation

The actual method of fitting up the various rooms depends to some extent on individual tastes, but more often the facilities available will be the governing factor. If, for example, wireless is to be installed in a new house, arrangements could be made in advance to sink the loud speakers and the control panels into the walls as shown in two of the illustrations. Where this course is not possible then a small block with a ten-point socket can be fitted in each room and a cabinet type loud speaker used in which could be embodied the control panel. Alternatively the control panel can be a separate unit on the end of a long cable and operated from any part of the room.

As there is no high voltage anywhere on the system the idea of using loose control boxes is quite feasible and perfectly safe. Light bell-wire may be employed, so that a very neat installation can be effected in any existing house.

Flexibility

A point on which stress is placed is that the whole equipment is extremely flexible and each situation can be examined and the apparatus designed to give the required service in the best possible way.

Thus it is possible to give only an approximate idea of the cost of this installation. A double-channel high-fidelity receiver AC mains-operated, including relay switching and output line circuits, costs between £65 and £70. Control panels for wall mounting cost £2 10s., or arranged as portable extension control boxes for plugging into a 10-way wall socket, £3 5s. Loud speakers with grille as illustrated cost £2 10s. each. The cost of wiring and other installation work depends to some extent on the number of rooms to be fitted; for three rooms the cost is £8, but for six rooms it would be £12 10s.

Listeners' Guide fo

Outstanding Broadcasts at Home and Abroad

SOME strange music from weird instruments will come to the ears of listeners to the third inter-continental concert which is originating in the Dutch East Indies and will be relayed Regionally on Sunday at 4. It is being arranged by the N.I.R.O.M. (Nederlandsch-Indische Radio Omroep Mastschappij) and will be broadcast from Java on short waves to be picked up by the Dutch transmitter Hilversum No. 1, and then relayed by most European stations.

The N.I.R.O.M., which has its headquarters in Java, and whose best-known station is at Bandoeng, operates a number of stations throughout the Dutch East Indies. The programmes which they transmit are mainly concerts of native music, and it will be a representative type of concert which we will hear on Sunday.

The programe will begin and end with the National Anthem of the Netherlands. Among the strange *orchestras* to broadcast are the *gamelan*, which is the traditional orchestra of Java and includes fleece drums and gongs; and the *ankloeng*, in which the players dance whilst shaking their unwieldy instruments constructed from bamboo pipes.

The broadcast should give a very good cross section of the arts and music enjoyed by the various peoples of these Islands.

JAVANESE music played by the traditional orchestra of Java, the gamelan, will be heard during the concert from the Dutch East Indies on Sunday.

THE SPORT OF KINGS

AFTER a conference of racing commentators and members of the B.B.C.'s O.B. Staff, it has been decided to have rehearsal commentaries at races from which broadcasts are not being radiated. It is hoped thereby to enable racing commentators to acquire a freer style of description.

There are many difficulties to be overcome at Newmarket whence a description of the Cesarewitch will be given at 3.10 (Reg.) on Wednesday. As those familiar with the course know, visibility is frequently poor, and to obviate difficulties arising from this the observers have been to Newmarket to decide on positions which will permit a complete coverage of the course.

◈ ◈ ◈

SNOOKER

THE microphone will visit various professional billiards matches during the season, the first visit being to Thurston's on Thursday for the Davis-Inman snooker match.

The arrangements for broadcasting a snooker match are simple but effective. Three microphones are employed, one for the commentator, who is in a sound-proof box at a vantage point overlooking the table, another placed over the table to pick up the sound of the impact of the balls, and a third for the marker, Charlie Chambers, who will call out the score after each shot. The observer will be Willie Smith, the ex-snooker and billiards champion, who will tell listeners, shot by shot, what each player has achieved and how the balls are left. This broadcast will be heard by National listeners on Thursday at 8.

BRIDGE CHALLENGE

THE Austrian team, winners of the World Bridge Championship held at Budapest last May, have accepted the challenge of a group of English players to a 300-board match to be played at the Waldorf Hotel, London. Prior to the opening session, which takes place on Saturday, two or three hands will be played specially for listeners. These will be described by Tommy Woodrooffe on Saturday at 4.10 (Nat.), whose return to the microphone on the occasion of the reception of *Endeavour I* was, I am sure, welcomed by many thousands of listeners.

The competition proper consists of 300 hands, and the final day of play is Thursday. On this day for a quarter of an hour from 4.45 Tommy Woodrooffe will broadcast a description of the play during the session. The commentator will, from a sound-proof cabinet, first describe the hands, then the microphone suspended over the playing table will be switched in to hear the actual bidding, during which the commentator from his box will help listeners to follow the play by indicating the leads and the tricks won.

◈ ◈ ◈

GOLD RUSH

MEMORIES of the Coolgardie gold rush of 1892 will be recalled for listeners to the National programme on Tuesday at 9.20, when Frank Gerald, who is now 82, speaks in the series "I Was There." He can well remember the excitement when the first load of gold, packed in sardine tins, milk tins and the like, arrived at the bank, and he will describe the trek from Southern Cross, where he kept an hotel, to Coolgardie, which took about five days through scrub in terrific heat.

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ORGAN EFFECTS

PHIL PARK has devised a clever arrangement of parodies on a visit to the Motor Show, and he and Reginald Foort at the Theatre Organ, will "put them over" during Saturday night's "Music Hall." Elsie and Doris Waters, radio's Gert and Daisy, have been booked by John Sharman to

TOMMY WOODROOFFE will again be the commentator for the broadcast of a bridge contest. After his previous broadcast it was found that a surprisingly large number of listeners were interested in such commentaries.

the Week

make another of their popular appearances before the microphone in this programme also. Al Stone and Tich Lee, "the American hit-wits," who are in the same programme, will be making their first broadcast in this country. Also in the bill are Elsie Carlisle and George Formby, the comedian son of the famous comedian, who will be making his first broadcast from a London studio.

PIATIGORSKY, the world-famous 'cellist, will be the soloist during the Royal Philharmonic Society's concert at the Queen's Hall on Thursday, which will be broadcast Nationally from 8.15.

ANOTHER SCRAPBOOK

THE Baily-Brewer team have now completed their plans for the next Scrapbook, which will recall memories of 1907. It was in this year that the *Lusitania* broke the Atlantic record, that the Ascot Gold Cup was stolen from a table at the back of the Grandstand, that the Brooklands Racing Track was opened, and (it may surprise some readers to know) that a talking film (sound on disc) was shown at the London Hippodrome.

Among the outstanding musical events of the year was Madame Tetrazzini's début at Covent Garden in "Traviata" and the first production of Franz Lehár's famous operetta "The Merry Widow" at Daly's, in which Lily Elsie rose to fame in a night.

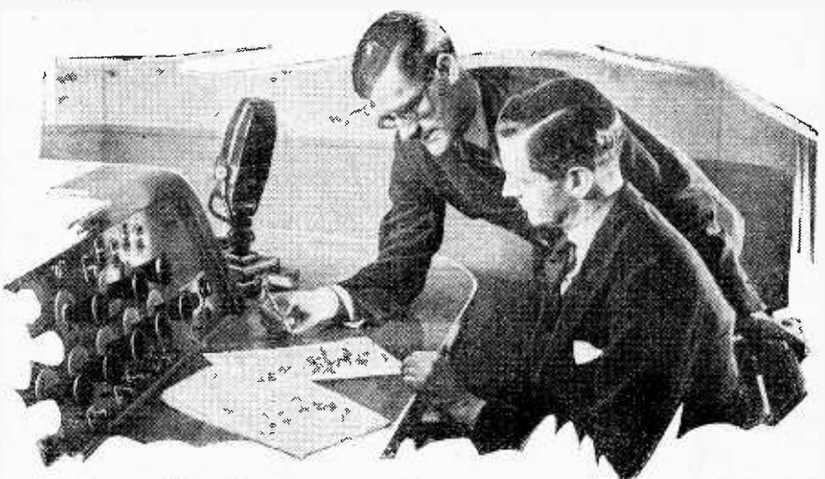
These and many other interesting and outstanding facts of 1907 will be recalled for listeners on Monday at 9 (Reg.) and again on Tuesday at 8 (Nat.).

◈ ◈ ◈

OPERA

THOSE who love Gounod's "Faust" will have three opportunities of hearing it this week. On Friday the third and fourth acts are being relayed by Stockholm from the Royal Opera at 9. Athlone is giving Act I on Sunday at 5.45, Act II on Tuesday at the same hour, Act III on Thursday at 5.30, and Acts IV and V on Friday, October 29th. From Milan on Wednesday at 8 it will be heard in its entirety.

The studio production of "The Rhinegold" from Milan on Friday at 8 and from Rome on Saturday, at the same hour, is part of the Italo-German exchange of compliments which is a feature of both countries' programmes during recent weeks. Germany's contribution consists of a full-dress performance of Verdi's "Rigoletto" in Munich on Sunday at 7, and of his "Macbeth" from the State Opera, Dresden, at 6.30 on Tuesday, as well as the Puccini opera concert from Cologne on Monday at 7.10.



SCRAPBOOK COLLABORATORS, Leslie Baily (wearing glasses) and Charles Brewer, Assistant Director of Variety, going through a script at one of the D.C. Panels.

Alfano's four-act opera, "Resurrection" (after Tolstoy's immortal story), is being broadcast from the Milan studio on Sunday and from Rome on Tuesday at 8.0. It was this opera which established that fine musician's reputation when produced at Turin in 1904. Alfano is one of the best living Italian composers from the technical point of view. When broadcast on Tuesday the B.B.C. will relay the first act Regionally at 8.0.

THE AUDITOR.

HIGHLIGHTS OF THE WEEK

FRIDAY, OCTOBER 22nd.

Nat., 7.30, Claude Bampton and his orchestra, with Ronald Gourley (piano). 8, "Dearest Fanny": an interlude in the life of Lord Nelson.

Reg., 8, Songs You Might Never Have Heard. 8.45, Paul Hermann ('cello) and John Ireland (piano). 9.20, "Mendip, wot on't": an impression of its life, history and legend.

Abroad.

Brussels No. 1, 8.30, 21st anniversary of the Battle of Yser. Grand concert in honour of holders of the Croix de l'Yser.

SATURDAY, OCTOBER 23rd.

Nat., 6.30, French Theatre Music: the Theatre Orchestra. 8, Music Hall. 9.40 and 10.30, Acts III and IV of Verdi's "Aida" from Sadler's Wells.

Reg., 4, "Eight Bells." 6, "Dearest Fanny." 9, "Cochrane, Wolf of the Sea": a biography of the great sailor.

Abroad.

Rome, 8, Wagner's opera "The Rhinegold."

SUNDAY, OCTOBER 24th.

Nat., 6.15, Albert Sandler and his orchestra. 9.5, Hero and Heroine: Love duets from operas and operettas. 10.5, Recital: Maggie Teyte.

Reg., 4, World Concert from the Dutch East Indies. 5, German Folk Songs relayed from Berlin. 7.55, Service from Hexham Abbey 9.35, "Old, Unhappy, Far-off Things."

Abroad.

Vienna, 7.5, "From Strauss to Lehár": Viennese potpourri.

MONDAY, OCTOBER 25th.

Nat., 7, Monday at Seven. 8, "Design in Everyday Things." 8.30, Broadway Matinée: variety from America. 9.35, Yvonne Arnaud (piano) and the International String Quartet.

Monday, October 25th (*continued*).

Reg., 8, Carroll Gibbons and the Savoy Hotel Orpheans. 9, Scrapbook for 1907.

Abroad.

Cologne, 7.10, Puccini Concert including scenes from "The Girl from the Golden West" and "Turandot."

TUESDAY, OCTOBER 26th.

Nat., 8, Scrapbook for 1907. 9.20, "I Was There": the discovery of the Coolgardie Goldfields, 1892.

Reg., 8, Relay of Act I of "Resurrection" from the Rome studios. 9, Variety from the New Theatre Northampton.

Abroad.

Leipzig, 6.30, Verdi's opera "Macbeth" from the State Opera, Dresden.

WEDNESDAY, OCTOBER 27th.

Nat., 6.40, B.B.C. Military Band and George Hackford (marimba-xylophone and vibraphone). 8.10, "The Transmutation of Ling" from Ernest Bramah's story.

Reg., 3.10, Commentary on the Cesarewitch. 6.20, "Ladies Night": an Empire programme. 8.40, Variety at Home. 9.30, Jack Payne and his band with guest artistes.

Abroad.

Strasbourg–Rennes, 8.30, Music of the Nations.

THURSDAY, OCTOBER 28th.

Nat., 6.40, From the London Theatre. 8, Commentary on the Davis-Inman Snooker Match.

Reg., 6, Bach recital by Harold Darke from St. Michael's, Cornhill. 8.15, The Royal Philharmonic Society's concert from the Queen's Hall.

Abroad.

Kalundborg, 7.10, Sixth Thursday Concert. Guest conductor Fritz Busch.

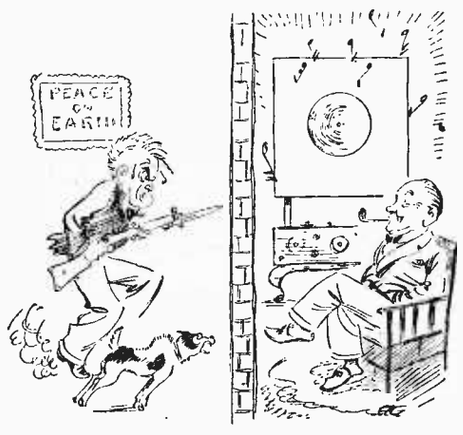
UNBIASED

By FREE GRID

Unsolved Murders

ALTHOUGH we hear a good deal nowadays about legislation to deal with the ever-growing menace to broadcasting of interference caused by the thoughtless use of "unsuppressed" electrical apparatus by non-listeners, we don't, in my opinion, hear half enough of the other side of the question. I refer, of course, to the far more serious menace of the interference with the comfort of non-listeners by the utterly thoughtless habit indulged in by the selfish type of listener who lets his or her loud speaker (it is usually her) drool away all day and far into the night also at super-normal volume level.

This type of listener, whose name is legion, frequently takes refuge in the old superstition that first-class reproduction is impossible unless the sound output from the loud speaker is the same as that of the original signal. Such an argument can, of course, soon be brought to the *reductio ad absurdum* position of trying to cram a full symphony orchestra or the massed bands of the Brigade of Guards into the corner of the average listener's den, and I am not to be moved from my position nor intimidated by any contrary arguments trotted forward by "Cathode Ray" or any other of the Editor's technical hirelings.



Running amok.

This conduct on the part of certain listeners has already led, in more than one case, to a long-suffering neighbour running amok with a rifle and bayonet and similar war souvenirs. But what is far more serious is that, as the result of a recent conversation I had with a man well known at Scotland Yard, I feel quite sure that this is the true explanation of the many unsolved and unaccountable murders that are still on the books of the police. Although a Mills bomb, or some similar weapon is the natural thought of the average citizen who has to put up with this trouble, it must not be forgotten that there are plenty of others whose psychological make-up is such that far more sinister methods of murder make an appeal, and I invite the police to apply my theory by making diligent enquiry into the broadcast-listening habits of all murder victims.

What Shall I Do With It?

IT is extraordinary what a lot of interest was created by my recently published comments on the state of wireless-listening in the island of Tristan da Cunha. As many of you will remember, an item of news was published in this journal to the effect that the local sky pilot, who had been on a visit to this country, was taking back with him a wind-driven generator to keep the accumulators of the island's wireless set fully charged. My principal comment was that it seemed strange that it should be necessary to rely for battery-charging on the erratic behaviour of the wind when such a large and perfectly regular power supply lay to hand in the form of the twice-daily rise and fall of the tide.

It now appears that Tristan da Cunha is by no means the only remote island which relies for its wireless-listening on the vagaries of Boreas, but that there is many a lovely islet in the Pacific where an exasperating silence on the part of the wireless set develops, due to the failure of battery power during a period of calm; and, needless to say, owing to the general cussedness of things, this nearly always occurs when some particularly interesting broadcasts are waiting to be heard. In the case of Pitcairn Island, of *Bounty* mutiny fame, however, the wind must be more unreliable than usual, as I noticed a news item in *The Wireless World* the other week to the effect that the accumulator has to be sent over 3,000 miles to New Zealand to be charged, and this self-same accumulator has to work a transmitter, too.

When I suggested the use of sea power for charging the Tristan da Cunha battery I described a perfectly straightforward and sensible scheme and I did not realise that I was going to be made the recipient of all sorts of madcap ideas for harnessing the power of the sea for the generation of electrical energy. The scheme which takes the proverbial cake emanates from the part of the country which is, I believe, notorious for this sort of thing. No doubt many of you will be able to put a name to it.

In brief, my correspondent proposes to seek out an island where there is a very considerable deposit of copper ore, and another which is rich in some other metal. He claims that these automatically form the electrodes of a gigantic primary cell, the sad salt sea being the electrolyte, and

An exasperating silence.

it only remains to run connections to these islands to have available an almost inexhaustible source of electrical energy.

I am not at all sure what is the right course for me to adopt in dealing with this suggestion. I am strongly tempted to adopt the obvious one, but my mind cannot help harking back some forty years to the time when several eminent scientists suggested that this obvious course was the right one to adopt in connection with Marconi's idea of bridging the Atlantic by wireless.

A Meaningless Comparison

WHY is it, I wonder, that when anybody is writing about television and desires to pay a tribute to the excellent state of development to which it has reached, he nearly always says that it is "as good as a home cinema." There is, of course, nothing fundamentally wrong in using a home cinema as a basis of comparison, although as relatively few people have ever seen a home cinema I do not see what is the use of employing it as a standard of comparison; in any case, of course, there is no such thing as a home-cinema standard, for, as anybody who knows anything about it at all is aware, they vary enormously.

What I object to chiefly, however, is the seemingly implied sneer both to television and to the home cinema, chiefly to the latter. It is just as though the writer had said, "Television is pretty poor stuff but, at any rate, it is no poorer than a home cinema." I cannot help thinking that people who say this sort of thing can never have seen a real home cinema, for nowadays a proper one is fully as good as a professional one and I defy anybody to contradict me. Surely, therefore, it would be better to use the ordinary professional cinema, with which nearly everybody is acquainted, as a standard of comparison.

New Push-Pull Feed Circuit

CHOKE-COUPLED PHASE-CHANGING VALVE

By LAWRENCE H. COOPER

THE demand for high-fidelity reproduction has been responsible for greatly increased use of push-pull output stages, and until recently the most widely used phase-splitting device for preceding such a stage has been the inter-valve transformer with centre-tapped secondary.

Unfortunately, various forms of distortion are often introduced by such transformers, particularly by those which provide the grid voltages required by many output valves, so that they have in some instances been eliminated by the use of the resistance-capacity circuit shown in Fig. 1. Here the anode resistance of the valve is split into halves R1 and R2, so that at the points A and B equal and opposite voltages are developed with respect to earth. These are then fed via condensers to the grids of the output valves; the driver is biased through the grid coil (or pick-up, etc.), by means of the resistance R3 shunted by C1.

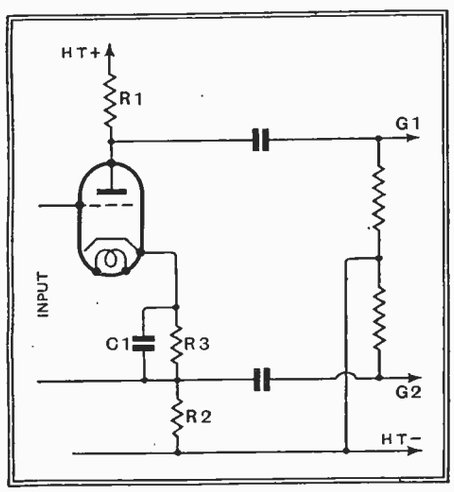


Fig. 1.—The conventional resistance-coupled phase-splitting stage. Connections to the grids of the output valves are indicated by G1, G2.

With low-voltage HT supplies it is often difficult to use values of R1 and R2 which are great enough to extract the required AC voltages from the driver valve and yet maintain its HT voltage at a reasonable value; in such cases a solution of the problem may be found by the use of two identical AF chokes in place of R1 and R2.

It will be appreciated that identical AC voltages appear across each of these chokes, exactly in phase, so that both windings may be incorporated on a common core as shown in Fig 2; the windings may be resistance-loaded by R1 and R2 if required.

It is well known that the inductance of a choke wound in this manner is nearly

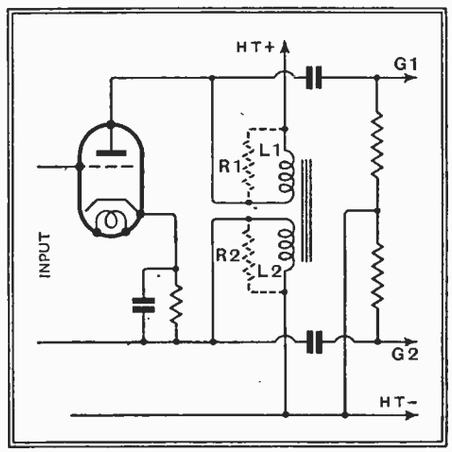


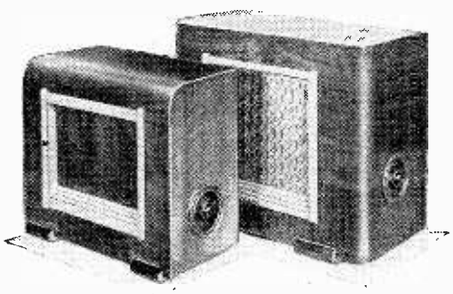
Fig. 2.—The use of a double-wound choke in place of a pair of resistances gives more anode voltage to the valve and a lower potential difference between heater and cathode.

proportional to the square of the turns, so that if two windings, each with the same number of turns as used in the individual chokes, are mounted on *one* similar core, the total inductance in the anode circuit is *doubled* with half the space and little over half the cost.

Naturally, the DC resistance of each winding is somewhat higher owing to decreased winding space, but the effect of this is negligible.

Extension Speakers for Remote Control

HERE are two examples of the 1938 range of Stentorian extension speakers which we have recently tested—the "Cadet" and "Senior" models. Both are fitted with



tone compensated volume controls and provision for "Long Arm" remote control. The moderately priced "Cadet" suffers only from some restriction of extreme bass due to its small cabinet size, and the "Senior" model, with its exceptional power-handling capacity, deserves to rank in quality of reproduction with the best "main" loud speakers fitted in broadcast receivers to-day.

