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COVENTRY: Hertford Street.

Telegrams: "Autocar, Coventry." Telephone: 5210 Coventry.

BIRMINGHAM:

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EDITORIAL COMMENT

The Broadcast Licence A Question of Interpretation

THE latent ambiguity in Statute law is once again emphasised by the dismissal recently at Marylebone Police Court of a summons taken by the Postmaster-General against the tenants of a block of London flats for receiving broadcast programmes without a wireless licence.

The P.M.G., in his capacity as trustee of the ether—which includes the ultimate control of broadcasting—has always maintained that the legal liability to take out a licence depends upon the tenancy of the premises in which the set is installed. A sole tenant may use as many sets—or loud speakers—in his own house, as his inclination fancies, and cover them all with a single licence. But where there are different tenants in the same house—or block of flats—then each tenant must take out a separate licence in respect of his own apparatus.

Up to the present, this contention appears to have been upheld by the Courts whenever the P.M.G. has asked them to enforce it, so that the Marylebone ruling is bound to come as something of a bombshell both to the powers-that-be, meaning the P.M.G. and the B.B.C., as well as to those listeners who have already accepted the contention as legally established and have paid their yearly tribute accordingly.

The Magistrate based his decision on the wording of the present Act, which obliges a person to take out a wireless licence before "installing or working apparatus for wireless telegraphy."

"I find," he says, "that 'working' must mean 'tuning-in' . . . I do not think that plugging-in to a set in another flat constitutes 'working' any more than would the opening or shutting of a door to admit or exclude the sounds from that set."

There for the time being the matter must rest, though we hardly think the last word has been spoken.

To us it appears that the position of relay services, too, is intimately associated with this question.

Many of our readers will recall a somewhat similar position which arose over the interpretation of the word "transmission" as used in the Wireless Telegraphy Act of 1904. That Act forbade the *transmission* of messages by wireless telegraphy, except under licence, and heated arguments arose, when the broadcast service started, as to whether the word also covered the *reception* of the B.B.C. programmes. If it did not, there was an end to the broadcast service, which obviously could not be run without an income. In this case the ambiguity was removed by the Wireless Telegraphy (Explanation) Act, which made it clear, without any shadow of doubt, that transmission includes the reception as well as the sending of wireless messages.

Short Wave Record

South Africa Receives Alexandra Palace

ELSEWHERE in this issue we publish a log of reception at Johannesburg of the sound transmission of the Alexandra Palace programmes. The items recorded as heard have been substantially verified as emanating from the television station. We believe that this reception over a distance considerably in excess of 5,000 miles must indeed constitute a record for this frequency and open up interesting possibilities for the future, even to the point of visualising that reception of the picture transmissions themselves might prove possible at such distances under specially favourable conditions.

Wireless Education

Definition of an Engineer

COMMENTS in our issue of November 13th on the question of the status and qualifications of wireless engineers have brought forth opinions which we publish in this issue from various authorities. We are glad to find that the difficulties are recognised and that a good deal is to be done to remedy the present state of affairs.

Sound Recording

PART I.—POSSIBILITIES AND LIMITATIONS OF SYSTEMS FOR HOME USE

By S. R. EADE, A.M.I.E.E. (Of the Research Dept., B.T.H. Co., Rugby)

ALL known sound-recording systems may be classified under four headings or combinations of these four. They are: photographic; mechanical; magnetic, and chemical. Each of these four broad classes may be further sub-divided as follows, but this list must not be taken as necessarily complete.

Photographic records may be of constant photographic density and of varying width; of varying photographic density and constant width or a combination of these two. The essential feature is that the record shall offer a light transmission which is proportional to the frequency and amplitude of the sounds recorded. We have such records in the following forms: (a) 35 mm. sound on film—the commercial size used for cinema projection. (b) 16 mm. sound on film—the sub-standard size. (c) Multi-track records on 16 mm. or 35 mm. film for use with long-playing reproducers when a picture is not required. (d) Helical tracks on cylinders of sheet film for similar purposes to (c). Negative records in this form have been printed to give positive printers' ink copies on paper which may be reproduced in a similar way. (e) Special photographic records such as the circular tracks on glass discs used in the G.P.O. speaking clock.

Mechanical, Magnetic and Chemical Systems

Mechanically produced records usually consist of a narrow spiral or helical track in a suitable disc or cylinder, this track being modulated either transversely or vertically with respect to the record base. Examples are:—(1) The conventional gramophone record which is a transversely modulated spiral groove. (2) The high fidelity "hill and dale" record of the Western Electric Co., which is a vertically modulated spiral groove. (3) Edison's original phonograph was a vertically modulated helical track in a cylindrical record, and the "Ediphone" used in offices is a modern example of this system. (4) Transversely or vertically modulated tracks in flexible strip, such as gelatine or the acetate base of cinematographic film. (5) Composite methods such as the Philips' system of a variable area form of record produced by mechanical means, but reproduced by means similar to those used with purely photographic records.

In magnetic systems, sound is recorded in a magnetic material by producing in it a permanent change of its molecular arrangement proportional to the frequency and amplitude to be recorded. As a record material, steel tape, steel wire and various flexible non-magnetic supports coated with ferrous compounds have been used.

A commercial system is the Blatner-phonograph.

Various chemical methods have been proposed in which the sound to be recorded, in its electrical form, is arranged to produce a visible chemical change in a specially treated record material. The record, as in photographic methods, can be of variable width or variable density form, and the result will be reproduced in a similar way.

No commercial system is in use.

In any method of recording sound the

THE very considerable interest shown by readers of "The Wireless World" in all matters relating to the recording of sound has suggested these articles. The writer first states the problems involved and then, by an analysis and description of the known methods of recording sound, attempts to predict the probable direction of future development in apparatus for home use.

ultimate aim must be to obtain a record from which can be reproduced without distortion sounds of all frequencies within the limits of audibility of the average human ear over a power range such that the pressure reaching the ear can vary within the pressure limits for the average ear.

Fig. 1 shows the well-known auditory sensation curve for the human ear. Sound pressures (or "volumes") outside the lower boundary curve are inaudible, while those above the upper curve are so loud that they are felt rather than heard and tend to become physically painful. If the sound pressure at any frequency is

gradually increased step by step from a value denoted by the lower curve, the ear can appreciate the changes until the upper boundary curve is reached. After this point, increases in intensity cannot be detected.

From this curve it will be seen that the audible limits of frequency and pressure for the average ear are:—

Frequency: 20-20,000 cycles per second.

Pressure: 4×10^{-3} to 4×10^3 bars.

Power: 3×10^{-9} to 1×10^4 microwatts.

No sound-recording method at present in use can provide this ideal range of pressures, and to obtain the ideal of frequency range is also very difficult; luckily, a very much restricted range will permit of good quality sound.

Fig. 2 shows the fundamental frequencies corresponding to the piano scale together with the range of many musical instruments. It will be seen that a range up to 5,000 cycles would include most fundamentals, but this must, of course, be increased if the overtones or harmonics are to be included. It is these harmonics which give the character to each individual instrument and human voice, and the frequency range should ideally be extended to the limit of the ear audibility curve or 20,000 cycles for optimum quality. It has been found, however, that if we provide a frequency spectrum of 30 to 10,000 cycles we can obtain quality which from this point of view is almost perfect.

Reverting now to volume range, the

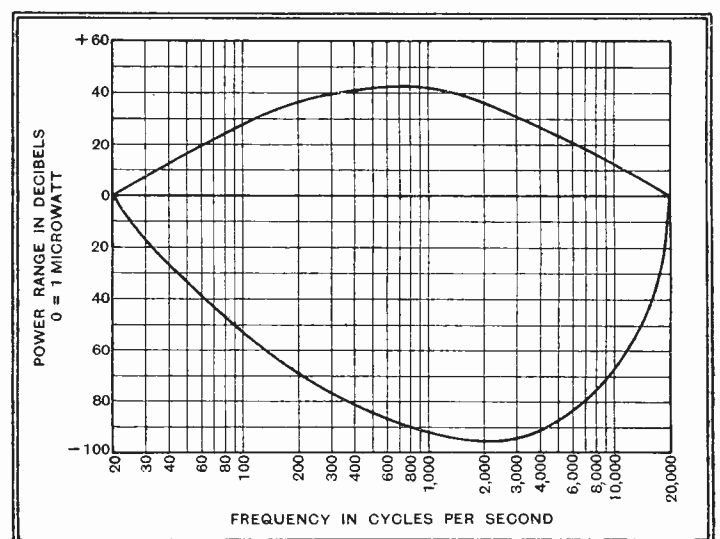


Fig. 1.—Limitations of the human ear. Sounds below the intensity represented by the lower curve are inaudible while those above the upper curve tend to become painful.

peak value accepted by the average ear is 137 db., as shown in Fig. 1. This value, however, is never required at one time, because it can be shown that the volume limit for average speech is only 57 db.,

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whilst that for a full orchestra is 70 db. These two may not, of course, cover the same part of the curve in Fig. 1, because the lowest level of the orchestra will be considerably in excess of, for instance, the level of whispered speech. If, therefore, we can provide a volume range of 70 db. (e.g., 10,000,000 to 1 in power), we can, by operating the volume control of the reproducer between individual items, obtain the required optimum result. Unfortunately, we cannot obtain even this range from most modern methods, and we have to be content with a volume range in the neighbourhood of 40 to 50 db. (or 10,000 to 1 in power).

The third important consideration is the ratio of signal to background noise which will be obtained from the reproduced record. The background is obviously important at low volumes, and it does in fact fix the value for the lowest volume which can be recorded. It is theoretically desirable to keep the noise level 30 db. below the lowest signal level, but this would leave us with practically no effective volume range, and so in practice we consider the lowest signal level to be equal to the noise level.

Signal-to-noise Ratio

As we can obtain a measure of the physical track modulation corresponding to this noise level, and also we can fix a limit to the maximum permissible modulation for any recording system, we have an exact measure of the total volume range available.

In addition to and combined with the three considerations enumerated above, various types of distortion can occur. These are phase distortion, amplitude distortion, and the introduction of spurious harmonics by modification of the wave form. These items will be discussed as they arise in descriptions of various methods.

The general principles of the photographic sound record upon a talking film are probably well known to readers of this journal, but it may be as well to review them briefly before considering more technical details.

The sound track at the side of the picture occupies a total width of $\frac{1}{10}$ th of an inch on the film, but the actual width modulated is only 0.070 of an inch in variable area records. Two distinct forms of record are possible, and these are known as "variable area" and "variable density" respectively. A combination can also be used.

The variable area form is the easier to understand, because it is well known that any sound may be represented by a complex sine wave of the sound pressure waves plotted to a time base.

This is actually what is done, but a single line tracing the wave form is not sufficient, for we can only reproduce our record by shining light through it, and a constant width line, no matter what complex shade it traced out, would not change

the amount of light which passed through the film. To overcome this difficulty the area on one side of the curve is made completely black and the area on the other side remains clear.

This form of sound record in the simplest case is made by exposing the film as it is drawn past an aperture of breadth equal to the sound track required and having a width in the direction of the film travel small in comparison with the wavelength of the highest frequency which it is required to record. This aperture is illu-

which, with no modulation, the transmission over the whole width is proportional to the mean of the maximum and minimum intensities of the recording light beam. When the system is modulated the track over its whole width becomes alternately more dense on the positive half-cycles and less dense on the negative. In effect, the sound photograph appears to have a series of striations running at right-angles and to the full width of the track. The density of these striations at any point is a measure of the volume level recorded,