Letters to the Editor

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

B.B.C. and Quality

IT is sad but true that the B.B.C. appears to be no longer interested in high-quality reproduction of its programmes; or, at least, is satisfied with a standard that is a long way below the best obtainable with modern apparatus. Their claim (*The Wireless World*, Aug. 27th, page 191) that the quality of Droitwich transmissions is comparable with that of the best medium-wave transmitters cannot be taken seriously, as, apart from the serious limitations of the long-wave transmitter itself, the highest frequencies do not even get as far as Droitwich. (I note that the B.B.C. suggests that we should suspect our sets if poor quality is experienced, but we are no longer amused by that chestnut!)

Furthermore, here in South London the field-strength of the medium-wave National transmitter is so low that after dark the selectivity of the receiver has to be increased to such an extent, to avoid interference, that quality is hardly any better than that obtainable from Droitwich.

Hence, during the winter months, it will be impossible, in this district at least, to receive the National programme with really high quality at any time of the day or night.

For those listeners who, like myself, are keen music-lovers, and have taken the trouble to equip themselves with apparatus capable of reproducing the whole range of musical frequencies with a minimum of distortion, this is a serious matter which, I contend, is worthy of more consideration by the Corporation. The solution surely lies in the use of the ultra-short-wave transmitter at Broadcasting House to radiate all programmes of good music originating in London, whether National or Regional. I cannot understand why this service is being withheld for so long.

It is unfortunately true that only a small minority of the music-loving public and the musical profession has any idea of how good the reproduction of broadcast music *can* be; but it is surely regrettable that any policy of the B.B.C. should stand in the way of those who are enlightened enough to be satisfied with nothing less than the best reproduction that modern methods and apparatus can provide.

ERIC H. DOUGHARTY.

London, S.W.16.

I HAVE noticed for the past few months in the columns of *The Wireless World* and elsewhere allusions to poor quality put out by the Droitwich long-wave transmitter. I see now, in addition, friend "Diallist" has added his pen to the outcry. I propose, therefore, to say a few words in defence of this much-accused station.

As you will observe, I live about 30 miles "as the crow flies" north of Droitwich, and that my two local stations are Midland Regional MW and the aforesaid National LW, both, of course, erected on the same site. On the average programme there is no perceptible difference between the high frequency response of these stations, and certainly there is no reason for stating that the long-wave transmitter puts out poor quality!

I think there is no doubt that every time the fault lies in the receiver—in the long-wave coil windings. I must hasten to add at this juncture that I am a fanatical high-quality fan, a fact which will perhaps be doubted by other members of this fraternity.

My method of solving the problem is simply by employing an aperiodic RF stage. This is fed by a 66ft. outdoor aerial tied directly to the grid and a half meg. resistance in the grid circuit. The anode circuit is choke-coupled to a single broadly pre-tuned circuit feeding a diode detector with switching arranged for Midland and National only. Strange to say, I experience no interference troubles with the exception of a 9 kc. whistle on the long-wave programme. The diode is then coupled to a three-stage quality amplifier and Hartley-Turner speaker

Anyone hearing this combination would immediately appreciate the top response.

I agree that I am fortunately situated both from distance and the interference point of view, and that it would not be diplomatic for a person suffering from static to employ an aperiodic RF circuit. This, however, does not affect the fact that Droitwich does transmit really good quality—good enough to satisfy the most hardened top addict!

I notice that "Diallist" has recently tested Droitwich quality on "a score of new models." I presume that these are of the average manufactured variety and, with all respects, about as useful for such a purpose as an ammeter for testing milliamps. The solution of the problem would appear impossible on a normal commercial set, which, for obvious reasons, must have selectively tuned RF circuits (especially up to and including the frequency changer in superhets), unless suitable tone correction is added in the LF stages or damping of the tuned RF circuits is effected—the latter a most unlikely solution. In home-constructed and specialised quality receivers the solution is quite simple.

In conclusion, I would request the quality fans that before they start throwing mud they just test this circuit out for themselves.

Walsall. A. A. COTTERELL, LL.B.

Hands Off Droitwich

WILL you please tell your various contributors to keep their hands (or pens) off Droitwich. Be the quality what it may, here, at any rate, it is the only worth-while B.B.C. station. The medium-wave Nationals are hopeless at night owing to fading, and the Regional is none too steady. Further, I have no interference on Droitwich, but plenty on the medium waves. I cannot imagine the B.B.C. doing anything so disastrous as giving up their long wave, but if they did I should either have to give up wireless altogether or change my domicile, neither of which I particularly want to do.

Brighton. A. H. BRIDGES.

Television at the Show

I WAS interested in Mr. Puckle's letter in your issue of September 10th, 1937, re the Television Demonstrations at Olympia, and I quite agree with his idea of one large hall with receivers of all manufacturers arranged so that the public can make direct comparisons.

From my own experience it is very difficult to carry in one's head the results from various screens. In fact, I made this suggestion to various officials of a number of television companies at Olympia, and everyone agreed it was the only logical way to give a satisfactory demonstration.

Regarding the question of attending other firms' demonstration booths, although I had an engineer's pass, I was in most cases unable to pass the doorkeeper, unless there happened to be an engineer about from the particular firm whom I happened to know. I did eventually, during the run of the show, manage to view all the receivers on demonstration, but it was far from satisfactory for purposes of comparing the different makes.

In conclusion I endorse Mr. Puckle's suggestion that it would be interesting to hear what other people and firms have to say through the medium of your paper.

Dagenham. D. SHANNON.

Speech Coil Design

WE were interested in an article in *The Wireless World* of October 8th referring to an improved method of moving-coil speaker speech coil construction using an aluminium former.

We manufactured aluminium formers for the speech coils of our speakers in 1927, a little over ten years ago. The article reminded us that we have been manufacturing moving-coil speakers for quite a long time now—over twelve years.

ARTHUR BAKER,
Baker's Selhurst Radio, Ltd.

Croydon.

"Direct Current" or "Zero Frequency"

WILL you permit me to endorse most enthusiastically the "realistic" attitude of mind of Mr. Scroggie in his delightful articles in *The Wireless World*, and in particular in his championship of "zero frequency" in your issue dated September 24th? I am sure Mr. Scroggie will be flattered rather than the reverse when I assess him as a most "practical" electrical engineer, *vide* his articles on laboratory equipment. Yet all of us, however practical, must surely realise the essentials of our art, namely, the diversity of electrical phenomena. In the course of my profession I frequently have to instruct the young idea in electrics and mechanics, and the first principle which I try to instil is that of the "rhythmic" or "periodic" nature of all natural phenomena, such as organic growth, the seasons, natural frequency of the solar system, and so introduce the fundamental oscillatory nature of electrical phenomena. I have, therefore, always treated so-called "DC" electrical engineering, with which, incidentally, I have the most practical dealings, as a special case of "zero frequency."

Unless we are broadminded and fundamental in our teaching, how can we expect our successors to be other than narrow-minded specialists?

G. W. HARPER.
Lt.-Comdr. R.N.

I WAS interested in reading Mr. Scroggie's letter in your issue of September 24th.

One must admit that the term "DC current" is rather crude, but an improvement on "DC current" would possibly be "D current," and "A current" would perhaps be better than "AC current." The terms AC and DC would, of course, apply to alter-

Letters to the Editor—

nating current and direct current when used properly.

I notice in Random Radiations by "Diallist" in the same issue the following expressions are used: "When the source is AC," "His DC figures will not be enormously different," "A 240-volt DC supply," "His AC resistance," "Not content with DC results alone he went on to see what happened with AC." These expressions are, of course, correct. "ZF" is in poor contrast with "AC."

With regard to the term "DC voltage" mentioned by Mr. Scroggie, this would perhaps be better expressed simply as "voltage," and this would overcome the objection. In your issue of July 23rd, page 78, it reads: "In a home model, for which a screen 2ft. by 1ft. 10in. is employed, the light source is a specially developed mercury lamp consuming 3½ amperes at 70 volts DC, or 250 watts approximately." Surely the DC could very well be omitted, and this would then read: "Consuming 3½ amperes at 70 volts, or 250 watts approximately." This would be a perfectly clear statement. To add "ZF" would not make it any clearer.

To describe a direct current as "steady" or "unvarying" or "continuous" is certainly crude—so why do so?

But "Zero Frequency"—never!

Exeter, Devon. D'ARCY FORD.

NEWS FROM THE CLUBS

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

Mr. H. Rivers-Moore, the President of the Society, recently gave a very interesting talk entitled, "Acoustics and Modern Sound Reproduction." The lecturer brought along with him a paraphase amplifier fitted with an automatic control which quietened crescendo passages, the effect being opposite to that of volume expansion. On October 26th Mr. L. F. Marshall will speak on "Making Electrical Measurements," and on November 2nd a lecture on "Sound Reproduction" will be given by Mr. W. J. Bird.

Kettering Radio and Physical Society

Headquarters: The Ivy Café, Gold Street, Kettering.
Hon. Sec.: Mr. J. L. Holmes, "Miami," The Close, Headlands, Kettering.

The Fifth Annual Radio Exhibition organised by the Society was a great success. A short-wave section of the Club has been formed and a Morse class started. It is hoped shortly to recommence transmitting under the Society's call-sign G5KN.

Lecturers on radio subjects are required for the session, and the Secretary would be pleased to know of anybody who can be persuaded to give a talk on any aspect of radio.

Eastbourne and District Radio Society

Hon. Sec.: Mr. S. M. Thorpe, 74, Brodrick Road, Hampden Park, Eastbourne.

This Society is one of the oldest in the country, and, after a period of dormancy, has made a fresh start with twenty new members. Will those interested get into touch with the Hon. Secretary or call at Messrs. Dowsett and Co., Ltd., 48, Grove Road, Eastbourne.

Faraday Radio Society. Walworth Men's Institute

Headquarters: Nelson L.C.C. School, Trafalgar Street, London, S.E.17.
Meetings: Tuesday and Wednesday evenings at 8 p.m.
Hon. Sec.: Mr. J. Paton, 39, Penton Place, London, S.E.17.

This club is free to members of the Walworth Men's Institute, the membership fee of which is 1s. 3d. per term. A 40-metre crystal-controlled transmitter, which has been heard in all continents, is being rebuilt and increased in power. An instructor in radio is provided by the L.C.C., although the classes are conducted on very informal lines. An interesting programme has been prepared for the season, including a series of lectures on "Marconi, His Life and Work," for which Marconi's Wireless Telegraph Co. has kindly provided lantern slides and original pieces of apparatus.

Bideford and District Short-Wave Society

Headquarters: Migonette Walk, Bideford.
Hon. Sec.: Mr. W. G. Couch, "Hillside," Glen Gardens, Bideford.

A vigorous programme has been prepared for the session, including Morse classes, practical talks and demonstrations, general constructional work, and the installation of a transmitter.

West Sussex Short-Wave and Television Club

Headquarters: The Waggon and Lamp, Chichester.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Leading Aircraftsman J. Williams, H.Q. Flight, 43 (F) Sqdn., R.A.F., Tangmere, Sussex.

At a recent meeting, the President, Mr. Gerald Marcuse, gave an interesting talk on his wireless experiences, commencing with the pre-War period and dealing with his Empire broadcasting experiments. The next general meeting takes place on November 2nd.

Glasgow Short-Wave Radio Society

Headquarters: Masonic Hall, 75, Berkeley Street, Glasgow, C.3.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Mr. J. Neilson, 14, Bolivar Terrace, Glasgow, S.2.

The Society gives instruction in short-wave radio reception and transmission, including the Morse code. The annual subscription is 7s. 6d.

Battersea and District Radio Society

Headquarters: The Battersea Men's Institute (L.C.C.), Latchmere Road, London, S.W.11.
Meetings: Tuesday and Friday evenings.
Hon. Sec.: Mr. S. H. Harris, The Battersea Men's Institute (L.C.C.), Latchmere Road, London, S.W.11.

The Society has recently completed the construction of a broadcast receiver, and hopes shortly to commence work on a S.W. receiver. The quarterly subscription of 1s. 3d. admits also to all other facilities of the Institute.

Leicester Amateur Radio Society

Headquarters: Winn's Turkey Café, Granby Street, Leicester.
Meetings: Alternate Tuesdays at 8 p.m.
Hon. Sec.: Mr. T. Cribb, 55, Knighton Drive, Leicester.

A lantern lecture entitled "Metal Rectifiers," sponsored by the Westinghouse Company, will be the subject of the next meeting of the club on November 2nd.

Slade Radio

Headquarters: All Saints' Parochial Hall, Broomfield Road, Slade Road, Erdington, Birmingham.
Meetings: Alternate Thursdays at 8 p.m.
Hon. Sec.: Mr. G. C. Simmonds, 38, Rabone Lane, Smethwick.

Last Thursday Mr. Stockton, of the G.E.C., delivered a lecture on "Modern Television Transmission and Reception."—On November 4th Mr. Wynne, of Aston Technical College, will lecture on "Visible Ether Waves." This latter meeting will be held at the College, Whitehead Road, Aston, at 7.30 p.m. The annual subscription to the club is 10s., the entrance fee being 2s 6d. and the cost of the club badge 1s.

Southall Radio Society

Headquarters: Southall Library, Osterley Park Road, Southall.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. H. F. Reeve, 26, Green Drive, Southall.

At the opening meeting of the season, Mr. Douglas Walters, the Society's President, presented to Mr. L. J. Swan the silver cup which he won in the open DF contest during the summer. Mr. Swan followed tradition by filling the cup with champagne, after which a discussion on direction-finding followed.

RANDOM RADIATIONS

By "DIALLIST"

The American Invasion

A READER begins a letter to me: "I notice that lately you seem to have been recommending American sets. . ." I don't know how he formed that idea for I certainly haven't. All along I have held that our manufacturers could make, if only they would, the best and most suitable sets for our market. What has been so disappointing is the way in which they have ignored the demand that exists for the bigger and more expensive types of wireless receiver incorporating the refinements in technique that have been developed during the last few years. Again and again *The Wireless World* has told them that if they wouldn't cater for this potential market somebody else would step in and do it for them. And that is just what has happened. I mentioned recently that one important American firm was starting to manufacture luxury apparatus in this country; now comes the news that not one, but three such firms are engaged in digging themselves in.

No Price War

Our set makers cannot complain that these American firms are striving to compete by offering sets at low prices. They are doing exactly the opposite; they are going to market sets at prices a great deal higher than those of British-made receivers. In a word, they are out to capture not the popular market for medium-priced and low-priced sets, but this big luxury market of whose existence many of us—though not apparently British set manufacturers—have been aware for so long. There is not a question that we could produce for ourselves sets every bit as good. If you've handled any of this year's British sets priced at from £25 and £30 you'll realise what marvellous performers could be turned out for double the money by the firms that made them.

A Queer Position

Matters wouldn't be so bad if American makers of high-class sets had made their invasion at a time when the wireless market in this country was expanding with great rapidity. It's obvious that we must now be within measurable distance of the saturation point about which so much has been written, for more than two-thirds of the homes in this country now have their wireless sets. In the future, therefore, the market must take on more and more of a replacement character. And into this market come the Americans offering high-priced receiving sets backed not by a three months' or a twelve months' guarantee, but a guarantee of five years. One, at any rate, of the firms in question does not bring out new models each year; it produces them only when research and experiment have shown that it is genuinely worth while to change the designs. Even if its original purchaser doesn't keep it for the whole five years, a set carrying such a guarantee will doubtless retain a good second-hand value, and that won't help the replacement market for new receivers. It's a queer position, isn't it?

Time We Knew

ISN'T it about time for the Television Committee to give us some idea what they propose to do about the television transmissions in the future? You'll remember that when the Alexandra Park service was inaugurated there was a guarantee that no alteration affecting receiver design would be made for two years in any event. Well, one of those years has gone already, so at the moment we are assured of only another twelve months of transmissions of the present kind. The public should certainly have some guarantee that receivers bought now will be usable when the two-year period comes to an end twelve months from now, or at any rate that they will be convertible at small expense if any alterations are made in the system. To give one instance of a possible change, it is obviously desirable that all countries should adopt one and the same number of lines and of frames per second as standard. At present there are two different standards, our own of 405 lines and 50 frames a second (with which the French seem inclined to agree), and that adopted in Germany and America with 441 lines and 60 frames a second. Does the Television Committee contemplate adhering to its present number of lines and frames, or is it likely to plump for the higher numbers? A change would probably not affect existing televisors.

An Awful Word!

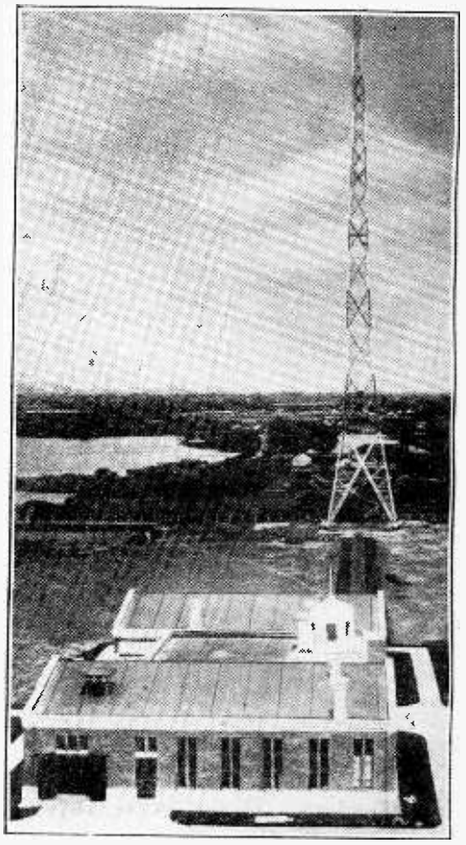
FOR some time past an appalling new addition to the language has been cropping up in American wireless pages. This is the word video, used in such expressions as video transmitter, video receiver or video amplifier, to distinguish television and television apparatus from the older branch of wireless, which is always known in the States as radio. Clearly we want a word which is less of a mouthful than television. It's a waste of breath or ink to speak or write about television frequencies or television reception. Visio would seem to fill the bill quite well and there's nothing offensive about it. Video, on the other hand, is just nonsense, since it means "I see." New words have to be coined continually, for the language is always growing, but there's no need for them to be ugly and meaningless words. And talking of new words reminds me that I saw a very good suggestion recently in one of the lay papers for something better than televisor. This was radioscope. What do you think of it?

An Old Fallacy

THE old idea that a dry high-tension battery must be a jolly good one if it shows considerable recuperation in EMF when given a rest for a time still keeps on cropping up. Actually, if the depolariser is doing its job properly and the battery isn't overloaded, recuperation is small, for the very good reason that there is no great fall in EMF during working hours to be made up whilst the battery is at rest. Big recuperation simply means this: Whilst the battery is under load its internal resistance is rising more or less steeply, since its depolariser is unable to deal sufficiently quickly with the growing accumulation of hydrogen bubbles round the carbon electrode; but when the battery is placed on open circuit over-night the slow-acting depolariser gradually clears off the hydrogen bubbles, with the result that the internal resistance falls and EMF returns into much higher value. The ideal depolariser would be instantaneous in its action, getting rid of the bubbles as fast as they formed. Nobody has produced this yet, but in a good dry battery suitable for the work in hand there is no big fall in EMF during working hours to be followed by spectacular recuperation after a long period of rest.

The Noisy Loud Speaker

THE Birmingham Watch Committee, I see, has recommended to the City Council that a by-law should be approved, making it an offence against the peace of a neighbourhood for people to disturb their neighbours by the use of over-noisy wireless sets or gramophones. I'm heartily in favour of such regulations, which exist in a good many places nowadays, for there are few worse nuisances than these. It is curious to notice that the offenders are not infrequently people who will run small sets all-out. The resulting distortion is pretty horrible at close quarters, but it's far worse if you are some distance away and hear little but certain oft repeated and nerve-shattering thumps and squeals. There is a standard form of by-law which to my mind has one bad defect. Action cannot be taken against an offender unless three householders complain. Often there are not three neighbouring houses affected by the nuisance. It would be better, I believe, if one householder's complaint were sufficient, provided that he could convince the police by demonstration that it was genuine. In Switzerland, by the way, they go a good



BOMBED. The Chinese Government High-power Wireless Station at Nanking, built by the Telefunken Co., was considerably damaged and put out of action during a recent air raid on that city.

deal farther in this direction than we do. It is an offence in built-up areas to use a loud speaker in a room with the windows open. That's just a bit too drastic, don't you think?

Worth Hearing

WE think we're soccer fans in this country, but our enthusiasm pales beside that of many Continental countries nowadays. Listen to the immense lists of results in the Sunday evening's news bulletins and you'll realise what a vast part football now plays in their lives. Better still, tune in a running commentary on Sunday afternoon from Radio-Paris, or Stockholm, or Vienna, or one of the German stations, and you will find an atmosphere of excitement that is difficult, if not impossible, to match in our broadcasts. You needn't know much of whatever language is being spoken to be able to get at any rate a glimmering of what is going on, for the great majority of football words used by all nations are either English, or literal translations of the English terms. The commentator works himself up into a perfect frenzy: at times you feel that he must be on the verge of tears. And the spectators are equally keyed up, as you can tell from their frantic shouts, their roars of triumph, or their moans of pain when things are not going too well for the side that they support.

International matches between Continental countries are the best of all to listen to, and it is amusing to switch over to the different points of view by tuning in now a station of one of the nations engaged in the battle and now a station belonging to the other side.

Teachers Not Satisfied

TEACHERS in London schools and, one gathers, in others as well, aren't satisfied with the B.B.C.'s special broadcasts for the benefit of their classes. They complain that twenty-minute talks are far too long for small children, and that a great deal of the subject matter selected is dull or otherwise unsatisfactory. It is stated, apparently with some pride, that one in every seven of the schools in England and Wales takes the broadcasts. I shouldn't have thought that one in seven, which, after all, is but 14 per cent., was much to write home about. I wonder what proportion of the Scottish schools, whose special transmissions cause such complete disorganisation of the whole country's programmes, make any use of them. The actual figures might be pretty interesting to those who suffer by the silence five days of the week of the London and North Nationals.