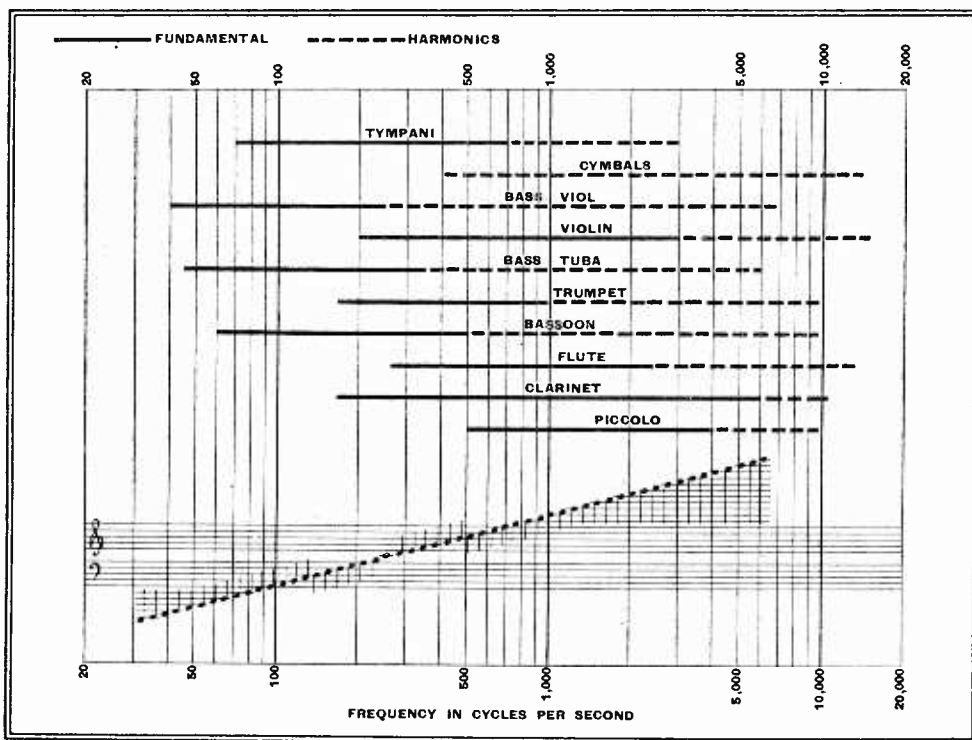


Fig. 2.—Fundamental and harmonic ranges of various musical instruments.

minated on the side remote from the film by a patch of light, which, by electromagnetic means, can be caused to traverse the breadth of the aperture. Thus in the equilibrium position of the system, when no sound is being recorded, this patch of light is stationary and covers exactly one-half of the breadth of the aperture, but when sound is recorded the beam of light may, on one half-cycle of sound pressure, move to cover the whole aperture, and on the next half-cycle the aperture will be emptied.

Variable Intensity of Illumination

The variable density form of track is produced in a very similar manner and is reproduced in exactly the same way. In fact, the two forms of recording are reproduced by the same equipment without change. In the production of a variable-density record in its simplest form the film is again propelled past a stationary aperture, but in this case the length of the illuminated portion is not changed, but rather is the aperture illuminated throughout its length and the intensity of the illumination changed proportionally to the volume of the sound to be recorded and at the same frequency.

By this means is obtained a track in

while the distance apart of successive striations is a measure of the frequency.

In all but news-reel work the original sound and picture records are made on separate films, these individual negatives being afterwards exposed in contact with a third film to form the combined positive. The use of these two negatives is partly for mechanical convenience, but more particularly because the photographically fast stock required for the picture camera entails a coarse emulsion structure which is quite unsuitable to record the fine definition required for the higher sound frequencies. Thus a slower emulsion is used in the sound camera, which is electrically interlocked with the picture camera to ensure synchronism.

The amplified electrical energy from the microphone is fed, *via* the amplifier channel, to the device controlling the exposure of the sound camera. For variable-area recording this is usually in the form of a mirror galvanometer.

In its most simple form a loop of fine wire carrying the speech current is suspended in the plane of a magnetic field. A small mirror cemented to the centre of the loop completes a mechanical system rotating about an axis through the plane of the mirror. In more complex apparatus the primary mechanical system carrying

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a larger mirror is coupled to a magnetically controlled armature. The object of this elaboration is to make possible the use of a larger mirror and so increase the optical efficiency.

For modulating a variable-density recording system many forms of gas discharge lamp have been proposed, but the majority of commercial work is done by means of an electro-magnetic shutter device known as a light valve. A length of flat metal ribbon is formed into a loop with adjacent edges of the strip separated by about 0.002 inch. This loop is suspended in a magnetic field in such a way that when speech current is passed through the loop the aperture formed by the edges of the strip opens and closes on alternate half cycles.

Wide Frequency Range

Any of these modulating systems must be capable of giving an exposure proportional to the amplitude of the applied speech current over a frequency range of 20 cycles to 10,000 cycles per second.

For 35 mm. recording the rate of film travel is 18 inches per second, and so the maximum linear space occupied by one cycle at 10,000 cycles per second is 1.8 thousandths of an inch. This means that the width of the recording light beam in the direction of film travel must be small compared with the half-wavelength, or 0.0009 inch, because when the two figures are equal the modulation at 10,000 cycles becomes zero. The beam width used is of the order of 0.0005 inch, and this is obtained in the form of an optically reduced image of a larger aperture. Even this small slit causes an attenuation as the frequency increases, as shown in Fig. 3.

The mechanics of the recording camera must be carefully considered to provide constancy of film motion, and in good modern apparatus the film speed of nominally 18 inches per second is controlled to within 0.0001 inch at any instant. This problem needs a somewhat complex mechanical arrangement for its solution because of the physical nature of the film to be propelled, and this fact alone will always prevent the development of any very cheap film-driving mechanism.

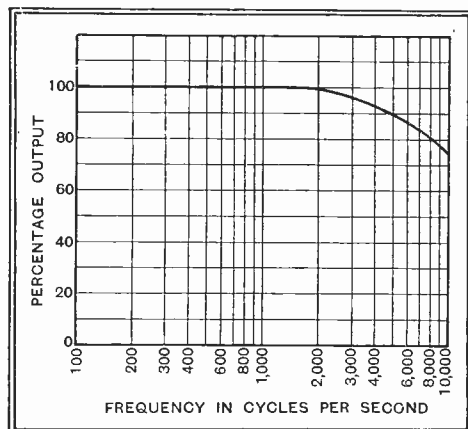


Fig. 3.—Attenuation of higher frequencies due to recording beam-width.

The chemical and physical properties of the film and emulsion affecting the sound recording are matters which have required a very considerable amount of attention, and improvements in these directions are still taking place.

The resolving power of the photographic emulsion can be simply stated, as its ability to record fine definition and its importance can be shown as follows.

It has already been explained that at normal recording speed of 18 inches per second for 35-mm. film, the wavelength of a 10,000-cycle tone is less than 2 mils. Thinking of a half-wavelength, its maximum width is 9/10,000 of an inch. This must be clearly defined with its peak tapering to a point of negligible dimensions, and, what is even more difficult, the valley between successive cycles must be sharply defined and free from fog. The actual resolving power of the emulsion is determined by the size of individual emulsion grains, which are the smallest exposable units, and also the slight scatter which takes place in the emulsion and which has the effect of exposing emulsion grains outside the boundary of the required wave shape.

To obtain the maximum volume range and minimum background noise from the photographed track it is necessary to

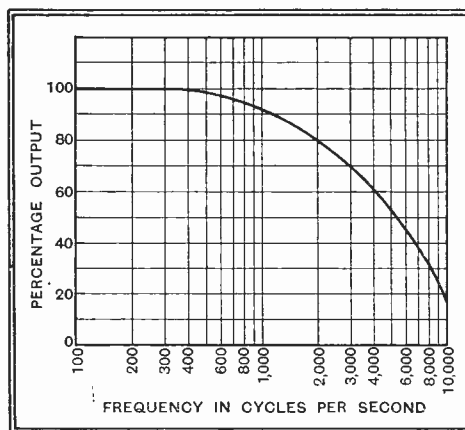


Fig. 4.—Attenuation due to lack of resolving power in the film.

achieve a density on the dark side of variable-area recording of 1.2 to 1.6, whilst maintaining the clear side absolutely clear. This is exceedingly difficult owing to stray light in the recording optical system and imperfect definition of the recording edge.

The positive prints for reproduction made from the original negatives must maintain this same standard in all particulars, and great care has to be taken in the mechanics of the printing machine to ensure that no distortion of the wave-shape is introduced by imperfect propulsion of the two films.

Variable-density recording has the same and also its own particular difficulties owing to the necessity for maintaining its range of exposures on the linear portion of the emulsion exposure-density curve.

The attenuation of the higher frequencies due to lack of resolving power is shown for an average negative record in Fig. 4. A further attenuation, of course, occurs when a print is made.

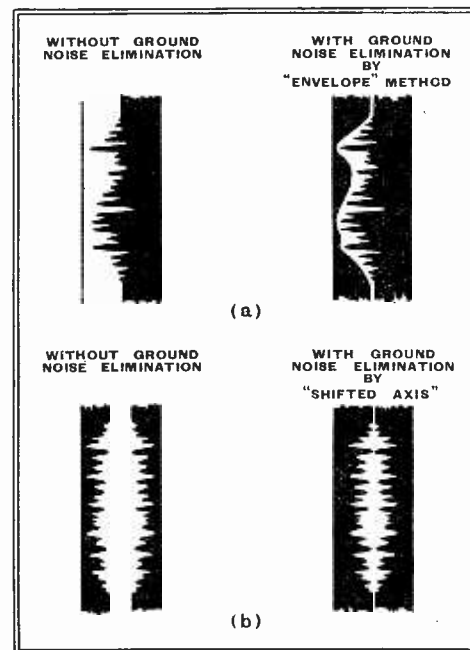


Fig. 5.—Methods of noise elimination with two forms of variable-area track.

A simple track made in either of the forms described will have a high noise level, due to the fact that the reducible substance in photographic emulsion is silver nitrate, in the form of grains of determinate size. This granular structure has the effect of modulating the excitation light in the reproducer to produce a background hiss. In addition, noise is produced by the dirt and scratches collected by the film during its useful life, and a third source is the "shot effect" in the photo-electric cell, which in amount is approximately proportional to the light flux on the cell.

It is evident that an unmodulated form of a variable-area track need not consist of two bands of equal width, one clear and the other dense, with modulation taking place about their dividing line. It can equally well take the form of a track which is dense over its whole width during unmodulated passages, providing that it is arranged that the track assumes its normal form for full amplitude signals and that correct relative widths are arranged for all intervening depths of modulation. A second condition is that the rate of change of the mean density shall always remain below the minimum rate of change of track density which can be audibly reproduced. In other words, the slope of the line representing this change of mean density shall always be less than the slope of the wavefront of the lowest frequency to be reproduced (usually about 30 cycles per second).

Anti-noise Measures

It will readily be seen that if this arrangement of track is adopted there will be no clear side of the track during silent intervals, and at any other instant there will be only sufficient clear track to accommodate the depth of modulation at that instant; the one change will thus almost completely eliminate both sources

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of background. In the silent and quiet passages there is no (or very little) clear track which can give rise to background, and at the same time the mean light on the cell will be reduced in the same ratio and cell hiss will be minimised. A track of this form is shown in Fig. 5a.

Another form of variable-area track is known as the bi-lateral, and this enables ground noise elimination to be used with a rather more simple mechanical arrangement than that required for the added envelope method described above. In this case the recording galvanometer can be turned through 90 deg. with respect to the mechanical slit and a triangular aperture used in the light source in place of a rectangle. The galvanometer is biased at zero modulation to bring the apex of the beam down to the mechanical slit. It will be seen that a track recorded in this way consists of two symmetrical records placed one on each side of the centre line (Fig. 5b). During quiet passages the whole track area is black and the axes of the two wave-forms almost coincide in the centre. As modulation increases these axes move outwards to positions, respectively one-quarter and three-quarters across the width of the track by the operation of a rectifier circuit which lowers the galvanometer bias as the amplitude increases.

If we now make a summation of the

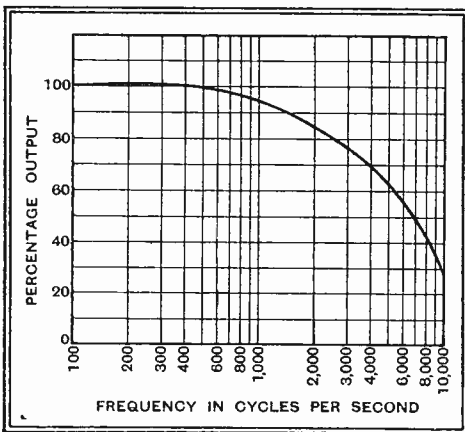


Fig. 6.—Total attenuation of the higher frequencies in the processes of recording and reproducing.

losses enumerated in the foregoing description of 35-mm. photographic recording we find that the frequency characteristic of the whole recording and reproducing process is as shown in Fig. 6. This assumes that amplifiers, microphones, loud speakers, modulating devices, and so on have flat frequency characteristics, and the loss shown is attributable to the photographic processes and the recording and reproducing scanning systems inseparable from the process.