Background Noisiness

AFTER having something to say on a topic which I raised recently in these notes—the extraordinary way in which apparatus with major defects sometimes slips through the manufacturer's final tests—a Devonport reader asks why it is that so many modern sets are prone to background noisiness of the mushy type. He is inclined to ascribe the trouble to the use of certain types of frequency changer, though I am not sure that the intermediate-frequency stage is not often the more guilty. He is referring, of course, to the low-priced set without any signal frequency stage. In a place like Devonport, which is at present outside the service area of any of the high-powered home stations except West Regional and possibly Droitwich, such a set must necessarily be worked with the volume control tuned pretty well up, and, with the IF valve going nearly "all out," background noisiness is bound to occur. Matters should be very much better when the Start Point transmitter gets to work. Till that time the only solution appears to be to use, in that part of the world, a set with sufficient reserve of SF and IF amplification to make "all out" working unnecessary.

Empire Needs

FROM Lahore, in the Punjab, I have a plaint that the Empire programmes are a long way from being what they should. Reception in India is generally not too bad; it is the programmes themselves that come in for criticism. I do sometimes listen myself to one or other of the Empire transmissions, and, except when some big item is being put over, I agree that they would stand quite a bit of improving. It is rather a blow to one's pride to hear, as one does, from people living not only in India but in other parts of the Empire, that they get better entertainment from Germany, or Holland, or Italy than they do from the home stations. The difficulties, I know, are considerable (that of £ s. d. being probably not the least); but now that the Empire station has first-rate transmitting equipment we ought to see that its short-wave programmes are the very best going.

The Wireless World 1938 Diary

THE appearance of this well-known annual publication reminds us of the approach of the New Year. The Diary pages proper, apart from giving the dates of the more important happenings in the world of wireless, contain useful hints for constructors and listeners.

Once again this year a comprehensive list is given of the European broadcasting stations together with their frequency, wavelength and power. Another list deals in a similar manner with the short-wave stations of the world. Complete information is also given concerning the various wavebands on which amateur stations are to be found. The Morse Code, as well as the QSA and RST abbreviations, are also included. In the section dealing with technical data is to be found complete information concerning the various formulæ and other details needed by the constructor and experimenter, including, among many others, output transformer ratios, decibel calculations, amplifier design and the colour code for resistances. Among other features are abacs for quickly ascertaining various facts from certain data without the necessity of lengthy calculations. Standard wire tables, diagrams and details of valve bases, and complete data in tabulated form concerning every type of valve, are also given.

One of the most popular sections, namely, circuit diagrams of modern sets and amplifiers, is again to be found brought completely up to date, while there is also some valuable information concerning the suppression of electrical interference. The Diary, which costs 1s. 6d., may be obtained through any newsagent, or for 1s. 7d. post free direct from the publishers, Messrs. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

Recent Inventions

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

CATHODE-RAY TUBES

THE fluorescent screen of a cathode-ray tube is deposited on the inside surface of the glass bulb, and an elongated lens is mounted hard up against the corresponding outer surface of the bulb, so as to project the picture on to an external viewing-screen. The end of the lens in contact with the glass has the same curvature as the bulb, but the farther end is of greater curvature.

A slot formed midway along the periphery of the lens serves to reduce total internal reflection, and the formation of "ghost" images. The virtual image produced by the lens has a curvature opposed to that of the fluorescent screen and so helps to offset spherical aberration.

Marconi's Wireless Telegraph Co., Ltd., and N. Levin. Application date December 27th, 1935. No. 467995.

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RADIO-GONIOMETERS

THE electrical symmetry between the windings of a radio-goniometer, which is necessary to secure a clear-cut indication when taking wireless bearings, is obtained by the use of powdered-iron cores. On the one hand this enables any capacity effect between the stator and rotor windings to be eliminated, and with it the undesirable "vertical antenna" effect which tends to blur the critical point of minimum reception.

On the other hand, the well-known "quadrantal" error can readily be corrected by so shaping the magnetic pole-pieces that they generate a compensating voltage of the required sinusoidal shape and amplitude.

Soc. des Etablissements Henry-Lepaute. Convention date (France) November 26th, 1935. No. 467547.

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DIRECTION FINDING

THE direction of a distant transmitter is indicated visually on a cathode-ray tube, and means are provided for distinguishing the directional signals from "jamming" signals and other undesired interference.

As shown in the figure, the pick-up voltages from two crossed-frame aerials A, A1, are applied in succession to a tuned circuit B, through a change-over switch consisting of two diodes D, D1, which are rendered alternately conducting and non-conducting by the AC voltage from a transformer T. The resultant output from the frame aerials is applied through an amplifier C to one pair of deflecting plates in a cathode-ray tube K, the other pair of deflecting plates being fed from the transformer T.

The aerial structure is rotated until the two traces formed on the fluorescent screen remain at constant amplitude, which indicates that the aerial is in the critical position. The presence of jamming or interference is easily distinguished from the beacon signals by the general level of the patterns produced on the screen of the cathode-ray tube.

Marconi's Wireless Telegraph Co., Ltd., and G. M. Wright. Application date November 20th, 1935. No. 467892.

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AN AID TO TUNING

THE tuning of a superhet set, particularly when working on the short waves, is so critical that one may easily "pass through" a desired station without hearing any sound to indicate its presence. One way to overcome this difficulty is to provide a special oscillator valve, which is tuned very close to the intermediate frequency of the set, so as to produce an audible beat frequency with the signal, which will, of course, be reproduced in the loud speaker.

To avoid the use of an extra valve, the invention consists in arranging one of the ordinary low-frequency valves to serve the required purpose. The valve is automatically switched over to act as a high-frequency oscillator during the actual tuning operation, and is similarly switched back to normal operation, by a control on the tuning handle, as soon as it has given audible warning of the presence of the desired carrier-wave.

E. K. Cole, Ltd., and H. C. Rowe, Junr. Application date March 2nd, 1936. No. 467754.

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TELEVISION RECEIVERS

THE fluorescent screen of a cathode-ray tube is replaced by one upon which an incandescent picture is produced by the heating effect of the electron stream. It consists of an open-work mesh of refractory material, which may be woven from very thin tungsten or molybdenum wire as shown enlarged in Fig. 1.

When placed in position the screen S, Fig. 2, is subjected to the bombardment of the electron stream from the cathode C, so that the varying intensity of impact, as controlled by the grid G, throws up the image of the picture in graded incandescence. A lens L projects the picture on to an external viewing-screen O.

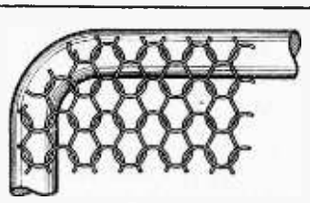

Fig. 1.

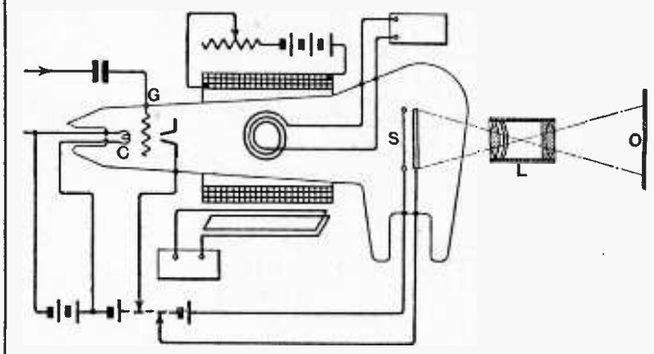

Fig. 2

Fig. 1. Construction of wire mesh screen used in place of usual fluorescent screen in CR tube. Fig. 2. Assembly details of CR tube for projecting image on to external screen.

Farnsworth Television Inc. Convention date (U.S.A.) May 7th, 1935. No. 467366.

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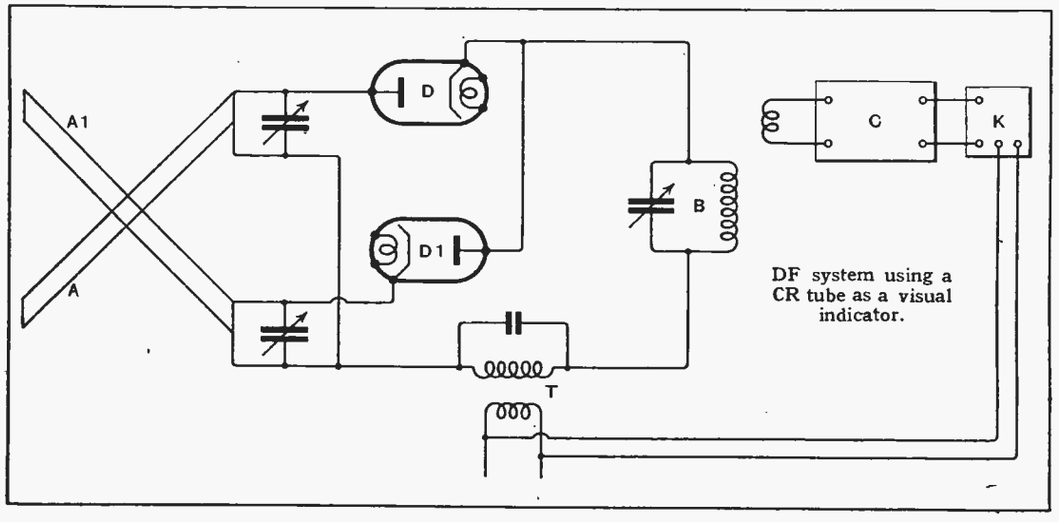
MAGNETRON OSCILLATORS

RELATES to a magnetron valve of the kind in which the anode is split into two halves arranged coaxially around a straight cathode. In this type of oscillator, the output is normally controlled by means of an external magnetic field which is applied in a direction substantially parallel with the axis of the anode sections.

According to the invention, an additional external control field is applied at an angle to the direction of the main magnetic field. This may be derived from a local oscillator which is connected through a pair of Lecher wires across the split anode. The effect of the auxiliary field is to produce impulsive changes in the anode current, which may be used for frequency-doubling.

Telefunken Ges für drahtlose Telegraphie m.b.H. Convention date (Germany) December 22nd, 1934. No. 467840.



DF system using a CR tube as a visual indicator.

The Wireless World

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EDITORIAL COMMENT

Secretiveness

Unprofitable and Misleading

WE have in the past expressed regret that the organisation of the radio industry in this country does not lend itself to the encouragement of research and development work on the part of individual receiver manufacturers to the extent which we consider to be desirable for a healthy and progressive industry.

To illustrate what we mean, it is necessary to explain something of the detail of the organisation which has grown up gradually over a period of years.

It is well known that the three or four large valve manufacturers whose principal customers for valves are the receiver manufacturers, maintain well-equipped research departments and, as part of their service to their customers, are prepared to supply to set manufacturers complete receiver designs as well as details of special circuits associated with new valve types. In addition, the set manufacturer has at his disposal the inventions developed or acquired by those organisations with whom he has a general patent licence agreement.

With such sources of information available to them it is not unnatural that set manufacturers should be discouraged from maintaining expensive research and designs departments of their own and, in consequence, tend to restrict these departments to just enough to meet their current needs without much concern for technical developments of the future.

Now apart from the fact that these circumstances lead to the concentration of research in a very few laboratories so tending towards a standardisation in receivers, it has also the effect that these laboratories hesitate to disclose, except for the direct benefit of their customers, the results of research work they carry out.

We can now see what effect this has upon the reputation of our industry as a whole.

In the eyes of the onlooker, and particularly those in countries abroad, wireless technique here lags sadly behind other countries because new developments here are first disclosed in marketed sets, and it is common knowledge that there may be an interval of many months between the time that a new idea emerges from the laboratory and its incorporation in a marketed product.

Tell the World!

If new developments of laboratories were promptly published after the necessary patent protection had been applied for, we believe that a very different picture would be painted of the state of radio development in this country.

The publication would serve to enhance the reputations of the laboratories from which they emanated, creating a greater demand for their products or the use of their patents whilst serving also to uphold national prestige.

How much more satisfactory, too, would it be to manufacturers of sets to know that the importance of the new features they had introduced had had preliminary recognition so emphasising their value, whilst at the same time indicating their British origin instead of leaving the public to assume, in the absence of any other evidence, that the ideas were copied from abroad where the policy is to publish results of research as they occur.

The Television Race

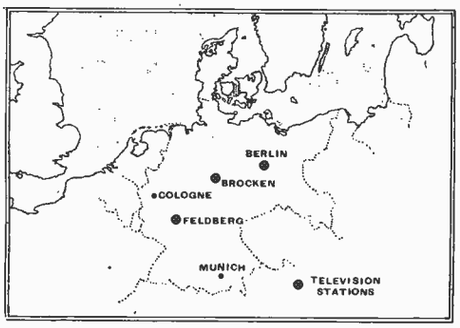
OUR BERLIN CORRESPONDENT SURVEYS THE EUROPEAN SITUATION

GERMANY is following this country closely in establishing a national television service, but is adopting a method of distribution fundamentally different from our own. Instead of installing her stations in large centres of population, she is building them on isolated mountain tops, expecting that the gain in range thus obtained will more than offset the wasted radiation over sparsely populated districts in the immediate vicinity of the stations.

AN extensive tour in Europe has permitted me to study television conditions in a number of countries. Surveying the material and impressions gathered, I find that London, at the moment, is the only city in Europe with a properly organised and really public television service on more than 400 lines.

In Italy construction of a transmitter for Rome is under way, and that city will probably enjoy its first regular television broadcasts some time next year.

In Paris the standard of definition for the Eiffel Tower transmission will shortly be increased, and at the moment 455-line interlaced pictures are being demonstrated at the exhibition. But the fickle Parisians have been slow in taking television to their hearts, and recently a French colleague expressed the opinion that it was high time to start a publicity campaign to popularise it.



Germany's public television service will start with three stations.

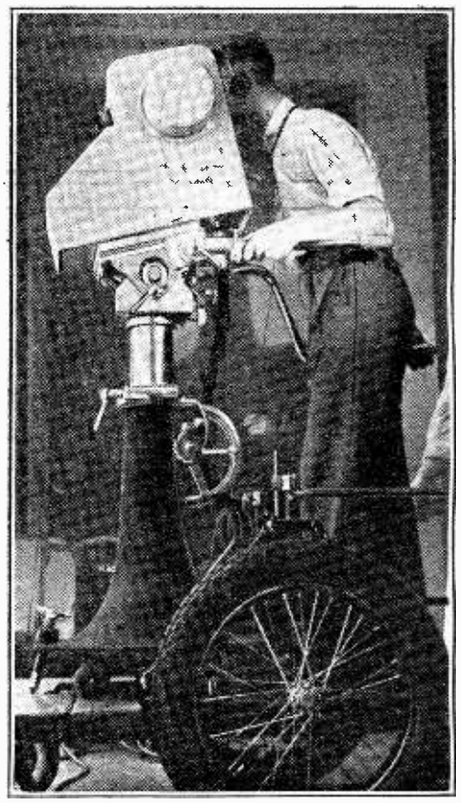
In Holland television is being followed very closely from a technical point of view, and the well-known Philips concern is concentrating on the development of apparatus in its laboratories.

Warsaw is shortly to have an experimental transmitter, and the same applies to Prague. But, next to Great Britain, Germany has advanced farther than any other country towards the establishment of a real service.

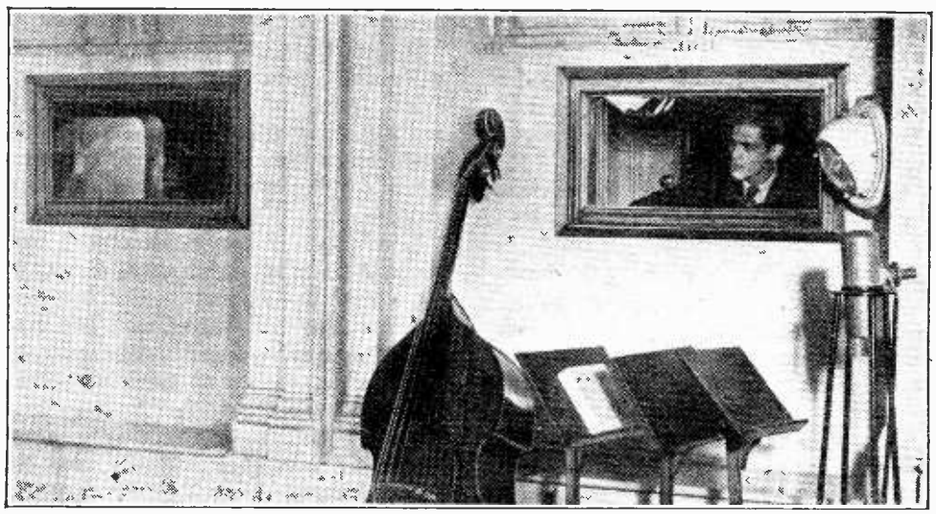
By this autumn Germany will have three stations broadcasting 441-line pictures to a potential "viewership" of roughly 13 million people.

At the time of writing, the only service available is the Berlin 180-line 25-frame transmission from the Witzleben Tower. Germany will thus be a year later than London, but she will also be ahead of Britain insofar as she will have three stations and not one.

The reason for these is easy to find. The number of persons able to spend fifty pounds on a television set is much smaller in Germany than in Britain. Again, only about 6.5 per cent. of the total population of Germany live in Berlin, whereas roughly 20 per cent. of the population of Great Britain live in or around London. Germany, therefore, has to spread its television area, as it cannot reach the same number of would-be viewers as Britain with a single station. The larger the possible number of viewers the better will be the opportunities for real mass production, which will be the only hope of the German television industry. To be a success a receiver will have to sell at twenty or twenty-five pounds (four to five hundred marks) at the most. Even that would not be enough to make the German authorities decide to introduce television, as they would then be opening a public service for the rich only. It is here that large-screen receivers come in. Halls will be equipped so that every German, however poor, will be able to enjoy television.



Iconoscope cameras have been used in Germany on special occasions, but have not yet come into regular service.



The Paris television studio has double windows through which visitors may watch the proceedings.

Scope of Germany's Service

This is the great and fundamental difference between television in Germany and television services in other countries which intend relying for their audiences on those people who buy sets.

German television programmes have been criticised. It has been said of them that they would not satisfy a sophisticated London audience. This is true, and they

The Television Race—

never will aspire to cater for a limited city audience with the counter-attractions of music-halls and theatres. German television programmes are for the masses, and the average viewer, for whom they are planned, is certainly unable to pay five hundred marks for a receiver. Quite apart from this consideration, one cannot at the moment compare London and Berlin television programmes. London has been operating in a lavishly equipped studio with flexible cables and television vans for over a year. Berlin has been restricted to a spotlight-scanning studio for direct vision except on rare demonstration occasions such as the Olympic Games and a football match in November, 1936. Once the German programme builders have the use of the same technical equipment as their colleagues in London it will be time to make comparisons.

After all, London appeals to the general public; Berlin at the moment has a limited audience of "regulars" who sit in a few television-viewing rooms scattered over Berlin. And then, of course, there is the money question. Germany is spending all her television funds on technical development and equipment, and next to nothing on programmes. For the broadcasting organisation television is an additional expense at the moment. They work with the strictest economy in arranging sound programmes, and even more so for television.

Those responsible for the technical side of television, the Post Office, have large sums out of the broadcast-listening fee at their disposal, and it is out of that that they buy apparatus from the German television industry, equip public televiewing rooms and lend receivers to those occupied in the development of the technique.

Careful tests and calculations proved to the German authorities that a transmitter erected on high ground would cover a much larger area than one in flat country. They therefore made a bold move, deciding to erect stations on the summits of high mountains, although it was realised that the areas in the immediate vicinity of the stations is more or less wasted coverage, owing to its sparseness of local inhabitation. The summit of the Brocken has been chosen to serve a part of Central Germany, with towns like Hanover, Brunswick, Halle, and perhaps even Leipzig, Cassel, Magdeburg, etc. This area has a population of roughly three millions.

Serving Sixteen Millions

The second mountain station, the one on the top of the Feldberg in the Taunus mountains near Frankfurt, will cover an area with roughly five million inhabitants. Important towns such as Darmstadt, Frankfurt, Coblenz, Wiesbaden, etc., etc., will be within range. The Berlin station will also cover a rough eight million. There are rumours of a further transmitter which is said to be under construction somewhere in the Rhine industrial district. From the above it will be seen that Germany has had to build three stations to get very little more population coverage than that of the Alexandra Palace.

At the recent Berlin Radio Exhibition apparatus was demonstrated to the public which showed that Germany is now ready to launch out on a 441-line service and provide the programme builders with adequate equipment.

Undoubtedly the two provincial stations will have to depend largely on film for their programmes, unless funds are forthcoming which will permit of more than just experimental studios to be erected in a town near to the new stations. There is also the possibility of a cable link with Berlin, but there is no information available as to how far the cable to Frankfurt now extends.

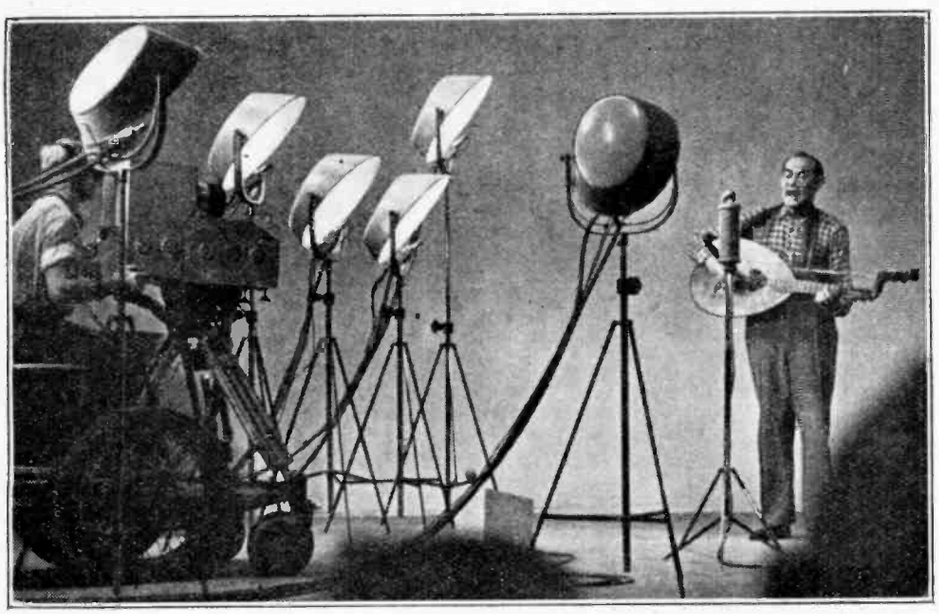
Five firms in all are interested in television in Germany: Fernseh, Telefunken, Loewe, Lorenz, and Tekade. Philips will no doubt be ready for the German market when the time comes. Of these firms four have projection receivers suitable for medium-sized halls. All of them have "home" receivers, and several have the so-called "home" projection receiver which is intended for use in public televiewing rooms for audiences of up to about fifty.

Two very neat little portable televisors attracted attention. They gave images the size of a VPK photo, and, although hardly portable in the sense of a battery radio portable, they will be ideal for use in vehicles. At the moment they are employed for checking and control purposes.

The Fernseh A.-G., pioneers of mechanical scanning, now have two systems for film transmission: electrical and mechanical. It seems a marvel to many that it should still be possible to employ an ordinary scanning disc for 441-line work, and yet Fernseh do it, and it was the opinion of most visitors that their mechanically scanned film pictures were better, clearer and more stable than those on their own or other firms' electrical scanning sets.

The disc revolves in a vacuum, six revolutions to each frame. The speed is very nearly that of sound. The disc revolves at 290 metres per second, while sound travels at 330 metres per second. The astonishing thing is that an ordinary 900-watt lamp is sufficient illumination. The firm are of opinion that wherever stationary studio equipment is required the mechanical system is more accurate for film than any other at the moment. By the way, this firm used to employ a Farnsworth type camera for direct vision, but it now uses an entirely new arrangement which is based on a storage principle similar to that of the Iconoscope.

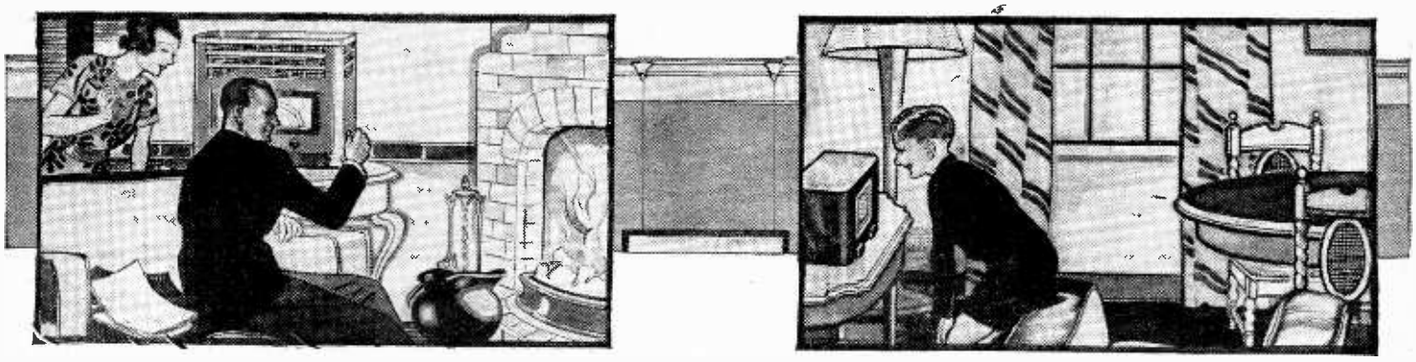
To recapitulate: Britain and Germany are well ahead of other European countries, while France follows. Italy, Poland and Czechoslovakia are soon to have stations. German television is different from the British in conception. Germany's new mountain transmitters will provide extremely valuable data for future development in Germany and elsewhere, notably in regard to service area



"Cold" lighting for television was successfully demonstrated at the last Berlin Exhibition. Water circulating through the mercury vapour lamps minimises radiation of heat in the studios.

NEW READERS' NUMBER

Our issue of next week will contain, in addition to a normal issue, a number of pages directed especially to the new reader. In compiling these pages our aim has been to provide new readers and those who may have allowed their knowledge to become rusty during the summer months with information which will bring them up to date with current progress and enable them to follow future issues more readily. We should appreciate it if present readers would take the opportunity of introducing next week's issue to any prospective new readers of their acquaintance.



New Uses for Extension Speakers

ADAPTING A RECEIVER FOR INTER-ROOM COMMUNICATION

By "CATHODE RAY"

"OFFICE communication equipment, right now, is one of the busiest corners in the electronic market," says *Electronics*. The American journal is referring to the loud-speaking telephone that sits on the desk of the Big Business Chief to save him the trouble of lifting an instrument to his face. It does more than that, of course, for he can listen to what is going on in any department, and can yell at any subordinate without going through the formality of ringing him up. Equipment of the sort is on sale in this country, though not yet on anything like the American scale, and it usually takes a form very similar to that of the well-known* midget sets. Which is a reminder that the ordinary radio receiver is easily adapted to serve the same purposes.

As a small boy, anxious to duplicate and if possible excel the exploits of Craig Kennedy with his detectophones and other equipment for overhearing the dastardly plots of criminals, I experimented with concealed microphones of various sorts, but as this was in the pre-valve era success was only moderate. Now with a valve amplifier in every home things are different. I am, of course, merely warning readers that if they have loud-speaker extension systems, and sons passing through the detective age, everything they say in one of the extension rooms is probably issuing indiscreetly from the loud speaker downstairs to the amusement of their progeny; and, to warn them, the following is an account of how it is being done. As well as a warning to some, this description may be helpful to others who may be contemplating the staging of those innocent parlour amusements that while away the long winter evenings. It may also be a suggestion to some who have a local communication problem to solve—say, between a bed-ridden invalid and a living room—which may not justify the purchase of special apparatus. Or an impecunious office may have an old receiver about the place that could at negligible expense be used to put the establishment on the most advanced level of business efficiency. Or a shopkeeper in the back regions may care to hear what is going on in the showroom; or, if in the latter, to give instructions to the former. These are a small selection of the things that can be performed with nothing more than an ordinary receiver, one or more extension pieces, and (probably) a transformer and switch. Note that a microphone is *not* required.

* Perhaps too well known.

Simple Circuit Alterations

The basic arrangement is shown in Fig. 1, diagram (a) being the original system, and (b) the same modified for two-way communication. They are only schematic diagrams; in practice the gramophone pick-up sockets are not connected direct to the grid of the output valve but to a preliminary stage of amplification, and, in general, that is necessary for this talking system, too, unless the mouth and ear are within a few inches of the respective loud speakers. Assuming that the speaker coils are connected direct to the low-impedance extension line, and are of the usual 2 to 15 ohms, the extra transformer can effectively be almost any microphone-to-valve type, preferably not less than 1 : 100 ratio. But, although the amplification is rather less, it is quite practicable to use an ordinary output transformer, such as might be supplied with the extension speaker.

With the switch on the "Receive" (R) position, the distant speaker acts as an electrodynamic microphone, and its output is amplified and operates the internal speaker. With almost any ordinary type of receiver anything audible in the room containing the extension speaker is also audible in the room containing the receiver. When the switch is put over to "Send" (S), the functions of the two speakers are reversed. Provided that the person at the receiver operates the switch at the appropriate moments he can carry on a conversation with someone anywhere in the other room or rooms. Then, by switching the receiver from "Gram." to radio, it is available for reception as usual, and the "S-R" switch serves to put either internal or distant speakers in the circuit. If both are required at once it is necessary either to use an extra switch or, more neatly, to use as the "S-R" switch a type having a middle position in which the contacts are adjusted so that the upper of the two moving arms in Fig. 1 touches both. If it makes things easier there is no reason why the connections to the moving and fixed contacts should not be interchanged.

When there are several extension speakers paralleled on the same line the sounds picked up by them are combined, and, of course, they all speak at once in the "S" switch position. But if separate lines are available a selector switch can be put in at the receiver end to steer the call to the right extension (or to eavesdrop in the right room). There are obviously unlimited variations on the same theme; for example, if two receivers (or amplifiers) are available, the fellow at the distant end need not wait to be called before he can get in touch.

Possible Modifications

Now for complications. I mean involuntary complications due to the nature of the apparatus available. It is assumed in Fig. 1 that one "Gram." socket and one side of the output transformer secondary circuit can be joined. Generally they are both already earthed. But in the rare

New Uses for Extension Speakers—

cases where undesirable results would follow—if, for example, there is a grid bias voltage between "Gram." and "Earth"—a four-pole switch is necessary to change over both leads of each speaker.

Or the difficulty is that the extension line is of the high-impedance kind, with step-down transformers at each end. Remedy: Change over to low-impedance direct connection and use one of the surplus output transformers to step-up to "Gram." (if a better transformer is not available).

The simple diagram is all right for permanent-magnet speakers. The extension speaker almost certainly *is* a permanent-magnet type. But there are more than

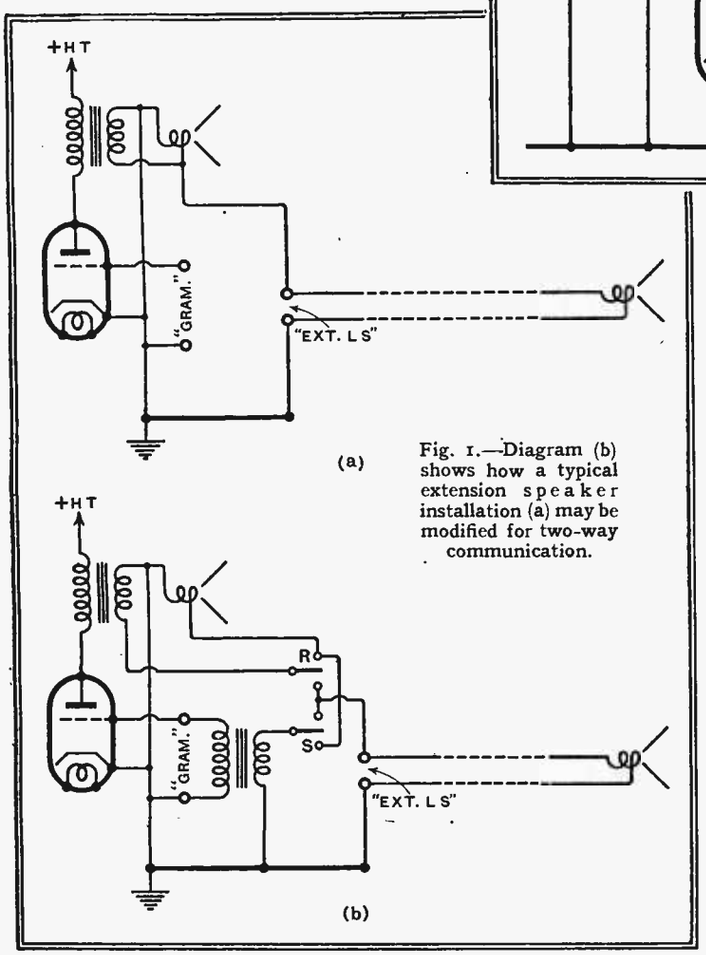


Fig. 1.—Diagram (b) shows how a typical extension speaker installation (a) may be modified for two-way communication.

even chances that the receiver speaker is not. In which case the extension will buzz like an amplified bee when on "S." That really is rather a problem, because the slight hum inevitably present in an energised speaker has the full amplification between it and the extension. It is doubtful whether there is any reasonably simple way of getting a really silent background when the transmitting speaker is energised, but a number of things can be done to cut down the hum. There will be a "hum-bucking" coil in series with the moving coil (Fig. 2), and it is unlikely that it is perfectly balanced. Try shunting a variable resistance of about five times the speaker impedance across each coil in turn, and it will probably be found that there is an adjustment that brings hum to a minimum. An extra 8-mfd. electrolytic condenser in parallel with C1 often works wonders. So may a condenser of selected capacity (try 0.1 to 0.5-mfd.) across the field coil, but perhaps at the expense of some quietness in the receiver speaker.

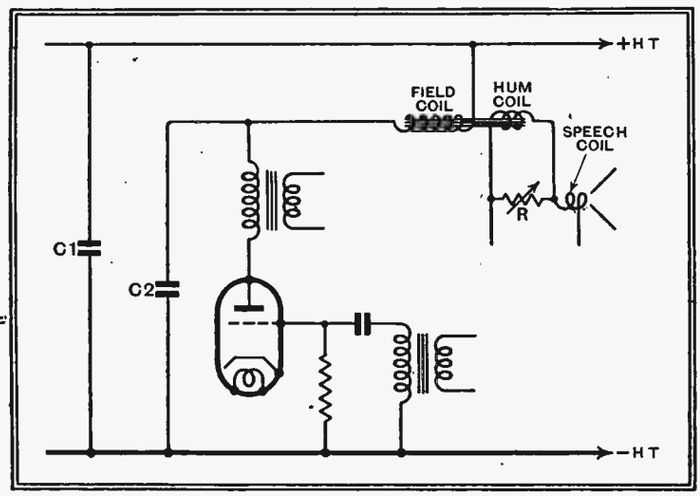


Fig. 2.—Methods of reducing excessive hum in cases where an energised speaker is used.

One predisposing cause of severe hum is that there are two loud speaker bass resonances and two cabinet resonances multiplied, so to speak. Apart from hum this may make tone rather bass-heavy, particularly if the system is being used for speech. So far as this is concerned the speakers would be better in midget cabinets or no cabinets at all. But as that is a remedy unlikely to be considered with enthusiasm when the "talk-back" scheme is only a side-line to high-quality broadcast reproduction, the favoured alternative is to put a condenser in series with the input transformer secondary. Try 0.002-mfd. and a 1-megohm leak if there is no conducting path there already, as also shown in Fig. 2. This cuts hum and bass, but leaves all the elements necessary for intelligible speech. A perceptible amount of hum is generally an advantage for letting the person at the extension know when talking is futile; and even a loud hum may have its uses to call attention. Assuming that speaker-cum-cabinet resonances are not excessive, and that a PM speaker is used at the transmitting end so that distorting anti-hum devices are unnecessary, the quality of reproduction is not so markedly different from direct broadcasting as to give the show away when anything in the nature of a hoax is attempted. It would be quite possible to speed a non-departing guest by making a suitable S O S announcement in Oxonian tones. The quality is, in fact, devoid of the usually recognisible characteristics of carbon microphones.

Apart from hum due to the loud speaker field coil there may be some caused by the input transformer coupling to the power transformer or smoothing chokes. So, when fitting it, turn it about in all directions and positions till hum is least. Earthing the set properly, and also the extension line, is most desirable.

News from the Clubs

Southall Radio Society

Headquarters: Southall Library, Osterley Park Road, Southall.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. H. F. Reeve, 26, Green Drive, Southall.

At a recent meeting a debate was held, the subject being "That Telephony is more Suitable for Amateur Working than CW." It was announced at this meeting that Mr. W. Ancrum, a former President, has presented a silver cup for the most valuable research work carried out by a member during the year.

On November 2nd there will be a debate on the future of television.

Exeter and District Wireless Society

Headquarters: Y.W.C.A., No. 3, Dix's Field, Southerhay, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. Ching, 9, Sivell Place, Heavitree, Exeter.

Members of the Society were recently given a lecture and demonstration by Dr. Wroth, of the Devon and Exeter Hospital, on high-frequency apparatus and X-ray work. Dr. Wroth took the members to the Hospital and showed them the various electrical therapeutic appliances.

At a subsequent meeting Mr. F. J. Thorn demonstrated a very full range of 1938 commercial broadcasting receivers varying in price from £5 to £100.

On November 1st Mr. F. S. Rumball will talk on Radio Reception on Moving Vehicles.

Golders Green and Hendon Radio Scientific Society

Headquarters: 60, Pattison Road, Hampstead, London, N.W.2.
Hon. Sec.: Mr. A. G. Griffiths, "Hornbeams," Priory Drive, Stanmore, Middlesex.

On Thursday, November 11th, a lecture will be given on fault-finding and correction in a wireless receiver by Mr. D. N. Corfield. This lecture will be held at the Regal Cinema, Finchley Road, N.W., at 8.15 p.m.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

Mr. B. R. Bettridge, of the Marconiphone Co., recently gave an interesting talk entitled "Recent Developments in Cathode-Ray Tubes." On November 2nd the Chairman, Mr. W. J. Bird, will lecture on "Sound Reproduction."

UNBIASED

By FREE GRID

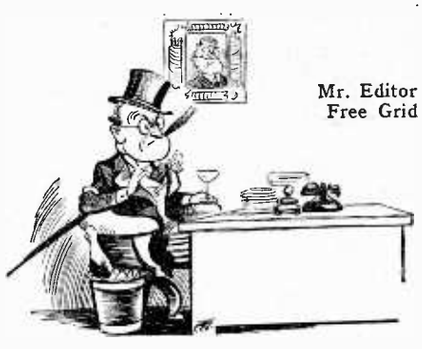
Brother, Can You Spare a Dime?

I SUPPOSE that all you fellows have duly done your duty and filled in the questionnaire form which the Editor, out of the kindness of his heart, so thoughtfully provided for you a week or two back. I regret to say that in preparing this historic document he took advantage of my temporary absence in Paris, whither I had gone to visit a sick friend, for, as you will have noticed, all reference to myself was studiously avoided.

Although I have not been privileged to see your replies, nevertheless by the simple process of bribing the office boy with a few cigarette cards I have succeeded in learning a good deal about your answers, and I find that, in spite of the absence of any question on this subject, many of you have contrived to make a few pointed remarks about myself and Mrs. Free Grid.

The net result of all this is that my mind is left utterly in a whirl as to what you would like my fate to be. While many of you warmly take the side of Mrs. Free Grid and express the opinion that I ought to be hanged, drawn and quartered, others take the opposite view and suggest the establishment of a penal settlement in the Pacific for the reception of all non-wirelessly-minded persons.

Apart from any question of Mrs. Free Grid's fate, the Editor is exceedingly embarrassed to know whether, as the result of the questionnaire, he ought immediately to vacate the editorial sanctum in favour of myself, or if, on the other hand, he should have a whip round among sympathetic readers to provide me with an electron organ or other suitable musical instrument to assist me to



Mr. Editor
Free Grid

commence earning my living in an honest way on the kerbside. Probably many of you would at least be willing to send me a few old components so that I could construct a suitable wireless set for trundling along the streets in a barrow in order to earn a few honest coppers in this fashion.

It is quite obvious to me, of course, that there is a vast conspiracy on the part of manufacturers and the B.B.C. to get rid of me, as I am told that the letters suggestive of shooting and other pleasantries nearly all bear the postmark of the Portland Place area or of districts in which is situated the headquarters of a manufacturer. Naturally this is because I have, in the past, always done my duty by you by my revelations of "trade secrets" which I have made from time to time in these pages in connection with Radiolympia and other matters.

If, therefore, you should see me in the near future playing an electron organ at the kerbside outside the princely portals of Broadcasting House you will know who is responsible, and I would ask you, in the words of the song, to "spare a dime." I am aware, of course, that the high Panjandra who frequent Broadcasting House do not usually deal in anything smaller than a one-pound note, but change will gladly be given by Diallist and Cathode Ray and other unfortunates who will probably be assisting me.

Thank You

MY problem of the commercial traveller's alarm clock, in connection with which I invited your assistance recently (1.10.'37), has brought me in an unexpectedly large number of solutions from the technical highbrows to whom I specially appealed. Many of them have sent me whole pages of mathematics which have, unfortunately, left me rather bewildered, as I am at a loss to know whether they are endeavouring to prove to me that the thing can't be done, or are offering me a solution to the problem.

My special thanks are due to certain of the controversialists in the recent "transients" dispute which has been raging in the Editor's Correspondence Columns. It has been definitely proved to me that since the tick of the clock is a transient it would be necessary for any filter circuit to be arranged so as to exclude *all* frequencies if I wished to get rid of the aforementioned tick. While I sincerely thank all those who sent me elaborate circuits for such a filter, it occurs to my humble and

No dole, large wife and family

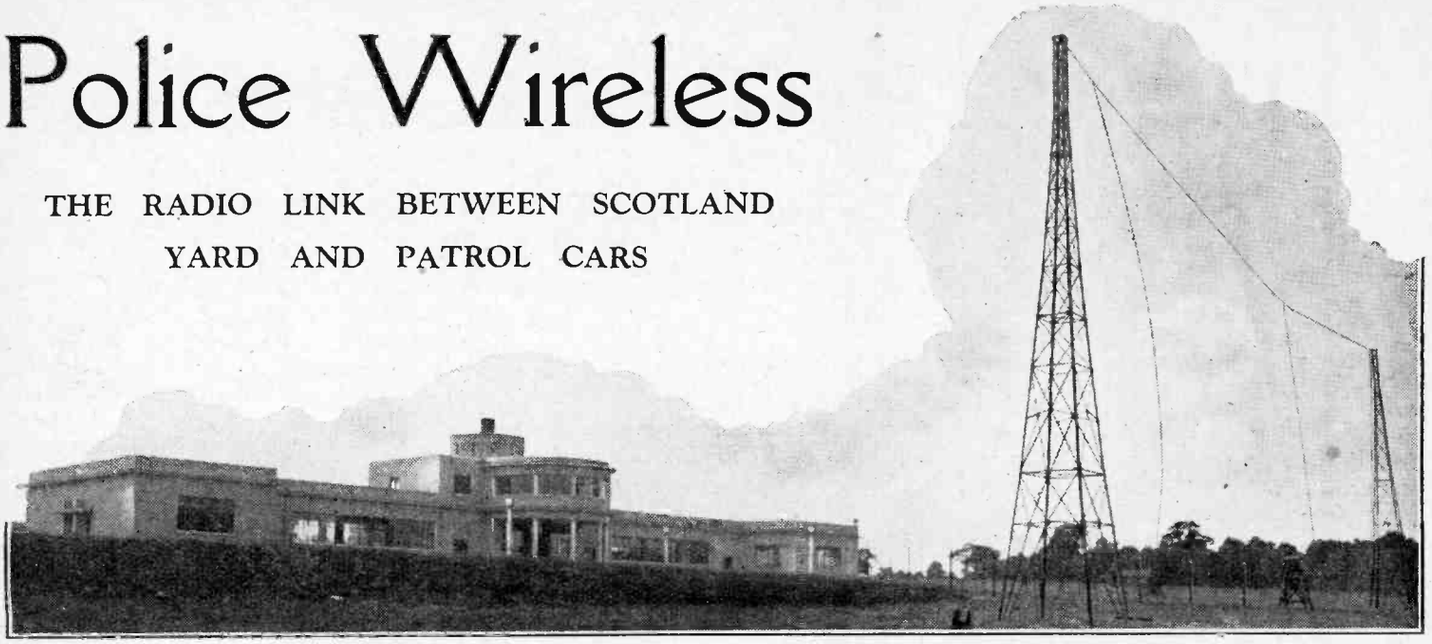
completely non-mathematical mind that since *all* frequencies, or, in other words, *all* sound, are to be excluded, a plain, unvarnished cut-out switch would be both simpler and cheaper. I think that even the highbrows will agree with me in this. However, I am willing to be corrected.