Assuming minimum signal-to-noise ratio to be 1 to 1, as previously defined, by the use of ground noise reduction methods the volume range available from the final print is of the order of 50 db. Various specialised methods have been proposed for extending this figure, and at

the present time there is considerable interest being shown in "volume expansion," in which the volume from the reproducer is made to increase out of direct proportion to the increase of volume on the record. This system, used in con-

junction with an inverse method of volume-compression during the recording, may prove a valuable means for obtaining an overall volume range approaching the ideal of 70 db.

(To be concluded.)

What is a Wireless Engineer?

Importance of the Question Recognised

OUR Leader on the above subject, which appeared in the issue of November 13th, has had the gratifying result of stimulating comment on the question from various authorities. Below we publish a statement which undoubtedly does much to clarify the position, and other views are expressed in the correspondence columns of this issue. It is important to observe, also, that Dr. E. Mallet, in his Chairman's address to the Wireless Section of the Institution of Electrical Engineers on November 18th, dealt with the same problem. Dr. Hughes' contribution, published below, was received some days before Dr. Mallet's address was given, and the views expressed largely coincide.

Much of the blame for the present state of affairs, we observe, is laid at the door of the manufacturer, who is considered to be taking a short-sighted view of the position and not offering worth-while jobs to trained men, nor pursuing a policy of building up a technical staff on the firm basis adopted in other industries.

The whole subject is one which demands most careful investigation, and the interest which is at present being shown in the matter is extremely encouraging to those who have so long wished to see the status of the Wireless Engineer defined.

THE short answer to the pointed question in a recent Editorial—
Why is there a lack of competent wireless engineers and what steps are to be taken to regularise their qualifications?—is that this dearth will continue until the radio industry thinks it worth while to attract men of adequate intellectual attainments, rather than to demand that its recruits shall be of immediate value as a result of over-specialisation.

A more full explanation takes us into the meaning of education and training and the realisation that the two are fundamentally opposed; in practice they can be made to overlap somewhat, with the result that their basic natures are confused.

By education we mean that development of innate ability and intellectual flexibility which enables the individual to live on terms of freedom with his fellow men.

**BY L. E. C. HUGHES, Ph.D.,
A.M.I.E.E.**

Dr. Hughes assists in conducting the Degree and Advanced Courses in Electrical Communication at the City and Guilds Engineering College and gives the results of some years' experience.

Psychologists divide thinking into factual and pleasure, the former denoting the capacity to infer inevitable deductions and inductions from observed facts, the latter to build on facts such cultural values which are socially useful. The former includes scientific activities and statistical data of all kinds, the latter politics, art, religion,

and other cultural ideas which are not supported by facts, but arise from the inner motives and desires of men. Education, which ingrains these distinctions, implants the broadest outlook in the individual, guards him from being misled by plausible ideas thrust on him by others acting from self-interest, and gives him some backing for permitting the social uses of natural and technical resources (e.g., in modern warfare). The educated man is one who can be relied on to make sound judgments, taking all relevant considerations into account.

By training we mean the acquisition of mental and manual procedures along pre-determined lines which can be relied on to function with regularity when required. A high degree of training means increased attention to a narrower and narrower field of activity, with the normal exclusion of attention to other fields, since human capacity is more or less limited.

Of the three important divisions of human activity, work, civics, and play, education emphasises the latter pair, while training ignores them. The great feature of modern education, if we read the recent Board of Education Annual Report aright, is to hold a balance between all three which is more in keeping with the needs of the modern world, and biased to suit the needs of the individual more closely than was attempted in the last century. The facilities for the rising generation to specialise and de-specialise and correct their outlook and usefulness as they develop are greater now than at any previous time, and with prevailing foresight and unless we lose our freedom this is certain to continue.

What is a Wireless Engineer?—

Before these ideas can be applied to recruits to radio engineering it is pertinent to define our field, not only of radio but of engineering. It cannot be denied that the field of radio is a very specialised section of electrical communication, which is one of the two definite halves of electrical engineering. The amount of strictly radio engineering that is used in any radio engineering work is again a small fraction. Consider, for example, microphones, loudspeakers, sound measurements, land-lines, masts, power plant and rectifiers, filters, the whole business of manufacture of transmitters and receivers, none of which has anything to do with the propagation of electro-magnetic waves or the control of the currents associated with them. At the same time the above-mentioned items are important in other fields of activity such as telephones, sound-films, civil engineering, electrical supply and the whole art and science of mass production. To be an engineer, specialisation is desirable to a moderate extent only; he will be the more valuable in his work the more he appreciates the introduction of ideas from other fields of knowledge and activity into solving the problems he has in hand. Real specialisation is for the scientist in the laboratory, untroubled by costs and the necessity of getting a job done.

An engineer is strictly an individual who can be relied on to make, and be responsible to his untechnical employers for, major technical decisions. When he is merely carrying out instructions, however complicated, but without freedom to make decisions, he is not acting as an engineer, whatever the popular idea of an engineer may be. At a recent discussion of the subject at a meeting of the Wireless Section of the Institution of Electrical Engineers it was pointed out that practically no one in the room had been trained as a radio engineer, and yet it was suggested that the hall-mark of a radio engineer was at least his acceptance by the Institution into this section. Such is the opinion of the leading body of radio engineers who substantially control the industry; it is difficult to depart from it on fundamental grounds.