Now, after wading for hours through the miasma of mathematics that some readers so kindly sent me, I was delighted to come across an absurdly simple idea sent in by two readers for preventing the amplification of the clock tick. Their suggestion was to arrange matters in such a manner that the clock itself switched on the amplifier at the same time as it commenced to sound its alarm. Could anything be simpler? At any rate, it works, and my commercial traveller friend has been enabled once more to sleep in hotels from which he had been excluded on the grounds of disturbing the neighbourhood. He is exceptionally grateful as he was getting rather tired of casual wards, which, apart from H.M. Hotels, are, I believe, the only places where a really reliable réveillé service is in operation. Once again, my very best thanks to you all.

Before leaving the subject I may say that, judging by your letters, very few of you seem to be acquainted with the habits and conventions of modern hotels, and I can't think where some of you are accustomed to put up when in a strange town. While some of you seem to be accustomed to the luxury which ruined ancient Rome, the majority appear to be habituees of what must be nothing more than glorified doss-houses. Of course, as I have mentioned before in these columns, all hotels are frightfully old-fashioned insomuch that they are completely lacking in proper wireless amenities. I cannot, for instance, recall a single hotel where ordinary headphone points are provided in the bedrooms, to say nothing of a complete all-wave set. You would expect that in the London area the least thing that hotels could do would be to provide a television set in every bedroom, but when I suggested this to the manager of a world-famous West End hostelry he somewhat coldly informed me that his guests were not accustomed to be in their bedrooms so early as 9 p.m., the hour of the evening television programme. He did not take it at all kindly to my retort that at any rate they would be there at 3 p.m., getting over the effects of the night before.

Police Wireless

THE RADIO LINK BETWEEN SCOTLAND YARD AND PATROL CARS

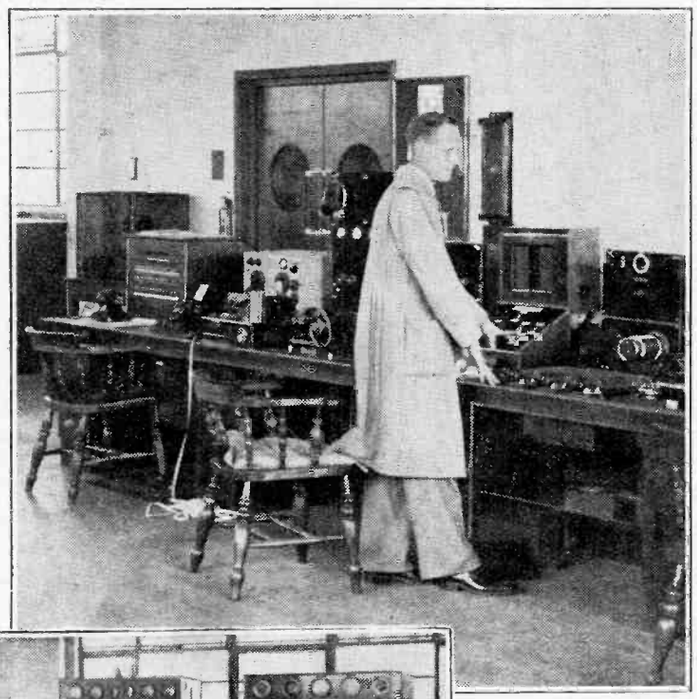


The new building at West Wickham, Kent, which houses the transmitting and power plant, wireless workshops and stores.

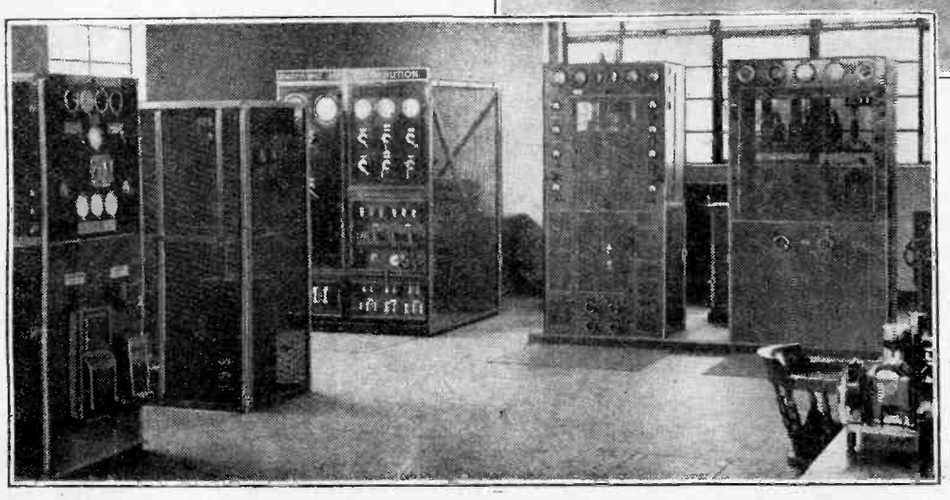
EXHAUSTIVE experiments at the Metropolitan Police receiving station, which was opened last year at Denmark Hill, London, were conducted in order to decide upon the most suitable site for a new transmitting station. As the result, the station has been erected at West Wickham on the high ground south of the city.

Built with a view to future development, the station is of generous proportions, and the equipment comprises the most modern apparatus to ensure efficiency for twenty-four hours of transmission a day. The station is designed to cover a radius of about 30 miles, so that any police patrol in the Metropolitan area is well within its service area.

Because of the high standard of reliability required of this station it was necessary to provide two transmitters, No. 1 being a Type SWB.8 Marconi, operating on a power of 1.5 kW, whilst the No. 2 transmitter is built by the police engineering staff and has an output of 1 kW. Each of these is built up in three cubicles containing respectively, rectifiers, HT supply for the high power and final stages of the transmitter, and the transmitter proper.



Below is seen one end of the transmitting hall, housing the Marconi transmitter on the right and the transmitter built by the police engineering staff, on the left of the picture.



Shown above is a section of the control desk which is adjacent to the transmitters.

Although the station has only just been completed it was actually in operation during the Coronation period, and it was then essential to use both transmitters simultaneously; provision, therefore, had to be made to couple the second transmitter to a separate aerial system. The coupling in such a case as this is made through a 600-ohm line. A third transmitter of temporary construction was also used throughout the Coronation.

The station operates only on telegraphy, and is controlled by the police staff in Information Room at Scotland Yard. Post Office landlines connect up Scotland Yard to the receiving station at Denmark Hill and from there to the transmitter.

Though these transmitting and receiving stations are so far removed from New Scotland Yard the operators there are in absolute control of transmission and reception, there being no question of manually relaying messages.

The call-sign of the station is GWW; it works on 145 metres, and is fully self-contained, deriving its power from three Diesel sets, one with an output of 75 kW, the other two delivering 25 kW each.

Auditorium Acoustics

PART II.—SIZE, ABSORPTION AND REVERBERATION

By D. B. FOSTER, M.Sc., Ph.D.

IT will be remembered that reverberation expresses the persistence of a sound in an auditorium after the sound has stopped, and the measure of this effect is the "reverberation time," which is the time taken for a sound to decay to one-millionth of its original value.

The main effect of reverberation in an auditorium is twofold: (a) it increases the average loudness from a given sound source, and (b) it causes overlapping of successive sounds or syllables tending to reduce the intelligibility of speech and to affect, not necessarily adversely, the artistic quality of music.

When a source of sound is continually radiating in an auditorium, the sound intensity builds up until the rate of sound output from the source is balanced by the rate of sound being dissipated. The dissipation of sound occurs at the boundary surfaces of the auditorium in the form of sound absorption. When a sound wave strikes such a boundary surface it is either reflected, transmitted, or absorbed. With most building constructions the amount of sound transmitted is negligible, and as a first approximation it is safe to assume that all the sound is either reflected or absorbed.

The Mechanism of Absorption

The absorption of sound, by the principle of conservation of energy, is accompanied by the production of heat and this occurs in either of two ways: (a) by viscous friction in the air contained in the small pores of the material, usually referred to as capillary absorption; or (b) by rubbing friction between the fibres of the material caused by bulk distortion, usually referred to as absorption by diaphragm action.

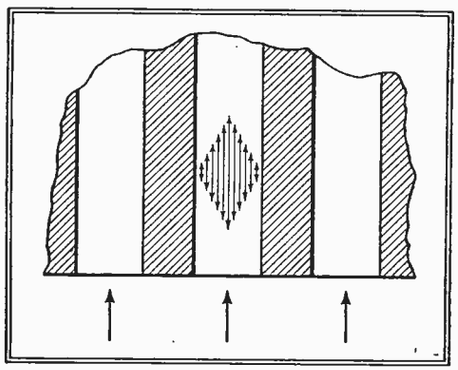


Fig. 5.—Magnified section of porous material illustrating capillary absorption.

The first method may be represented by Fig. 5, which is a greatly magnified cross-section of one tubular element of an absorptive material of porous nature in which the sound wave incident upon the material passes into the tube. The air in contact with the sides of the tube is almost stationary because of excessive rubbing friction, but it increases in velocity towards the centre of the tube as represented in the figure by the lengths of the arrows. This velocity gradient infers a generation of heat in rubbing friction between the adjacent layers of air having different velocities, and this dissipation represents the absorption of the material.

THE previous instalment was concerned with the effect of shape on auditorium acoustics and the current article discusses the effect of size and the sound absorptive nature of the boundary surfaces, and shows how "reverberation time" may be calculated.*

This type of absorption is particularly effective at high frequencies, where up to 90 per cent. of absorption of the incident wave may occur. At low frequencies, where for a given sound intensity the amplitude is greater, the wave tends to pass right through the absorptive material and to be reflected from the hard surface at the far side. Consequently, unless the absorptive material is about 6in. thick the capillary absorption becomes progressively less at low frequencies.

A low-frequency wave, however, tends to make the material move as a whole, particularly if it is freely suspended to move as a diaphragm, and this gives rise to the second type of absorption which is diagrammatically shown in Fig. 6. Consider a fibrous layer in the undisturbed position AAA with the fibres laid along this axis. If a sound wave strikes the material it will tend to make it oscillate between the two extreme positions ABA and ACA, and the fibres will have to slide over each other to accommodate this motion. This sliding action produces frictional heat representing the absorption of the material.

The total absorptive effect is, therefore, the sum of that due to capillary effect and that due to diaphragm action. It is customary to express the absorption of a surface in terms of its "absorption coefficient," which is the ratio of sound absorbed to the sound incident on the surface. The total absorption of an auditorium is equal to the average absorption coefficient multiplied by the total surface area.

If, for example, we consider a ray of sound of original intensity I in an auditorium with an average absorption coefficient of 0.7, its intensity after the first reflection will be 0.7I, after the second reflection 0.49I, and so on until it reaches a value of 0.000001I at the end of the reverberation time. A simple calculation will show that this requires a total of 39 successive reflections. It will be noticed that these 39 successive reflections can correspond to a very short time or a very long time according as the sound has to travel a short or a long way between successive reflections. This distance between successive reflections in an auditorium is usually referred to as the "mean free path," and naturally increases with the size of auditorium, so that, although the average absorption coefficient may be constant, an increase in size means an increase in reverberation time.

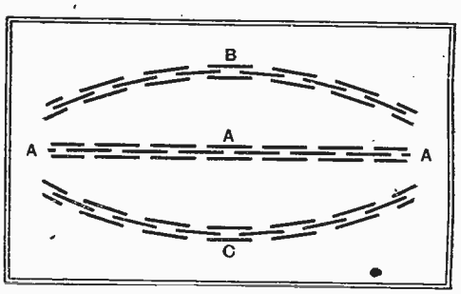


Fig. 6.—Illustrating absorption by "diaphragm action." Movement of the material is accompanied by friction between overlapping fibres.

Growth and Decay of Sound

In order to determine the precise formula for the reverberation time we must also consider the growth of sound intensity in an auditorium, which may be mathematically expressed by

$$I = \frac{4E}{SAC}\left(1 - \epsilon^{-CSAT/4V}\right) \quad .. \quad (1)$$

where,

E is the rate of emission of sound,
A is the average absorption coefficient,
S is the total surface area,
C is the velocity of sound in air,
V is the volume of the auditorium,
T is the time of prolongation of the source of sound.

At the point of equilibrium, which is reached when the rate of emission from the

* *The Wireless World*, September 17th, 1937.

Auditorium Acoustics—

source is balanced by the rate of absorption, the expression simplifies to

$$I = \frac{4E}{SAC} \quad .. \quad .. \quad .. \quad (2)$$

If the source of sound is suddenly stopped the expression for the decay becomes

$$I = \frac{4E}{SAC}\left(\epsilon^{-CSAT/4V}\right) \quad .. \quad .. \quad (3)$$

where T is the time after stoppage of the source. These three intensity relationships during the rise and fall of sound in an auditorium can be illustrated by the

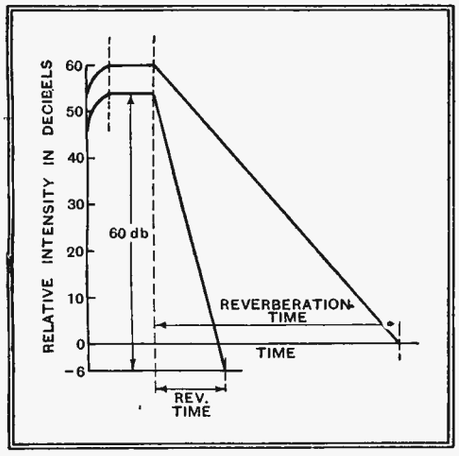


Fig. 7.—Growth and decay of sound in an auditorium. The lower curve is for an absorption four times that of the upper.

two curves of Fig. 7, which also shows the "reverberation time" taken for the sound to fall 60 db. The only difference between the two curves is the value of absorption which in one case is four times that of the other. The effect of the absorption is to decrease the maximum intensity and to reduce the reverberation time. The effect of either of these two characteristics on a series of successive sounds such as spoken syllables is shown in Fig. 8, and it will be noticed that the increased absorption accentuates the difference between the syllables, thus improving the intelligibility.

The reverberation time can be determined by equating to one million the ratio of the equilibrium intensity to the decaying intensity in equations (2) and (3) above, which when simplified gives us

$$T = \frac{0.05\ V}{SA}$$

This simple formula for the reverberation time of an auditorium was developed by W. C. Sabine and agrees with the experimental data for auditoriums in which the absorption is evenly distributed over the surface area. In auditoriums of more complex shape giving uneven distribution of absorption it has been found more accurate to use a modification of this formula due to Eyring,

$$T = \frac{0.05V}{-S \log_e(1 - A)}$$

This formula, therefore, enables the reverberation time to be calculated from a knowledge of the volume and the distribution of the absorption and a typical calculation for an auditorium of 150,000 cu. ft. and 1,000 seats is tabulated below.

Material of Surface.	Surface Area (sq. ft.).	Average Abs. Coeff.	Total Absorption.
Hard plaster ...	12,000	0.04	480
Building board ...	2,000	0.3	600
Curtains	500	0.25	125
Carpet	1,000	0.4	400
Wood floor... ...	1,000	0.08	80
Glass	700	0.03	20
Varnish wood ...	500	0.03	15
Seating area ...	9,000	0.25	2,250
Total ...	26,700	—	3,970

From the above table the average absorption coefficient will be $\frac{3970}{26700} = 0.15$ and the reverberation time by the Eyring formula = 1.73 seconds. This value of time is calculated without an audience, the coefficients for the seating area being for empty seats. It is usual to calculate the reverberation time for various audience conditions as tabulated below.

Audience.	Total Absorp.	Average Abs. Coeff.	Reverberation Time in Secs.
None	3,970	0.15	1.73
1/3rd	5,020	0.18	1.42
2/3rds ...	6,070	0.23	1.07
Full	7,120	0.27	0.89

It will be seen that the change of reverberation time with audience capacity may be considerable, and it is usual to adjust the reverberation time to suit average capacity, which may be about two-thirds full audience.

If the above auditorium were to be used for speech purposes its optimum reverberation time would be about 0.9 second, and

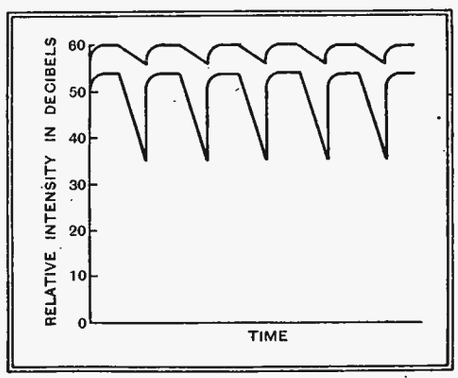


Fig. 8.—An increase in absorption results in greater separation of a series of successive sounds, much as the syllables of speech.

the reverberation time at two-thirds audience of 1.07 seconds should be reduced by 0.17 seconds by the introduction of a suitable amount of extra absorption. Substitution in the Eyring formula would indicate that the average absorption coefficient should be raised from 0.23 to 0.27, corresponding on the given surface area to a total absorption increase of 26,700 (0.23 – 0.27) = 1,060 absorption units.

In order to introduce this extra absorption use may be made of special materials such as hair felts, rock wool, or fibre tiles having exceptionally high absorption coefficients. For example, if it was decided to use a hair felt having an average absorption coefficient of 0.75, we should require $\frac{1060}{0.75}$ = 1420 sq. ft. and this could replace an existing area having a hard plaster finish of negligible absorption. It is usual to apply the extra absorption introduced in this manner to surfaces such as curved back walls which can produce acoustical defects due to their shape, so that double advantage may be made of the material.

The next article will deal with instrumental methods of measuring reverberation time.

Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

FRIDAY, OCTOBER 29th.

3, Friends from the Zoo, introduced by David Seth-Smith. **3.15,** Preview: highlights of the week. **3.20,** Gaumont-British News. **3.30,** "Full Moon": a revue for television.

9, Friends from the Zoo. **9.15,** Preview. **9.20,** British Movietonews. **9.30,** "Waterloo": a play by Sir Arthur Conan Doyle.

SATURDAY, OCTOBER 30th.

3, In Our Garden: C. H. Middleton on planting the herbaceous border. **3.15,** Footwork: a survey of the season's new ballroom steps. **3.25,** British Movietonews. **3.35,** Minor Music-Hall. **3.55,** Cartoon film.

9, A musical act. **9.10,** Gaumont-British News. **9.20,** Song and Dance No. 2: a little show presented by Dallas Dower. **9.35,** "The Jar": a Sicilian comedy by Luigi Pirandello.

MONDAY, NOVEMBER 1st.

3, "The Three of Us"—Pat Waddington, Anne de Nys and John Ridley. **3.10,** British Movietonews. **3.20,** "Red Pepper": an interlude with music by Noel Coward. **3.50,** Cartoon Film.

9, "The Three of Us." **9.10,** Making a Life Mask. Dora Clarke with the help of her caster and a living model will show how a life mask is made. **9.25,** Gaumont-British News. **9.35,** A costume programme.

TUESDAY, NOVEMBER 2nd.

3, Scenes from Ivor Novello's Drury Lane spectacle "Crest of the Wave." **3.15,** Gaumont-British News. **3.25,** Oscar Wilde's comedy "The Importance of Being Earnest."

9, Lubka Kolessa, Ukranian pianist. **9.10,** Body-line—3: Keep Fit Classes for Women. **9.20,** British Movietonews. **9.30,** Three Epic Dramas. 1. "Forging the Fifteenth Amendment"—a drama of the American Civil War. 2. "Mettawamkeag"—an Indian tragedy. 3. "Des deux choses l'une"—a drama of the first Empire.

WEDNESDAY, NOVEMBER 3rd.

3, A Little Show. **3.20,** British Movietonews. **3.30,** Ninety-first edition of Picture Page.

9, A Little Show. **9.20,** Gaumont-British News. **9.30,** Ninety-second edition of Picture Page.

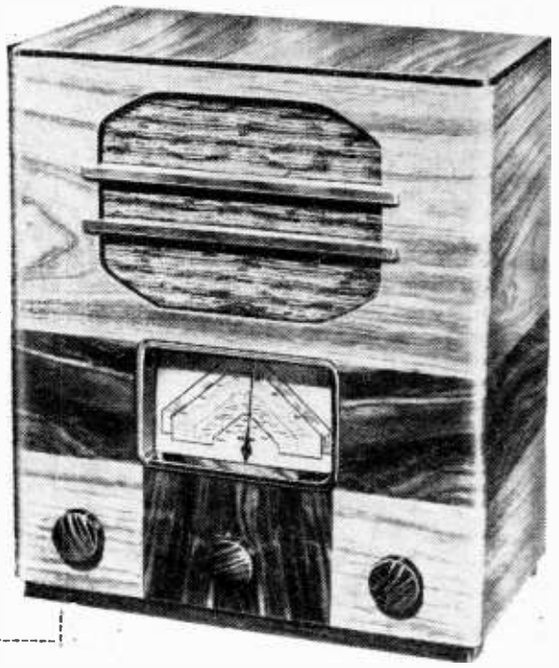
THURSDAY, NOVEMBER 4th.

3, Fashion parade. **3.15,** Carton Film. **3.20,** Kuda Bux—the man with the X-ray eyes. **3.30,** Gaumont-British News. **3.40,** Cabaret.

9, Fashion Parade. **9.15,** Lubka Kolessa, Ukranian pianist. **9.25,** British Movietonews. **9.35,** Experiments in Science—3: demonstration of electrical apparatus for the investigation of the physiology of the nervous system.

Ultra MODEL 105

AN ECONOMICAL AND EFFICIENT BATTERY SUPERHETERODYNE



FEATURES. *Circuit.— Triode-pentode frequency-changer — var-mu. pentode IF amplifier — double-diode second detector—pentode output valve. Automatic bias.* **Controls.** *— (1) Tuning. (2) Waverange. (3) Volume and on-off switch.* **Price.***—8 guineas.* **Makers.** *— Ultra Electric Ltd., Western Avenue, Acton, W.3.*

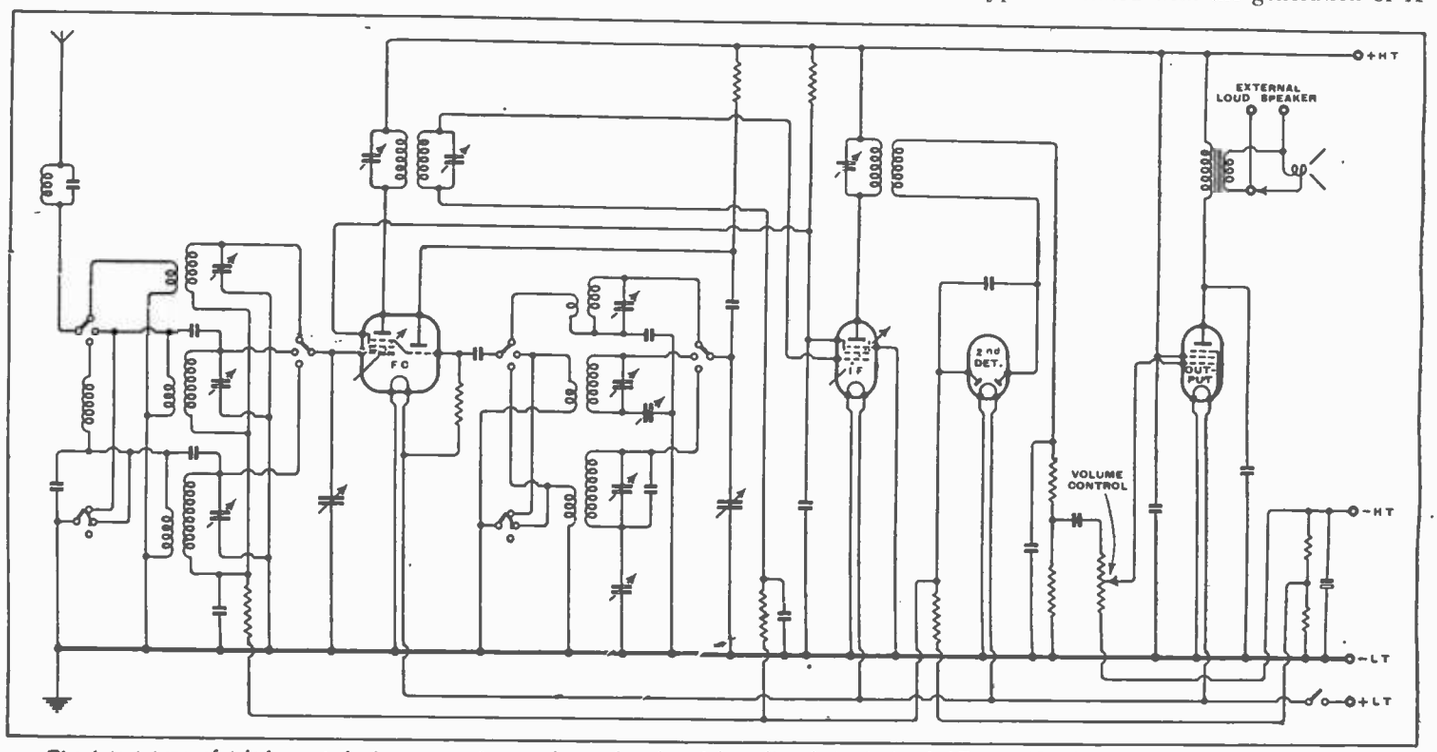
FROM a cursory glance at the circuit one might be led to expect an adequate but rather uninspiring performance from this set. There is no RF stage, the single IF amplifier has only three tuned circuits, and there is no intermediate AF amplification between the double-diode second detector and output valve. All the more credit is, therefore, due to the designers for the excellent volume and range which this set actually gives. On the medium waverange in particular a really sparkling performance is obtained with a wide choice of European transmissions coming in under daylight conditions with a volume and quality comparable with the various B.B.C. Regional stations.

It is of interest to record that during the period of the tests one item which we particularly wished to hear was better received from the North Regional transmitter than from the local London Regional station, as we were using an aerial of a length in excess of the 40-50ft. aerial recommended by the makers. Slight distortion when fully tuned to the local station could be detected with the volume control reduced. On the lower input from the Northern station this disappeared, yet maximum volume could be obtained with something still in hand.

Our customary tests for selectivity showed that it is possible to approach within two channels on either side of the London Regional station without experiencing interference when the set is working in the Central London area. Only one second channel whistle could be found on this range, but on the long-wave band a fair number were distributed throughout the range, though their strength, due to the whistle filter associated with the aerial circuit, was not such as to cause annoyance. The sensitivity on this band maintained the standard set by the medium-wave range, and the Deutschlandsender proved to be of first-rate programme value with the bare minimum of sideband interference from Droitwich and Radio-Paris.

On the short-wave range an extremely low background level gave the impression of a somewhat lower sensitivity, and it was also found that the volume control could be safely left at maximum when in search of fresh stations. Nevertheless, an excellent programme was received from W3XAL (Bound Brook), and if it did not give a volume approaching the maximum of which the output stage is capable, this deficiency was amply made up in the case of the various European "world broadcasts" located on the same waveband.

Repeat tuning points on the short-wave range could be found only on the more powerful stations, and seemed to be of the type associated with the generation of IF



The latest type of triode-pentode frequency-changer is employed and in spite of the lack of AF amplification between the second detector and the output valve the receiver has a lively performance.

Ultra Model 105—

harmonics rather than the more usual form of image interference.

Although the loud speaker diaphragm and its permanent magnet are small, the output in the lower register is sufficient for the foundation instruments of the orchestra to be heard in their proper proportion. It is easily possible to follow the double bass part, as there is no noticeable resonance to mask the reproduction in this region. As is usual, the middle register is adequately represented, and in the top the reproduction is particularly clear, giving unusually realistic pizzicato from the string instruments.

Looking further into the circuit for an explanation of the high performance, of which there can now no longer be any doubt, we take note first of the liberal use of high-efficiency iron-cored coils in the aerial tuning and IF circuits. It must also be remembered that big improvements have recently been effected in the design of battery valves of all types, and in this connection it is interesting to find that a new type of triode pentode frequency-changer with internally strapped grids has been employed.

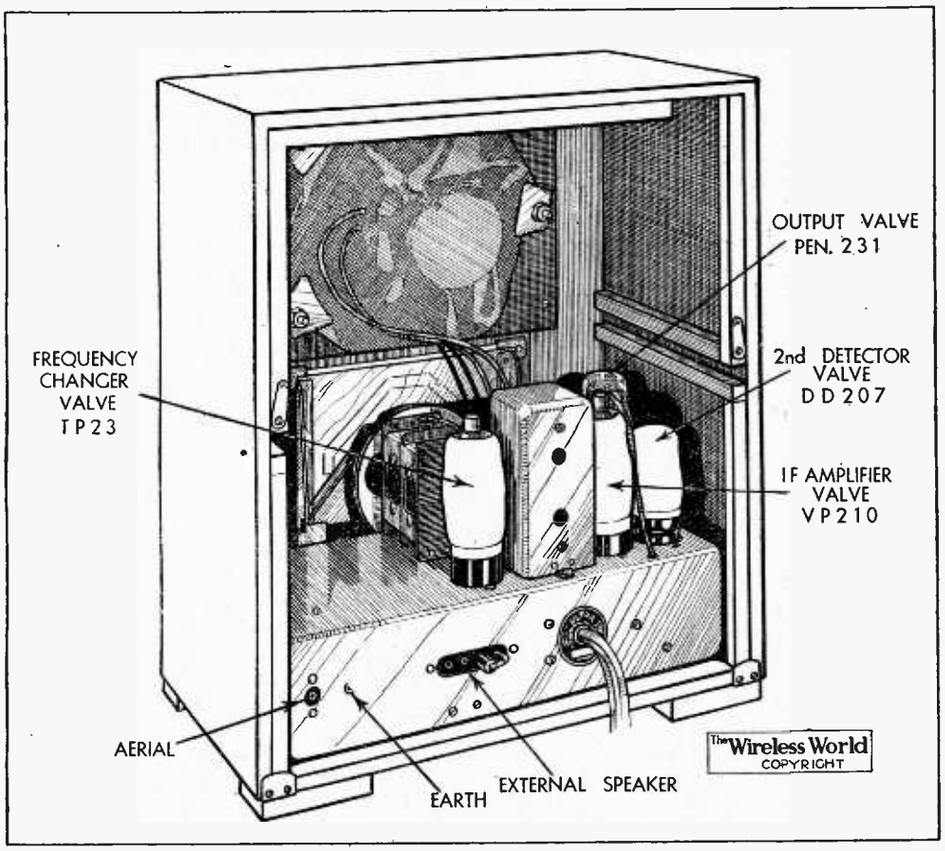
Automatic Bias

The intermediate frequency is 470 kc/s, and a point of interest in this stage is the untuned secondary of the output IF transformer. The ratio here has been designed to take account of the low impedance of the double-diode frequency-changer and AVC rectifier. Grid bias to the high-slope pentode output valve is derived from a resistance in the negative HT lead and a tapping on this resistance provides the delay voltage for the AVC diodes.

A system of plugs and sockets in the secondary circuit connections of the output transformer enables the internal loud speaker to be disconnected when it is required to use the external unit only.

The chassis layout is in some respects unconventional, and the large open space to be seen at the left in the view of the back of the receiver indicates the position of the tuning assembly on the underside. An efficient layout from the electrical standpoint is obtained in this way, and for this reason users will not begrudge the initial inconvenience of growing accustomed to a centrally disposed waverange switch and a tuning control which is offset to the right of the front panel. A removable shelf is provided to carry the HT and LT batteries, which, incidentally, are not included in the price. Removal of the chassis from the cabinet is simple after withdrawing three bolts from the base, and a glance at the components and their associated wiring is sufficient to satisfy the most critical eye for good workmanship and sound construction.

Measurements of HT and LT consumption on the particular receiver under review gave figures of 6mA. and 0.7 amp. respectively. This is remarkably low, having regard to the performance provided, and is in keeping with the general air of efficiency with which this receiver performs its various functions.



View of interior of Ultra Model 105 with battery shelf removed. The tuning coil assembly is mounted below the open space at the left of the chassis.

Extending the Organ Range

Advantages of Electrically Produced Tones in the Lower Register

WE have already described in these pages the principal types of "electronic" organ, but there is another application of electrically produced organ tones which should be of special interest to those associated with the building and playing of organs of traditional design. We refer to the possibility of extending the range of pedal notes, which in many cases has to be restricted from considerations of cost or of the space required for a rank of 16ft. or 32ft. pipes. In such instances it is usual to rely on a bourdon or closed pipe to reach the 16 cycles per second, which is the equivalent of a 32ft. open pipe, but the quality of tone is not to be compared with that of the longer open diapason, and it suffers also from a characteristic hesitancy of speech due to the third harmonic sounding before the fundamental tone is developed.

All these difficulties are circumvented by the addition of an electrically reproduced pedal stop, and, since the energy is confined to single notes in a comparatively restricted range, an adequate foundation of tone to balance the remainder of the instrument is provided by quite a reasonable expenditure of power.

Such an extension has recently been added, at St. Mary Abbott's Church, Kensington, to the specification of the organ built by Wm. Hill and Son and Norman and Beard, Ltd. Through the courtesy of the organist we were able to compare the quality of the new 32ft. electrical stop with the existing 32ft. bourdon, and there could be no doubt of the improvement from a musical point of view. A much fuller and rounder tone was obtained with a higher fundamental content and a quality somewhere between the wood and metal open diapason tone.

Amplitude Control

The source of tone is a single dynatron oscillator followed by a double diode triode valve which feeds back bias to the oscillator to ensure good waveform and constancy of amplitude. A series of standard electrical action organ relays are used to switch in the appropriate tuning capacities for each note, and a separate switching relay keeps the "stand-by" frequency off the main amplifier until a pedal is depressed. Attention has been given to the starting and termination of the tone to satisfy the organist's demand for prompt speaking without "pluck."

The main power amplifier delivers between 15 and 30 watts to a bank of sixteen moving-coil loud speakers suitably phased and mounted in a thick-walled cabinet approximately 5ft. square and 2ft. 6in. deep. Magnavox "Sixty-Six" units are employed. They are not modified in any way, and, as the input to each unit is only a little over 1 watt there is a generous margin of safety from the point of view of amplitude distortion even at the low frequencies concerned.

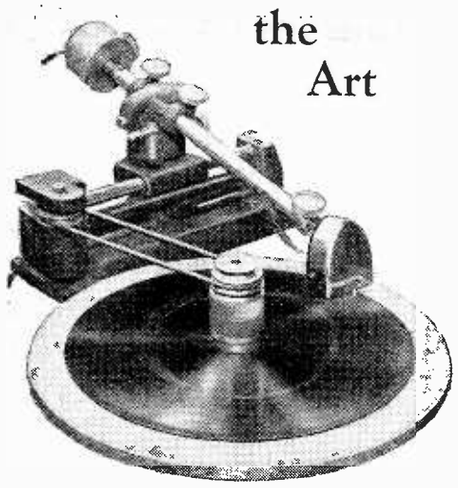
Those interested in further details of the possibilities of extending organ range in this manner can obtain technical information from the Calnorth Manufacturing Co., Ltd., 37-38, North Road, London, N.7.

High-Quality Home Recording

By JOHN R. ORD-JOLLY

IN view of the steadily growing interest in home recording, the author—who has been actively associated with private recording studios for a considerable time—believes that the information set forth in this article will prove of some value and interest to readers. As broad outlines have been dealt with by the technical staffs of several firms interested in the production of recording equipment in a recent issue of *The Wireless World*,[1] it is proposed to deal only with what may be termed the minor points involved. How important these points are in reality may best be left for the enthusiastic experimenter to judge.

Finer Points of the Art



For a beginning let all intending experimenters grasp this fact, namely—if you want to turn out high-quality work it is quite useless to hope to do so by slap-dash, "hit-or-miss" methods. It is the author's experience (a pretty extensive—and expensive—one) that it is meticulous attention to detail that makes the difference between a recording that is merely mediocre, and one of outstanding excellence, so if he appears to lay undue stress on what are apparently trivialities be assured there is very good reason for so doing—and remember that the sum of a finite number of infinitesimals is itself a finite quantity!

Let us consider the blank disc first. There are several on the market that are a practical proposition. Each has some individual merits, but, unfortunately, each has also its limitations. After making several test recordings, the author finally chose the "Simplat" disc as the most suitable for his requirements; this carries the recording medium on a glass base, is of good appearance, and will take a very wide frequency range. It can be processed very rapidly, it being only necessary to wipe over with the special hardening chemical, allowed to dry for about five minutes before applying the polishing fluid and the result is a hard and durable record. The author has himself played one of these records (with trailing needles) something like 200 times and there is no appreciable wear apparent.

Before attempting to record it is absolutely essential that the disc is in perfect condition. To this end it is necessary to store the discs in a place where they are not subjected to wide variations in temperature—they should be kept at about 50 deg. C. *constantly* and prepared for use by exposing to a slightly humid atmosphere for twenty-four hours. This is best done by placing them in a special metal container provided with racks and having the bottom lined with a layer of cotton wool beneath a sheet of metal gauze. The necessary humidity can then be produced by adding a small quantity of water (2 oz. per fortnight in summer and 2 ozs. per month in winter). This conditioning of the disc is most important if one is striving for first-class records with a good high-note response, absence of surface noise, response to transients and a reasonably long life for the cutting stylus.

Obviously, since the chemical coating of the disc is but a few thousandths of an inch in thickness, if it is too soft the grooves will be ragged, besides which the stylus may easily penetrate through to the base and so be damaged, and surface noise will be excessive. On the other hand, if it is too hard the cut will not be deep enough, which will lead, among other things, to tracking troubles when the disc comes to be played back and will also shorten the life of the stylus—in fact, its death will be immediate! The problem which thus arises at the outset is: How can the condition of the disc be definitely ascertained? Not by appearance and not by touch with any degree of reliability. The method the author adopts is to cut a few grooves near the centre—on the finished record these are covered by the label; if these trial cuts appear satisfactory when examined through a magnifying glass, and the thread comes away in a continuous length without any knots in it and does not feel "tacky" when rubbed lightly between the thumb and forefinger, then it has been found that the record will cut satisfactorily. If, in addition, the disc cuts perfectly silently it may be safely assumed that the stylus is in good condition, the pressure between the cutting head and the disc is correct and that the cutting angle is also right. If noise develops during the cutting of a conditioned disc it may be taken as a sign that it is time to replace the stylus. Incidentally, it may be mentioned here that the author has always found a sapphire the most satisfactory cutter, results more than justifying its slightly higher cost. One more point before leaving the question of discs: on applying the hardening dope it should go on smoothly. If it is found that there is the slightest tendency for the pad with which it is applied to stick, then the disc is too soft and will also probably have a dull matt finish instead of a bright shining surface.

Having dealt with the question of discs at some length, a few remarks regarding general equipment and procedure may not be out of place. If you want the best possible results—and since you are reading *The Wireless World* that is a foregone conclusion—you will employ a non-directional piezo microphone, with a pre-amplifier which will have in its first stage a special microphone valve such as, for example, the Mazda V312. Among the obvious advantages that the use of such a microphone confers are the ease and speed with which the pieces of an orchestra, for example, can be positioned to get the necessary tonal balance.

Importance of Tone Control

You will also take the greatest care to ensure that as far as is possible the overall response curve of your amplifier "fits" the response curve of the cutting head you are using. If you are using the same amplifier for both recording and playing back it will be necessary to have an efficient and flexible tone control system. This should be obvious, for your recording amplifier will have a rising characteristic from about 5,000 c/s upwards to get the necessary "top" on the record, and clearly on playing back through it without altering the treble response would result in over-emphasis of the upper register.

An efficient tone-control system is also imperative when it is desired to make copies from a master record, in order that the exact balance may be struck which will enable a faithful replica of the original to be obtained. When copying records it is important to make sure that the speeds of the turntables are identical.

[1] March 19th, 1937.

Listeners' Guide for the Week

Outstanding Broadcasts at Home and Abroad

THE memory of the British Expeditionary Force will be honoured in a programme on Sunday which will form a record of its exploits from the retreat from Mons to the first battle of Ypres—from August to November, 1914. The programme has been compiled by Beatrix Brice, who served with the Old Contemptibles and who is the author of the verses to the first six divisions, "O Little Mighty Force that Stood for England."

AT ROUEN, on August 18th, 1914. A train load of the 11th Hussars, part of the B.E.F., photographed en route for the concentration area. The story of the Mighty Little Army will be dramatically told on Sunday at 6.50.

ACOUSTICS

READERS of *The Wireless World* will doubtless be specially interested in the fifth of Anthony Bertram's talks in the series "Design in Everyday Things," which will be given on Monday at 8 (Nat.). In this talk he will deal with "Heat, Light and Sound in the House." It will be interesting to hear what he has to say about the acoustics of our homes with special reference to wireless reproduction.

TOSCANINI

IT is a rare occurrence for listeners to hear a B.B.C. concert conducted by the Maestro Arturo Toscanini at any time other than during the Promenade season. He will conduct the second and third of the series of B.B.C. Symphony Concerts at the Queen's Hall.

ARTURO TOSCANINI will conduct the next two B.B.C. Symphony concerts on Saturday and Wednesday.

The programme of the first of these two concerts, which is devoted to Brahms, will consist of his "Tragic Overture" and "Requiem." The soloists will be Isobel Baillie and Alexander Sved, while the choral parts will be executed by the B.B.C. Chorus of 42 voices.

Wednesday's concert is devoted to the works of Beethoven and will include his first and ninth symphonies, the latter being choral. On this occasion the soloists will be Isobel Baillie, Mary Jarred, Parry Jones and Harold Williams, supported by the B.B.C. Choral Society.

ASHANTIS

IN the next talk in the series, "I Was There," which will be heard Nationally on Tuesday at 9.20, Lt.-Col. S. H. Hingley will give his recollections of the Ashanti campaign of 1900 and of the surrender of Queen Ashantueh. Colonel Hingley was with the force that went to put down the risings and has vivid memories of the fighting in the African forests. He actually acted as escort to the queen when she was finally captured. His story will indeed be well worth listening to.

PALACE OF VARIETIES

AFTER an absence from the programmes of more than a year, Mr. Flotsam and Mr. Jetsam will be heard in Saturday evening's production of "Palace of Varieties." With them in this programme, which will be heard at 8 (Reg.), will be Stainless Stephen, Clapham and Dwyer, Doris Palmer, burlesque comedian, and Tollefsen, the wizard of the accordeon.

With the return of Flotsam and Jetsam, who have worked together as a dual act since 1926, we are reminded of the circumstances which brought about the combination. Malcolm McEachern (Jetsam) was being visited by B. C. Hilliam (Flotsam), when in the course of conversation Mrs. McEachern, in talking of the ups and downs in the music world, said "You know we're nothing but flotsam and jetsam on the sea of life." It was this remark which gave Mr. Hilliam the idea for the title of this popular variety act.

MYSTERY PLAY

THE Belgian detective of Agatha Christie's novels, Hercule Poirot, is to become a radio character, for Antony Holles, the well-known stage and screen actor, is to create the part in "The Yellow Iris," which the novelist has written specially for broadcasting. The play, which is to be produced by Douglas Moodie, of the Variety Department, will be heard Nationally on Tuesday, at 8, and Regionally on Thursday, at 9. Most of the action takes place in a Continental restaurant called "Le Jardin des Cygnes," at a table decorated with yellow irises. Instead of the music being incidental to the play, it is woven into the action so that it accentuates the atmosphere of the scene in a gay Continental café.

LOVELY VI'LETS . . . STOP!