Over-specialisation

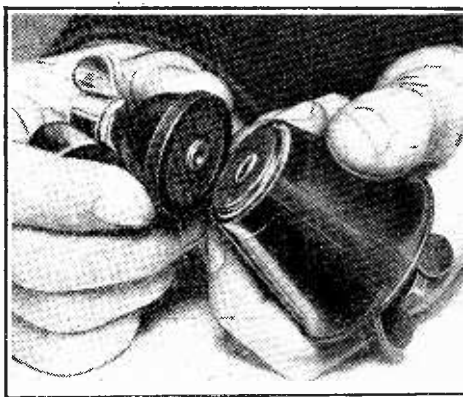
The claim is now put forward that radio is grown sufficiently to become a separate branch of the electrical industry and that it should set up its own standards of engineering status regardless of other branches of the electrical industry. The answer is that such a procedure would be the biggest dis-service to the radio industry that could be imagined. The large radio firms who manufacture radio apparatus other than broadcast receivers (and these can be counted on one hand), the Post Office, the B.B.C., the Services, and the cable companies all know quite well that the type of men they want and who are destined to take the responsible positions in ten and twenty years' time are those who have been thoroughly trained in the fundamental principles of applied science; they do not require that they shall be of much direct use for a number of years, but they are willing to invest in such men on the basis of their educational achievements and personality. Such men will be adaptable to changing conditions, and what they do not know for the use of their organisation they can be relied on to find out without much cost or delay.

The broadcast receiver industry stands

apart. It expects to take trained men from college and expects them to solve its problems in time for the next radio show. It has been living from hand to mouth, technically, for the last decade, without building up any sort of engineering background for the future, and now when there are so many other lucrative avenues for adequately trained engineers to take after their formal and regulated education it is feeling the pinch and is apprehensive of its brains in the future.

Briefly, one does not train radio engineers at all. At the City and Guilds College, where, on paper at least, we conduct the most comprehensive Electrical Communication course in the country, only one of the four final degree papers concerned with Electrical Communication deals with Radio, which amounts, in fact, to roughly 6 per cent. of the total degree marks. This is a result of many years' experience, and it is unlikely that the proportion will be increased. Of the dozen or so students who take the Advanced Course in Electrical Communication and do some academic radio research only a few find their way into the broadcast receiver industry, other openings leading to more definite careers. If the industry considers its sources of recruits it will find a variety which is comparable with the outlets found by students who have been trained with a view to possible absorption in the radio industry. In fact, we teachers are very careful to refrain from assuming that students will take up any particular occupation, and any advice we give is based on the longest view we are justified in adopting and is directed to the best interest of the individual. From this point of view the broadcast industry does not appear in a good light; we teachers want to know what the student is to get out of his work and what value it will be to him in 5, 10 or 15 years' time, when he will be the indispensable engineer willing to accept major responsibilities.

The output of the colleges in radio engineers *per se* is therefore not impressive in numbers, and the industry is seeking other methods of obtaining new trainees. To set up their own schemes might be of immediate value, but without educationists of long experience and the support of the existing body of radio engineers, such arrangements are not likely to be of permanent value. The intermediate step of inaugurating a National Certificate in Radio Engineering seems to offer the prospect of a satisfactory solution,



AFTER THE STORM. Although this Goltone lightning arrester was fractured when the aerial to which it was connected was struck by lightning the receiver was undamaged.

but the successful inception of this scheme resides solely in the acceptance by the professional body—here the Institution of Electrical Engineers—of the result obtained by candidates working under varied teachers in existing institutions when examined by these teachers, who will certainly not yield to pressure of the industry to do its work for it at considerable public expense.

The new Higher National Certificate in Radio, which is "internal" in that the teachers examine, or the existing Final City and Guilds Institute Certificate in Radio Communication, which is "external," that is, based on a common examination paper, are normally taken at the end of a long course of part-time study of at least five years, generally by students who, after a day of possibly uncongenial work, devote their whole leisure to study. Having obtained these hall-marks, are they radio engineers in terms of our definition?

Salary and Conditions

To get these certificates they have to take several subjects other than specifically radio, and although their specialised knowledge of radio is probably greater than students who take radio in their engineering degrees (also done by part-time evening study), it cannot be claimed that in the long run students trained for a specific vocation will necessarily be the technical leaders in their chosen profession in the future.

To be an engineer one has to exercise responsibility which is recognised by one's equals. To make it worth while for a good man to accept such responsibility in the radio field he must be offered a reasonable salary and freedom to do his work without too much worry. If the radio industry wants adequately trained brains it must pay for them in the open market. All other branches of engineering do it and find it profitable, but it is not too late for this latest branch of industry to learn to do likewise.

PUBLIC ADDRESS MANUAL

ALL who are concerned with the technical aspects of public address, whether in a trade or professional capacity, will find much to interest them in the Partridge PA Manual, by N. Partridge, B.Sc., A.M.I.E.E.

As a start the book gives full constructional details of two amplifiers. The first is a 12-watt three-stage model with push-pull transformer-coupled output and resistance coupling in the preceding stage. A special output transformer permits the accurate matching of varying numbers of speakers. The second amplifier is a 30-watt model which has already been mentioned in these columns; it employs a low-loading push-pull circuit, an arrangement which gives a large output at very low cost.

The advantages of pre-amplification are discussed, and single-stage and two-stage pre-amplifiers are described. The more ambitious model constitutes a complete control unit for PA work, providing for the independent operation of two microphones and two pickups, together with regulation of both bass and treble response. The associated subject of long inter-amplifier lines and the problems they introduce are dealt with at length, as is the question of speaker lines. Microphone technique, line technique, and intervalve couplings form the subject-matter of other chapters.

Copies of the book will be sent free to members of the trade who apply (mentioning *The Wireless World*), to N. Partridge, King's Buildings, Dean Stanley Street, London, S.W.1.

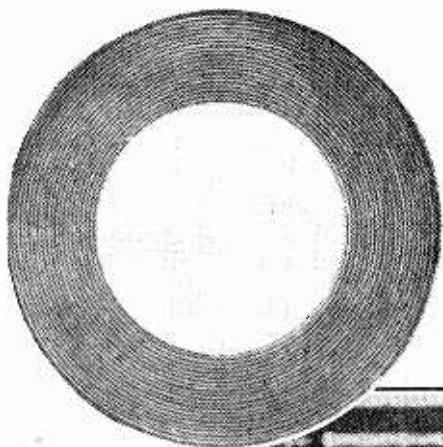
Recorded Interval Signals

NEW GERMAN SYSTEM— SOUND TRACK ON GLASS DISC

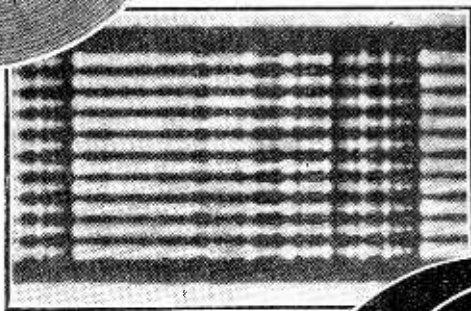
By Dr. H. J. von BRAUNMÜHL

ALL sorts of devices have been used in the past for producing interval signals. Either they themselves generated the required sounds, which were then taken up by a microphone, or else they took the form of electro-mechanical devices such as mechanically struck steel bars or reeds, whose vibrations were picked up electro-magnetically. In a few cases, gramophone records have been employed, as at Broadcasting House, Prague.