THE fifth season of the ever-popular weekly feature, "In Town To-night," will open with the 132nd edition on Saturday at 7.30 in the National programme. With its signature tune, "The Knightsbridge March" from Eric Coates' "London Suite," this feature, produced by A. W. Hanson, will again bring to the microphone personalities in the Metropolis. The producer was emphatic in his denial when recently it was suggested that *sometimes* recordings are used. Difficult as it often is to bring people to the studio, more than a thousand people have taken part since it was started in 1933.

ELECTION RESULTS

THE B.B.C. will this year again broadcast the results of the Municipal Elections which take place on Monday. These will be heard Nationally from 11.15—11.30 and from midnight until 12.15 on Tuesday morning.

DON GIOVANNI

IN commemoration of the première in Prague, 150 years ago, of Mozart's opera, "Don Giovanni," there will be two performances from the Continent to-night (Friday). At 6.10, Cologne will broadcast a studio production, whilst at 6.35, Prague will relay the festival performance from the State Opera.

HUNTING

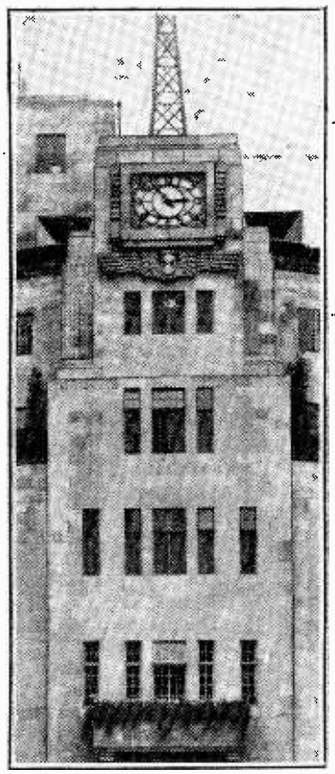
ST. HUBERTUS, the German patron saint of hunting, will be honoured in the programme of hunting songs and stories which Hamburg will give on Wednesday at 6.10. The rousing hunting songs will be accompanied by the famous band of the Goslar Hunters Regiment.

THE AUDITOR.

The weekly list of Highlights will be found on the next page.

BROADCAST BREVITIES

NEWS FROM PORTLAND PLACE



P.A. SPEAKERS ON B.H. The loud speakers fitted on either side of the clock on the roof of Broadcasting House, which are used to relay Big Ben, have an output of 150 watts.

An O.B. Worry

BACKGROUND noises and "asides" which get over the air during O.B.s are a source of worry to the B.B.C. One day some mute inglorious Milton may make a loud and glorious remark near the microphone which would land the Corporation in an action for slander.

Present methods of combatting the difficulty are (a) employment of a microphone bodyguard which watches any suspicious characters who may be lurking near, and (b) the construction of sound-proof boxes like telephone kiosks.

Engineers to Help

Method (b) was carried to an absurd point on Coronation Day, when a regiment of foreign commentators on the roof of Middlesex Guildhall were each housed in separate cubicles, giving a giant pigeon-cote effect.

New Mike on the Stocks

Research department at Nightingale Square is now busy on a non-sensitive, uni-directional "mike" specially for use in the open air. It will be no more susceptible to distant sounds than the ordinary desk telephone . . . with the advantage that there will be no wrong numbers.

In appearance it will be a throw-back to the microphone designs of the earliest broadcasting days, being fitted with a straight handle, like that in the now classic photo of Madame Melba broadcasting from Chelmsford.

B.B.C. and LS Nuisance

THE B.B.C. is "not guilty" where loud speaker nuisances are concerned, but officials have been casting furtive glances at the Corporation's own loud speakers on the roof of Broadcasting House following the latest decision of the Birmingham City Council. What Birmingham does to-day London may do to-morrow.

In Birmingham it has been decreed that a charge of creating a nuisance by private loud speaker can be laid if three householders lodge a complaint. Fines can be levied up to £5.

B.B.C.'s Own Speakers

The B.B.C. has only two public loud speakers which could be regarded as a potential nuisance. Mounted just above the clock at headquarters, they are used only once a day—at 1 p.m.—to broadcast the chime of Big Ben. At one time they were used more frequently, but this was stopped out of consideration for the occupants of an adjoining nursing home.

Broadcasting or PA

Actually, these speakers could relay the National or Regional programmes or be used for public-address purposes. In fact, they are part of the same scheme which has provided Broadcasting House with steel bullet-proof shutters and an independent water supply.

If the Director-General wished, he could, from his balcony just above Prospero, address a crowd extending beyond Oxford Circus.

B.B.C.'s Narrow Escape

LUCKY is the B.B.C. in finding the right site in Birmingham before being turned out of the present premises, the lease of which expires in two years' time. Not even the bitterest enemy of the B.B.C. would wish to see the Corporation "in the street." Or would he?

Anyway, the present buildings are needed for a civic development scheme, and the B.B.C. now has a chance to develop its own building scheme in a far-sighted way which will be equal to the demands of 20 and 30 years hence.

The new site will be planned essentially for television.

Convertible Studios

The architect will be instructed to see that all studios, even if used for sound broadcasting only in the early days, will be easily convertible for vision, with points for lighting equipment and ventilation to cope with the increased heat.

Broadcasting House, London, makes no such provision, and it seems doubtful whether the extension building will be any more up-to-date.

Only one television studio is projected—a small one for talks by celebrities.

Swopping Announcers

ANNOUNCERS are just as likely to get in a groove as dramatic control panel knob polishers, so the B.B.C. has made the important decision to send them on tours round the stations. General post will take place once a month, beginning in November, when one of the London announcers, Mr. R. MacDermot, goes to Manchester in exchange for Mr. H. Morris or Mr. D. Porter.

Hibberd for Edinburgh

A still bigger blow to lovers of local dialect is being saved up for January, when Lord Chief Announcer Stuart Hibberd—the "Voice of London"—will go for a spell at Edinburgh.

Announcers on tour are expected to "be themselves," and make no effort to copy the local accent. Not that this would make much difference, anyway, for B.B.C. announcing is more or less standardised to cope with the general interchange of programmes which is now the rule.

If local dialects were ever demanded, Nightingale Square might be called in to devise some sort of speech mixer, or side-band chopper, to provide the right amount of burr or vowel treatment.

HIGHLIGHTS OF THE WEEK'S PROGRAMMES

FRIDAY, OCTOBER 29th.

Nat., 6.45, Music from the Movies. 8, The Kentucky Minstrels.
Reg., 6.10, "The Transmutation of Ling," from Ernest Bramah's story. 8, Spending and Saving: a discussion in cock-pit form. 8.50, Music for Worship.
Abroad.
Prague, 6.45, "Don Giovanni" (Mozart). Festival performance from the State Opera.

SATURDAY, OCTOBER 30th.

Nat., 2.30, Act I of Verdi's "Aida" from Sadler's Wells. 7.30, In Town To-night. 8.30, B.B.C. Symphony Concert.
Reg., 4, The Kentucky Minstrels. 8, Palace of Varieties. 9.30, The Theatre Orchestra and Robert Easton (bass).
Abroad.
Rome, 1, 8, Lehár's three-act operetta "Frasquita."

SUNDAY, OCTOBER 31st.

Nat., 6.30, World Thrift Day: a celebration observed by thirty-one countries. 7.55, Service from Truro Cathedral. 9.45, "All Saints": a programme for the eve of All Saints Day.
Reg., 5, Falkman and his Apache Band. 6, The Commodore Grand Orchestra. 6.50, The Old Contemptibles: the record of the B.E.F.
Abroad.
Berlin (Funkstunde), 7, Gala concert from Cottbus with Erna Berger and Helge Roswaenge (soloists).

MONDAY, NOVEMBER 1st.

Nat., 7, Monday at Seven, including Jane Carr. 8, Design in Everyday Things—5. 8.30, Broadway Matinée. 10.45, Discussion on saving wild life.

(Monday, Nov. 1st *Continued*)

Reg., 6, Reginald King and his orchestra. 8, The Swift Serenade concert orchestra. 9.20, Songs You Might Never have Heard—3.
Abroad.
Strasbourg, 8.15, Concert of sacred music from the cathedral.

TUESDAY, NOVEMBER 2nd.

Nat., 5, Relay from Brussels of light music by the I.N.R. Radio Orchestra. 9.20, "I Was There". 9.40, The St. Hilary Players in "The Eve of All Souls."
Reg., 7.30, I Bring You a Song. 9, Relay from the Grand Opera House, Belfast.
Abroad.
Luxembourg, 9, The St. John Passion (Bach) relayed from the Salle Pleyel, Paris.

WEDNESDAY, NOVEMBER 3rd.

Nat., 6.40, "Family Tree": radio play by Philip Wade. 8.15, B.B.C. Symphony Concert.
Reg., 6.30, Medvedeff's Balalaika orchestra. 8.15, Geraldo and his orchestra with guest artistes. 9.30, The Rocky Mountaineers.
Abroad.
Strasbourg. 8.30, Concert from the Palais de Fêtes with the Strasbourg Municipal orchestra.

THURSDAY, NOVEMBER 4th.

Nat., 7.55, The Two Leslies present another "Radio Pie." 10.20, Light music through the ages—3: The Dance.
Reg., 8, The Microphone at Large: S.P.B. Mais visits Rockingham. 9, Agatha Christie's "The Yellow Iris."
Abroad.
Frankfurt, 7, Radio Day, Coblence-Trier Culture Week: concert from the Festhalle, Coblence.

Letters to the Editor

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

Television in England

IN your issue of October 15th, 1937, Mr. Sarnoff is quoted as having said that the Marconi-E.M.I. Television System is fundamentally based upon the R.C.A. Television System first developed in the R.C.A. Laboratories in the States.

To avoid any misinterpretation of this statement, I wish to make it clear that the vision part of the Marconi-E.M.I. System (i.e., excluding the apparatus for amplifying and radiating the carrier wave, which was supplied by the Marconi Company, and to which I presume Mr. Sarnoff's remarks cannot have been intended to apply) has been entirely developed in this country by E.M.I. without any co-operation from the R.C.A.

It will be noticed that Mr. Sarnoff refers to an exchange of patent licences. This is in contradistinction to an exchange of technical information and assistance, and up to the present time we have not received any such technical information or assistance from the R.C.A., nor been supplied with any item of television apparatus used in their transmitting system. It is only within the last few weeks, long after our system had already been proved a success, that arrangements have been made for exchange of technical information with the R.C.A. In fact, we are now supplying technical information to a group of R.C.A. engineers on a visit to our laboratories, and hope shortly to visit their laboratories for a similar purpose.

The two systems, in fact, have fundamental differences, but, in so far as they do have certain features in common, I think it is fairer to say that these features are fundamentally based on the ideas of early television pioneers, such as Lavington Hart, Campbell Swinton, R. S. Clay (who, incidentally, happen to be British) and others, rather than on the much later R.C.A. developments.

To illustrate how fundamentally the two systems differ I can do no better than quote the following passages from an article by two American engineers in the latest issue of "Electronics," which has just come to hand as I was about to sign this letter, referring to certain basic features developed by E.M.I., namely:—

> "The question was raised in the article entitled 'Television Standards' ('Electronics,' July 1937) whether certain of the present practices and proposed standards in the United States are wise. The principal items there discussed were three: The polarity of transmission, the transmission of the DC or background components, and the shape, amplitude and duration of the synchronising pulses.
>
> "This article aims to describe cathode-ray television as it exists in England, where the standards of operation on these three items in question are the *exact reverse of United States practice.*"

As to the importance of these differences, the opinion of the authors is interesting, namely:—

> "That these British standards constitute a major improvement over present American practices is an inescapable conclusion, because television is technically successful and an accomplished fact in England."

I. SHOENBERG,
Director of Research Laboratories,
Electric and Musical Industries, Ltd.

Comparative Tests on Radio Sets

I AM writing to draw attention to a method of comparative tests on radio receivers which gives entirely incorrect results and which is one very commonly employed by radio dealers and wholesalers, and even by persons comparing receiver performances in their own homes.

I refer to the general practice of having receivers wired up to a common earth and aerial. The common earth is all right, but the common aerial causes the receiver with the lowest impedance aerial circuit to take nearly all the signal and, consequently, to give a much louder result by comparison with the other set than it would do if each set were connected separately.

It is, therefore, vitally important when comparing receivers in this way that the aerial be connected only to the set under test, as in this way each receiver will give its maximum performance.

Moston, Lancs. J. BAGGS,
Ferranti, Ltd.

Recording

BEING keenly interested in the correspondence columns of *The Wireless World*, but not in the habit of writing myself, I have been eagerly awaiting a flood of letters on the subject of synchronising disc with sub-standard films as mentioned by Mr. D. W. Aldous in the issue of July 30th.

As a recording enthusiast I feel that there must be many others like myself who have encountered this difficulty and would appreciate reports from those who have had any sort of success in overcoming a fascinating problem.

Direct coupling between recorder and camera is, of course, an obvious solution, but the various disadvantages and serious limitations even with such an ingenious arrangement, as devised by Messrs. Pruden and Shore, convince me that the perfect arrangement has yet to be discovered.

Having tried (and abandoned) direct-coupling and several other methods, my experience has been that the "electro-human" interlock, if it can so be described, is the best, simplest and cheapest method for amateur use.

Very briefly it is as follows: A commutator driven by the recording motor feeds regular (predetermined and dry battery operated) impulses to headphones worn by cameraman (or projectionist, according to whether direct-recording or post-synchronising is being carried out) who turns the crank in step with the audible "clicks."

The greatest disadvantage to this process is that handcrank cameras or projectors *must* be used. Experience has proved that the "human element" is not such a weakness as it might appear, as turning in step becomes automatic with very little practice.

Because it allows the recorder to be any reasonable distance from the camera there is no fear of vibration or shock to spoil the disc, and the operator can work in comfort and privacy.

As a description of a system this must sound unconvincing, but it could be enlarged upon considerably. However, let it suffice for the moment to say that I have assisted in making several "talkies" of good-quality sound, perfect lip-synchronism and many changes of camera angle by this method. CECIL L. APPLEBY.

Shortlands, Kent.

CURRENT TOPICS

New Finnish Station

IT has been decided by the broadcasting authorities in Finland to erect another station, and already a preliminary survey is being made by engineers to find a suitable site. Field strength measurements are at present being carried out in the neighbourhood of Jyväskylä.

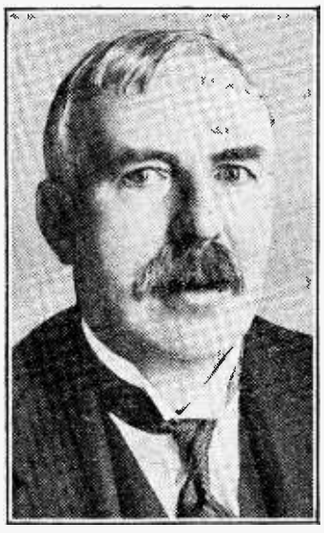
Leipzig Spring Fair

GREATLY increased space will be devoted to the electrical and wireless section at the annual Fair which will be held at Leipzig from March 6th to the 14th next year. All space was booked as early as September this year. This Fair is the German equivalent of the British Industries Fair, held every February.

Pirates in India

A STARTLING discrepancy has been noticed between the number of wireless licences issued in India and the number of receivers imported. This has been revealed by comparing the accounts of the Post Office with those of the Customs Department. As a result of this, it is realised that the number of pirate listeners in India is far greater than was generally supposed. It is proposed, therefore, to start a campaign to put a stop to free listening.

The Late Lord Rutherford O.M., F.R.S.



THE death of Lord Rutherford, which occurred at Cambridge on October 19th, deprives the scientific world of a very great physicist. From 1919 and at the time of his death he had filled the Cavendish Professorship. He was born in New Zealand in 1871, and the whole of his career had been devoted to experimental physics, his greatest contributions to science being in connection with his investigations into radioactivity and the structure and nature of the atom. Not only was the originality of his work impressive, but his remarkable energy and personality acted as a driving force, instilling his own enthusiasm into those who worked with him.

EVENTS OF THE WEEK IN BRIEF REVIEW

Television Plans for U.S.A.

AS mentioned in this journal recently it has been announced by Mr. William S. Paley, the president of the Columbia Broadcasting System, that plans are now being prepared for television programmes in New York. This well-known and influential figure in the American radio world has stressed the fact that the two greatest disadvantages of British television are the high cost of sets and the relatively small picture. Perhaps he will discover a solution.

Actually the television transmitter, which has been constructed at Camden, N.J., is now being given its initial tests there. It will be installed in the Chrysler Building, New York, early in the New Year. Its normal range is estimated at about 40 miles.

Largest Studio?

PLANS for the radio-electrical equipment of the new Belgian Broadcasting House in Brussels have now been completed. Thirty programme channels will be available. One of the seventeen studios has a capacity of 15,000 cubic metres, and is, it is claimed, the largest in the world.

Wives and Wireless

ACCORDING to a recent decision by a French Court, a wife must have the written consent of her husband before purchasing a radio receiver. A wireless trader was ordered to take back a set which he had sold to a woman and repay the money to her husband. The trader proved that the sale was actually made in the presence of her husband, but the Court ruled that this did not necessarily imply consent. French law restricts the power of a wife to buy articles of importance without her husband's consent.

Radio Finances French Theatres

THE following sums from the radio receipts have been granted as subsidies to various French theatres this year: The Opera, 2,400,000 francs; the Opera-Comique, 1,300,000 francs; the Comedie Française, 3,000,000 francs; and The Odeon, 550,000 francs. Further grants to the entertainment world which are to be made from the radio receipts bring the total to 31,250,000 francs.

Radio Record

NEARLY three-quarters of the total number of households in Denmark are provided with wireless sets. The actual number of wireless licences issued in the country is 673,914, which represents 72 per cent. of the households. There are 40,000 more listeners than at this time last year.

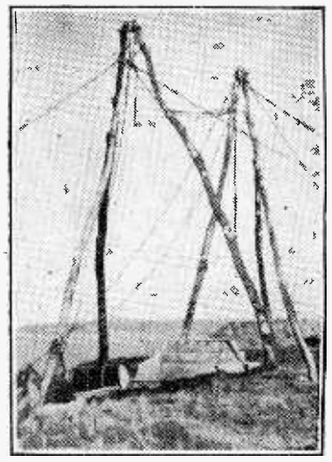
It is likely that before very long a receiver may appear on the market the equivalent of the famous German "People's Receiver," although it is not contemplated that the set will have Government backing or be in any sense an official receiver. The set is being designed by Mr. A. Kielsen, who was responsible for the midget radio apparatus briefly described in this journal a little while ago.

Television and Meteorology

EXPERIMENTS are being made on a ship off the American coast with the reception by television of the special charts published daily by the U.S.A. Meteorological Bureau. The weather bulletins are received normally by ordinary wireless methods, and it is hoped that by means of television it will be much easier and quicker to send a very comprehensive survey of meteorological conditions, since very full details of wind currents, etc., are shown on the official weather maps.

ALTERATION OF PUBLISHING DAY

Commencing with next week's special enlarged number for new readers, "THE WIRELESS WORLD" will in future be available on Thursday each week instead of Friday



MEMORIAL TO MARCONI. On the spot from which the first wireless signals to bridge the Atlantic were transmitted, the erection of a memorial to the memory of the late Marchese Marconi has been commenced at Poldhu in Cornwall. The stones forming the base are seen in position near the cliff edge.

Surprising Legal Decision

IF the recent judgment given in a Toulouse court is allowed to stand, French manufacturers are not likely to produce any more receivers having station names on their tuning dial. The court ruled that a buyer of a wireless set could regard the sale as legally void if a set did not give normal reception of any station which had its name marked on the tuning dial. This, in effect, means that makers of sets can no longer put the name of a station on a dial unless they can guarantee its reception even during daylight hours and in any locality in France, no matter how far removed from the transmitter.

Bohemian Schools' Broadcasts

A GREAT effort is being made by the authorities in Czechoslovakia to extend the scope of broadcasts to schools, and a conference has just been held at Brno between broadcasting officials and delegates from various educational establishments. Arrangements are to be made for broadcasts, not only for the Czech national schools, but also for those catering for the German- and Hungarian-speaking minority.

Australian SW Schedule for November

SYDNEY, VK2ME, 9,590 kc/s, 31.28 metres.—Sundays, 06.00 to 08.00, 09.30 to 13.30, 14.00 to 16.00.

Melbourne, VK3ME, 9,510 kc/s, 31.5 metres.—Daily, except Sundays, 09.00 to 12.00.

Perth, VK6ME, 9,590 kc/s, 31.28 metres.—Daily, except Sundays, 11.00 to 13.00.

On the Short Waves

NOTES FROM A LISTENER'S LOG

MODERN all-wave receivers, especially the latest 1938 types, are surprisingly efficient and give a very uniform performance over the various tuning ranges, but I have never personally been quite satisfied with their signal-to-noise ratio below 25 or 30 metres. Even the best frequency changers generate quite a lot of noise, and in order to overcome this a considerable amount of RF amplification is necessary. The intrinsic or unavoidable noise due to an RF pentode is generally less than one-quarter that of a frequency-changer valve, so that a considerable reduction in the noise is possible.

A device which is beginning to find favour in this country, on short waves only, of course, is the regenerative RF stage, the regeneration in the simplest case being intentionally brought about by poor shielding of the grid and plate circuits. In some cases the cathode of the RF valve is not returned to earth via the biasing resistance and condenser in the normal manner, but via a tap on the grid coil a few turns from the earthy end. In the more elaborate circuits an additional triode "reaction" valve is fitted.

It is surprising how regeneration or positive feed back in a short-wave RF stage improves the gain, reduces the noise and reduces image signal interference.

At the moment I am using a 10-metre aerial comprising two horizontal half-waves in phase one wavelength above the ground for receiving Daventry GSH, 21.47 Mc/s, in the afternoons, and Daventry GSG, 17.79 Mc/s, in the early evenings, and on my double superhet (IF's 3.75 Mc/s and 465 kc/s), with tuned regenerative RF stage before the first triode-hexode, a noise level of −40 to −50 dbs (when the received bandwidth is at least as wide as that transmitted) can be readily obtained. A similar ratio of signal-to-noise can very often be obtained also on W2XE on 21.52 Mc/s in the afternoons and occasionally on W3XAL 17.78 Mc/s in the evenings.

The "10-metre" aerial is directional on N. America, and appears to function very well up to 18 metres, it has an open wire (not transposed) feeder three-quarters of a wavelength long on "10 metres" (i.e., approximately 25 feet) followed by a short length of low-impedance flex. Incidentally, some other tests carried out recently with a half-wave dipole for 25 metres and a low-impedance twisted-pair transmission line showed that the performance of this aerial was quite reasonably good from 16 to 32 metres, with a definite improvement in the signal-noise ratio when the correct aerial circuit was provided.

The little extra gain which is provided by good aerials and RF stages has been needed during the past fortnight, conditions (listening on a good commercial receiver) have been quite poor, but an improvement took place around October 15th, and since that date W3XAL, W2XAD or W2XE have been available most evenings. In the afternoons W2XE on 21.5 Mc/s has been very good, and the 28 Mc/s amateurs have been very active, signals from the U.S. remaining audible until 9 p.m.

International Bulletins

A feature of interest nowadays is W3XAL's news bulletin on 17.78 Mc/s between 10.45 and 11 p.m.

This new international bulletin is much better and wider in scope than the former national rapid-fire "Esso" news which it now more or less replaces.

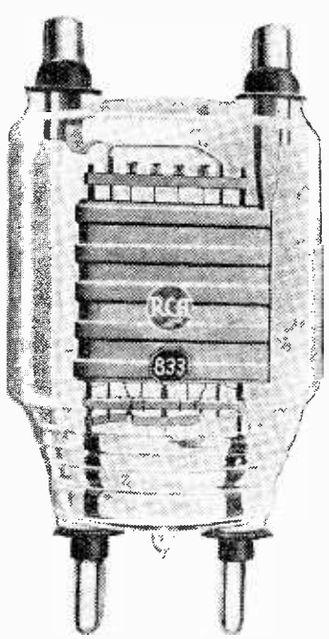
Some of the scientific talks from W2XE on 15.27 Mc/s are also well worth one's attention. I found one on "Comets" at 10.40 p.m. one evening particularly interesting. Even W2XAF 9.53 Mc/s has been performing well again during the past week, that is before he changes to his S. American beam around midnight.

Finally, a word for the highbrow, it now seems fairly well established that during Dellinger fade-outs the sun emits, from an eruptive hydrogen area, a greatly increased amount of ultra-violet light, increased perhaps a thousand-fold. The wavelength of the light emitted is very short indeed even for ultra-violet light, and in all probability is centred round the "Lyman resonance line" which has a wavelength of 1,215 Angstrom units ($1{,}215 \times 10^{-10}$ metres).

Only on this particular wavelength can ultra-violet light penetrate deeply into the atmosphere, and the sudden bursts which occur during bright hydrogen eruptions penetrate to the D region (80 km. high) causing a tremendous temporary heating up of the F_2 region on their way.

It is this combined fall in F_2 layer ionisation (by expansion) coupled with greatly increased D layer ionisation, a direct effect which causes the temporary fade-outs of practically all short-wave signals with which we are now so familiar. The effect is obviously one which is likely to occur in daylight only, a point which is also well known.

ETHACOMBER.



NEW AMERICAN TRANSMITTING VALVE. The R.C.A. 833 which has just been placed on the market is a triode rated for 2,500 volts anode potential and can be used as an RF amplifier, oscillator and Class B modulator.

RANDOM RADIATIONS

By "DIALLIST"

Floored!

PEOPLE fire some odd questions at you now and then, and sometimes you may find yourself completely stumped when you ought to be able to answer pat. That happened to me the other day. I was asked how many turns of wire would be needed for the broadcast band and the long waves respectively on a frame aerial with 15in. sides. It's years since I used a frame and longer still since I made one. For the life of me I couldn't recall any formula or remember how many turns I used to have on my frames. After some frantic thinking I hazarded a guess that fourteen turns wouldn't be far out for the medium waves. What answer would you have given? Actually, as you will see if you consult *The Wireless World* Diary, the best basis for a rough-and-ready estimate, is not size or number of turns, but the total length of wire needed. For the medium waves this is 75ft., and for the long waves 250ft. By a stroke of luck my guess wasn't a long way amiss. The total length of one turn on a frame with 15in. sides is 5ft., so that 75ft. of wire would make 15 turns. For the long waves the 250ft. of wire would produce 50 turns.

Milking the Transmitter

BEFORE now I've wondered whether a pretty copious supply of juice for purposes quite different from wireless could not be picked up by the use of collecting circuits in the immediate neighbourhood of high-powered broadcasting stations. It appears that it can, for the German broadcasting authorities have taken proceedings in the courts against several people with homes close to the 100-kilowatt Hamburg transmitter who have been using its radiations to supply their house-lighting current. The case was reported in *The Wireless World* of July 30th. For the prosecution it will be remembered that it was alleged that those accused were guilty of stealing electric power. Defending counsel urged that you can't steal something whose producer scatters it abroad in all directions and which would, in any case, be lost eventually. The judge adjourned the case to enable the authorities to bring proof that the accused had caused any diminution of the station's service area or in the field strength. I should imagine that it wouldn't be very difficult to prove this. If each of the milking circuits collected only 5 watts (they wouldn't be much use for lighting purposes if they didn't manage a bit more than that), a few thousand of them would certainly have marked effects upon the performances of radio receivers in the neighbourhood.

New Avenues

Meanwhile, I am waiting to hear that some bright German has evolved a self-running wireless receiver. You see how it might be worked? Juice-collecting circuits bring in sufficient current to be used, after rectification, for charging a large-capacity accumulator of, say, 6 volts. One cell of this is used for heating the filaments of 2-volt battery valves, and when the set is not in action the whole 6-volt accumulator is made to charge a high-tension accumulator battery of the nickel-cadmium type, whose cells are arranged in groups of four by means of a series parallel switch like that used in the Milnes HTB. And there you are. Wireless for nothing! The broadcasting station supplies not only the programmes but also the juice to enable you to hear them.

The Television Figures

THE revelation by Mr. David Sarnoff, President of the Radio Corporation of America, published recently in *The Wireless World*, gives one furiously to think. He stated, as you will remember, that after nearly a year's transmissions from the Alexandra Palace the number of television receivers in private ownership was less than a thousand, and that under a hundred had been sold at the Olympia Exhibition. One of the most important points to bear in mind is that, with a service area far larger than was originally anticipated, the Alexandra Palace station covers a region inhabited by at least ten million people, or about a quarter of our entire population. Amongst these is a very large proportion of the better-off folk in this country. Certainly there are thousands who do not mind paying £500 or a good deal more for a motor car, from £60 to £100 for a piano, £100 or so for a dog, or the same sort of amount for a radiogram. It isn't, therefore, the question of its cost that is preventing the televisor in private ownership from reaching at least the ten-thousand mark. Then what *is* the snag? There must be something very much wrong, for television has received enormous publicity and it is undoubtedly something that the public wants. The Television Exhibition at the Science Museum was an outstanding success; at Radiolympia throngs of people came to see the television demonstrations; any radio dealer who has a televisor, and lets his potential customers see what it can do, will tell you that he is besieged by applicants who want to see one of the programmes.

It's clear, then, that the man in the street wants television and is deeply interested. Clear, too, that those who can well afford to buy television receivers just aren't buying them.

Fair Play for England!

THERE'S just one more point that I'd like to make about the closing down of the English medium-wave Nationals until five o'clock in the evening from Monday to Friday. A surprisingly large number of grown-ups like to be able to listen to the talks to schools. The silence of the two Little Nationals means that a large proportion of those who live in big towns are unable to do so owing to the interference that is experienced on the long waves. This must also affect not a few schools in places such as London, Birmingham, Leeds, Manchester, Liverpool, Sheffield, and so on. In other words, the present arrangement means that the interests of both the grown-up listener and the school-child in England are being sacrificed to those of the school children of Scotland. A very simple re-arrangement would set the whole thing right and leave no ground for grouses. What happens in Scotland is that the National programme containing the school broadcasts is relayed by Westerglen and Burghead, whilst the Scottish National station sends out the main Regional programme. Wouldn't it be perfectly simple to do exactly the same thing in England? London, North and Scottish Nationals could then continue their synchronised working. It wouldn't be necessary for this arrangement to be in force during the whole of the day; it could apply just to the two periods from 11 o'clock till midday, and from two till four o'clock in the afternoon, during which school broadcasts take place.

CHAIRMAN I.E.E. WIRELESS SECTION.

Mr. T. Wadsworth, M.Sc., M.I.E.E., of the British Thomson-Houston Co., takes the chair for the 1937-38 session which opens on November 3rd.

"Drugged" to Bad Reception

SIR NOEL ASHBRIDGE hit the nail on the head when he told us that innumerable listeners become drugged to reception of very poor quality. What happens is that the deterioration which takes place in the performances of a neglected set is so gradual that the ear accustoms itself to it and does not notice it. The wearing out of valves is one potent cause of worse and worse reproduction, but it is by no means the only one.

I should be inclined to lay more blame on the source of high-tension current supply in battery receivers, particularly those worked from small dry batteries. There is one more interesting experiment that you can make if you contemplate asking one or two friends in to listen to something particularly good one evening. You will require a set (not one with class B output) drawing 10 milliamperes or more of high-tension current, a small HTB which has seen some service and whose original EMF of 120 volts is down to not much over 100, a volt meter and a milliammeter. The battery should have been allowed to stand idle for 24 hours beforehand to give it a chance to pick up.

Worth Trying

Connect up the battery, with the milliammeter in series with the HT negative lead, so that all the plate current is passing through it. Before the arrival of the friends upon whom you are going to experiment, tune in the station that they are to hear and regulate the volume so that the milliammeter just fails to show by kicks that overloading is taking place. Read the EMF of the battery under load and switch off. When you first switch on for the benefit of your friends reproduction will be pretty good, but it won't be long before falling HT voltage starts to introduce distortion. Make a note at intervals of the voltage and current readings, and of the doings of the milliammeter's pointer. Towards the end of the evening ask your friends whether they have noticed any variation of the quality. If they answer truthfully it is ten to one that none of them will have done so. Your

notes will tell you when distortion began to be offensive; they will show you, too, what a big fall in the EMF of a small overworked HTB can take place in the course of a single evening's listening. You can make the experiment still more striking if you have another battery showing rather better than 100 volts in reserve and connect it up quickly to let them hear what the set really was like when the evening began.

The Radio Industry

Leland Instruments, Ltd., 46, Bedford Row, London, W.C.1, have sent us booklets and leaflets describing the various American-made instruments for which they are agents. Much of the apparatus is of the type used by set manufacturers and in laboratories; interesting examples are the Ferris Standard Signal Generator, the Boonton "Q" Meter, and the Clough-Brengle oscillators and oscillograph.

In appealing for donations to the Electrical Industries Benevolent Association, Mr. Frank Parkinson, the President, has most generously offered to add 10 per cent. to the amounts contributed. Remittances should be sent to the Secretary at 6, Southampton Street, London, W.C.1.

Change of address: Runbaken Electrical Products to 13/15, Liverpool Road, Deansgate, Manchester, 3. The Runbaken works are still at Hapton, near Burnley.

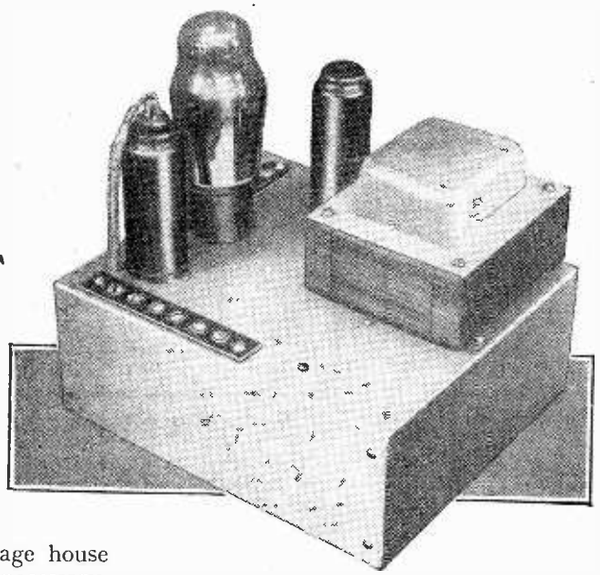
Mr. F. C. Bennett, formerly of the Lexington Instrument Laboratories, Ltd., has joined the National Radio and Television Service Company as service manager.

Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2, has now issued leaflets described the Electrolytic Condenser Bridge, Distortion Factor Meter, Variable Attenuator and Output Power Meter. These instruments are improved versions of earlier productions.

IN NEXT WEEK'S ISSUE

3½-Watt Triode Amplifier

Inexpensive High-Quality AF Equipment



FOR operation in the average house very large volume is unnecessary, and it is possible to obtain a very high standard of reproduction quite cheaply with carefully designed equipment. An output of some 3 watts obtained from a triode satisfies most requirements, and a single penultimate stage provides adequate gain for use either with a gramophone pick-up or after the detector of a receiver.

The amplifier to be described has a high-gain triode in the first stage and is resistance-coupled to the triode output valve. A full-wave rectifier is used in the mains equipment, which has sufficient capacity to supply a receiver in addition to the amplifier.

THE LIST OF PARTS REQUIRED.

Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.

1 Mains transformer, Primary: 200/250 volts, 50 c/s. **Sound Sales US/300**
Secondaries: 300-0-300 volts, 90 mA.; 2.5 volts, 2.5 amps. CT; 5 volts, 2 amps.; 6.3 volts, 1.5 amps.

1 Smoothing choke, 20 H., 60 mA., 700 ohms **Bulgin LF14S**

Resistances:
1 50 ohms, ½ watt **Erie**
1 3,000 ohms, ½ watt **Erie**
1 20,000 ohms, ½ watt **Erie**
1 250,000 ohms, ½ watt **Erie**
1 500,000 ohms, ½ watt **Erie**
1 2 megohms, ½ watt **Erie**
1 750 ohms, 20 watts **Bulgin PR4**

Condensers:
1 0.1 mfd., 350 volts, tubular **Dubilier 4603/S**
1 50 mfds., 12 volts, electrolytic **Dubilier 3016**
1 50 mfds., 50 volts, electrolytic **Dubilier 3004**
1 8-8-8 mfds., 500 volts, electrolytic **Dubilier 312**

1 Valve holder, 4-pin, American type **Premier Supply Stores**

2 Valve holders, octal type **Premier Supply Stores**

1 Skeleton captive screw strip, 2-way, "speaker" **Bulgin T10**

1 Skeleton captive screw strip, 6-way **Bulgin T12**

1 Valve top clip, octal type **Bulgin T96**

Chassis, with clip **B.T.S.**

Miscellaneous: **Peto-Scott**
2 lengths systoflex; small quantity No. 20 tinned copper wire, etc. Screws: 26 ¼in. 6 BA R/hd.; 4 ¼in. 4 BA R/hd., all with nuts and washers.

Valves:
1 2A3, 1 6F5MG, 1 5Z4MG **Premier Supply Stores**

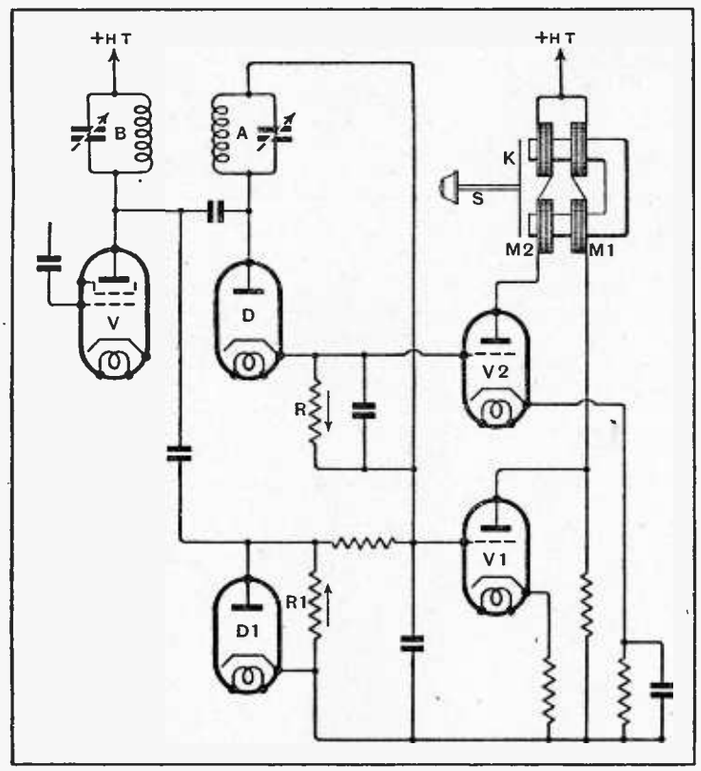
Recent Inventions

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

"LAZY" TUNING DEVICES

THE tuning of a highly selective receiver is facilitated by arranging for an automatic "check" to be applied to the movement of the control spindle as soon as it reaches the critical tuning position. The check is applied by an electromagnetic brake, which is brought into action at the correct moment by the output current from two "opposed" rectifier valves.

As shown in the Figure, the diode rectifier D is coupled to the intermediate-frequency amplifier V through a highly-selective circuit A. A second coupling B, less selective than the first, is provided between the IF amplifier V and a second diode D1. The load resistances R, R1 of the two diodes are arranged in opposition across the control grid of an auxiliary amplifier V2, as indicated by the arrows, whilst the resistance R1 alone controls the grid bias of a second amplifier V1.



Circuit providing automatic control of tuning.

So long as there is no incoming signal, the output from the amplifiers V1, V2 balances out across the magnet coils M1, M2, and no check is applied to the tuning-control spindle S. The receipt of a signal causes the diode D1 to inhibit both amplifiers V1, V2, but as the tuning approaches the critical point the diode D releases the amplifier V2 and energises the magnet M. This attracts the disc K, and so puts a positive "brake" on the further movement of the tuning control S.

N. V. Philips Gloeilampenfabrieken. Convention dates (Germany) August 20th, October 26th and November 8th, 1935. No. 467771.

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SCANNING SYSTEMS

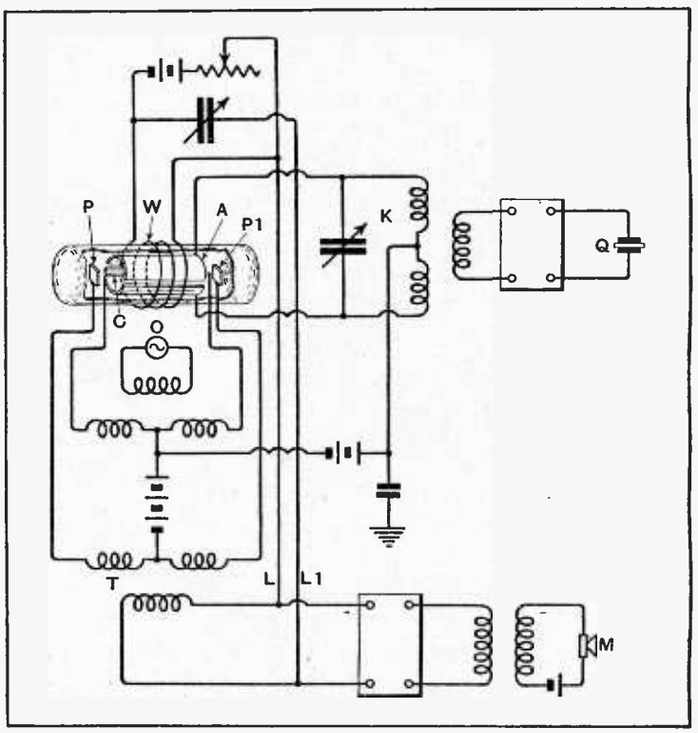
THE fluorescent screen of a cathode ray tube is replaced by a glass prism which is mounted at the end of the glass bulb of the tube. Light from an external lamp is focused on to the prism so that it strikes the surface which faces the "gun" part of the tube at the critical angle of reflection, and is reflected from there on to a viewing-screen mounted outside of the tube.

The impact of the electron stream, as it passes to and fro in its scanning track over face of the prism, alters the critical reflecting angle of the glass surface, so that the light which finally reaches the viewing-screen is modulated in accordance with the light-and-shade effects of the original picture.

Marconi's Wireless Telegraph Co., Ltd., and G. M. Wright. Application date December 27th, 1935. No. 467918.

TRANSMITTERS

RELATES to a transmitter valve of the Magnetron type in which the flow of the electrons from cathode to anode is controlled by the magnetic field from an external winding.



Magnetron high-frequency generator and method of modulation.

As shown in the Figure, carrier-wave oscillations are generated across the cathode C and split anode A of the magnetron, whilst signalling voltages from a microphone M are applied, in part to the external field winding W through leads L, L1, and in part through a transformer T to two end-plates P, P1. The latter may be biased positively so as to increase the power-output of the tube, or negatively to protect the glass ends of the tube from damage by electron bombardment. A quartz crystal Q is coupled to the output circuit K in order to stabilise the frequency of the generated carrier wave.

Standard Telephones and Cables, Ltd. (assignees of H. J. Scott). Convention date (U.S.A.) May 29th, 1935. No. 468271.

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TELEVISION RECEIVERS

A RESISTANCE-CAPACITY-COUPLED amplifier in a television receiver will sometimes produce "flickering" owing to a species of back-coupling through the common source of supply. In order to prevent this, a certain fraction of the supply voltage is fed through a condenser to the screen grid of the pentode amplifier. The arrangement serves to stabilise the valve against undesirable back-coupling, and also from casual voltage changes caused by variations in the load taken by other valves in the receiver.

Radio-Akt D. S. Loewe. Convention date (Germany) July 25th, 1935. No. 468350.

RECEIVERS FOR FREQUENCY-MODULATED SIGNALS

SIGNALS transmitted as variations in the frequency—as distinct from the amplitude—of a carrier wave are converted at the receiving end into corresponding amplitude modulations, and are then rectified. The incoming signals are first passed through an amplitude-limiter, and then fed in parallel to two amplifiers.

The output circuit of one amplifier is tuned slightly above, and the other slightly below, the highest signal frequencies present in the carrier, so that their resonance curves intersect at a point corresponding to the carrier frequency. The signals, which appear as amplitude fluctuations in the output, are fed to a pair of detectors arranged in push-pull. This removes any amplitude distortion that may be present, and also balances out second harmonics.

Marconi's Wireless Telegraph Co., Ltd. (assignees of M. G. Crosby). Convention date (U.S.A.) October 17th, 1935. No. 468172.