All these methods, except the last, have



The German optical-record interval signal system. Above is seen the spiral sound track photographically recorded on a glass disc, and to the right a microscopic enlargement of a portion of it.



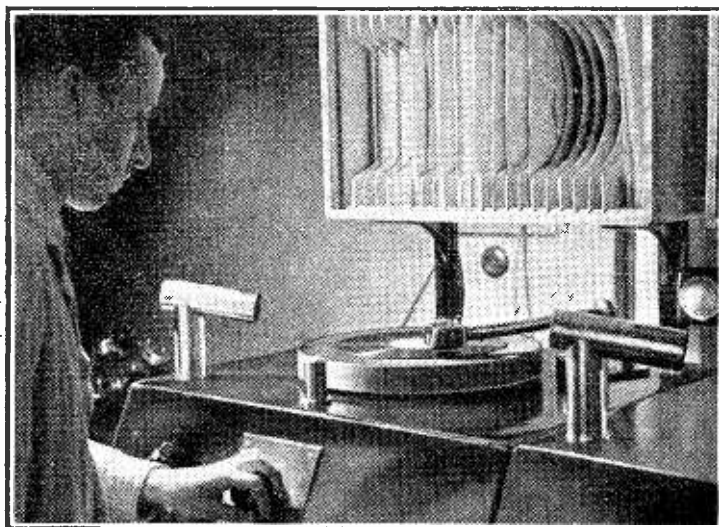
The slotted screen which slowly revolves under the recorded disc to give the radial scanning motion is seen below.



the disadvantage that only a limited number of effects are available, and each different effect means a change of apparatus; and they all are subject to some more or less rapid deterioration or de-tuning which requires attention. Obviously, therefore, there was a need for an apparatus which would be free from these defects and would, moreover, allow the most varied types of signal to be interchanged at will—passages of music, chimes, speech, bird songs, and so on almost without limit, and all of the highest possible quality. For such an apparatus the use of some type of sound-recording process was clearly the only possible solution, and the special suitability of "sound-on-film" recording was obvious.

has been found particularly satisfactory for this special purpose. As can be seen from the illustration of the microscopic enlargement of a short length of such a

The gramophone record and standard pick-up system is used at Prague by the Czechoslovakian broadcasting authorities.



In the apparatus recently constructed for the German broadcasting service, however, the "sound-on-film" record is not made on the usual somewhat fragile film strip but on a circular glass plate the shape and size of an ordinary gramophone record. This transparent disc is sensitised like the usual photographic dry plate, and the interval signal is recorded on it in the form of a spiral sound track by ordinary sound-on-film technique. Any of the various recording systems can be used, but one of the recent versions of the "amplitude" process, the so-called "multiple jagged-edge track" process,

sound track, it consists of a number of parallel streaks each of which has been made to vary in width in rhythm with the sound vibrations. As the photograph shows, all the streaks are identical; together, they form the thickness of the line which runs spirally round the disc, like the engraved track on an ordinary gramophone record. The 12-inch record diameter is adhered to, and the standard record speed of 78 revs per min. is retained. Since quite a short playing time (10 to 20 seconds) is all that is required, the recording can be spread out so as to ensure really excellent high-note reproduction.

Advantages of the System

For reproducing such a record it is, of course, only necessary to scan it, as it rotates, by a narrow illuminated slit, so that the light ray, modulated in intensity by the varying total width of the transparent sound track, may fall on a photocell on the far side of the glass disc, and thus produce electrical variations corresponding to the recorded sounds. Ordinarily, the illuminated slit and the photocell would have to move slowly in a radial direction from the outer edge of the disc towards the centre, just as a gramophone pick-up swings gradually towards the spindle. But such a mechanical arrangement is replaced, in the new apparatus, by a much simpler optical device which is free from all mechanical trouble and deterioration. The narrow illuminated slit is made long enough to cover the whole radial width of the recorded part of the disc, but between the disc and the photocell is mounted a slowly revolving screen in which three short lengths of spiral slit have been cut. This revolving screen cuts off from the photocell all the strip of light coming through the glass record, ex-

Recorded Interval Signals—

cept for one spot corresponding to the thickness of the sound track; and by suitably proportioning the speed of the screen to the speed of the glass record it is arranged that one revolution of the screen gives three complete scannings of the record—one for each of the spiral slits—separated by three short intervals of silence. The screen is driven, through reduction gear giving, once and for all, the correct speed ratio between the two discs by the same synchronous motor which drives the glass record.

The view of the chassis reproduced shows the long reflector of the lamp, close to the revolving glass-disc record. A mains unit and pre-amplifier are included. The apparatus was employed for the first time at the 1936 Olympic Games, where



The apparatus as assembled for use. The spiral slits in the screen below the glass record are not discernible in this rather small reproduction of the gear.

a recording of a fanfare from an orchestra of wind instruments was used as the interval signal.

On the Short Waves

NOTES FROM A LISTENER'S LOG

AN interesting sunspot theory has just been advanced by F. E. Stowe in the *Australian Journal of the Institute of Engineers* (page 268, July, 1936).

Stowe suggests that sunlight is due to radiations from a radioactive solar "crust" entering the earth's atmosphere.

Sunspots are thought to be due to penetration of this "crust" by non-radioactive material.

It is also stated that a slight increase of temperature is produced on the earth while a sunspot is forming.

Nobody has, so far, however, given a really satisfactory answer to the other sunspot mystery, which is why does the number of sunspots increase to a maximum every 11 years, approximately? Although a study of the beautiful and well-known "butterfly-pattern" led probably to the establishment of Schirer's "Law of Zones."

The first spots of any new 11-year cycle always appear near the solar poles, and from then onwards successive spots increase in number and intensity until the maximum of the cycle is reached. By this time, however, the number of spots appearing in or near the polar regions has greatly diminished, and spots appearing after the maximum period tend to group nearer and nearer to the equator.

It often happens at the time of the sunspot minimum period that the beginning of a new 11-year cycle is heralded by the appearance of spots in high latitudes, whilst a few spots of the old cycle occasionally become visible in the equatorial region.

This sequence of events is now known to astronomers as Schirer's "Law of Zones," to which reference was made in an earlier paragraph.

Before leaving the question of sunspots a recent statement in *Science* suggests that there is no definite correlation between the weather and sunspots, and that the 53-, 5.7- and 2.8-year weather cycles are not connected with the 11-year solar cycle.

We seem at last finally to have changed into winter conditions, in fact rather abruptly so as far as Sunday, November 8th, was concerned.

Strangely enough, too, the phenomenon

which was noted last winter—that is, good ultra-short-wave conditions in the afternoon often indicate poor conditions in the late evening—has again been experienced.

For example, at 4 p.m. the 28 Mc/s band was very active on this Sunday—stations like W1HFS and W1HQN peaking to R9 on the speaker—and also W2XE on 21.52 Mc/s was definitely good until close down at 6 p.m.

By 11 p.m., however, the only U.S. station audible was W1XAL on 6.04 Mc/s, and a deadly silence prevailed below 9 Mc/s. The Boston station W1XAL was really amazingly good, however, at R8/9, merit excellent.

The following night conditions were definitely better, and the U.S. broadcasters W3XAL, W2XAD and W8XK were all good, the latter remaining so until 10 p.m., at which time it still possessed adequate programme value.

Excellent results were again obtained from W1XAL on 6.04 Mc/s in the early hours of Tuesday and, indeed, it actually had a clear channel in the overcrowded 6 Mc/s band—a unique occurrence so far as the U.S. stations are concerned in this band.

Winter Conditions

There was again a tendency to winter conditions on Tuesday, November 10th, but W8XK again managed to hold his own on 15.21 Mc/s until nearly 11 p.m.—a remarkable performance for November.

The winter tendency became much more marked on Wednesday, which probably accounted for the excellent performance of PMN Bandoeng on 10.26 Mc/s during the afternoon; in fact this station has continued to give good results in the afternoon on this relatively low-frequency.

The best signals on Thursday, November 12th, were W2XAD, round about 7 p.m., and W2XAF at 12.30 a.m. (Friday)—both obtaining an excellent rating at the times mentioned.

Friday, the 13th, was characterised by low noise levels, even on 9 Mc/s—a fact which helped W1XK to put in a good appearance on 9.57 Mc/s at 9 p.m.

In the evening both W3XAL and W2XAD possessed considerable programme value, the latter being the stronger signal but closed down, as usual, at 8.45 p.m.

The Boston station W1XAL was best on 11.79 Mc/s on this occasion, with W8XK again performing well on 15.21 Mc/s until close down at 11 p.m. A weakish signal maintaining a good standard by virtue of a very low noise level—under which conditions a sensitive quiet receiver can be used to great advantage.

Conditions late on Saturday evening, November 14th, contrasted sharply again with the preceding day, practically no signals being audible above 10 Mc/s at 11 p.m.

Even W2XAD was very weak at 7 p.m., so weak in fact when compared with W3XAL, that it is possible the normal European beam aerial was not in use.

Ultra-short-wave conditions were again good on Sunday, November 15th, and at 5.30 p.m. I managed to hear one U.S. police transmitter on approximately 37 Mc/s (8m.), but was unable to catch the call-sign, owing to very deep fading. The signal was, however, peaking to R9.

W2XE was again very good on 21.52 Mc/s until close down at 6 p.m.

ETHACOMBER.

Book Review

Television Technical Terms and Definitions.

—By E. J. G. Lewis. Pp. 95+14 for notes. Thirteen figs. Sir Isaac Pitman and Sons, Ltd., Parker Street, London, W.C.2. Price 5s.

APERUSAL of this book brings home to one the extent to which television has developed and the wide range of sciences and arts that it embraces. Few of those who are now taking an interest in television have a grounding in all these subjects, or can spread their reading so widely as to keep abreast of all the rapid developments that are taking place. Here in one volume is easily accessible information for which one would otherwise have to search through vast numbers of books and papers.

Over 1,000 terms are explained, some of them in considerable detail; and there are thirteen diagrams illustrating the main principles of some of the more important devices used in television. In recognition of the rapid growth of the subject, fourteen extra pages are provided for alphabetical recording of new information.

Though the majority of the definitions are entirely helpful, a few are misleading or even quite wrong. A notable example is the so-called *Kerr Effect*, which is here not clearly distinguished from the *Faraday Effect*. The author has fallen into the common error of supposing the Kerr Cell to have a rotating effect on a beam of light, or rather its plane of polarisation; whereas it actually has the effect of elliptically polarising it. Moreover, this result is stated to be caused by an *electro-magnetic* force instead of *electric*.

The information on ultra-short wave aerials and on the super-regenerative receiver also is unsatisfactory; and the Scophony system deserves fuller and more up-to-date information than is provided. When a revised edition is required, these and a few other defects can be remedied. On the whole, however, the book is to be recommended as a guide to the technical terms now being used in the literature of television.

M. G. S.

CURRENT TOPICS

EVENTS OF THE WEEK IN BRIEF REVIEW

Indian Police Wireless

RADIO apparatus has been installed at police headquarters in Bombay and also at the Nagpara and Byculla police stations. These installations are operated in conjunction with two radio-equipped cars.

Anglo-German Licence Race

IT is expected that the number of German listeners will exceed those of this country by Christmastime. The latest figure, which was issued on November 1st, is 7,757,265. It is confidently anticipated that the eight-million mark will be passed some time in January.

New Tunis Station

THE French Government has announced its intention of providing a 100-kilowatt broadcasting station for Tunis at a cost of three million francs. The Tunisian Colonial Government will, however, be called upon to pay for the actual cost of installation. The running costs of the station also will be a charge on the local Government.

New Short-Wave Stations

IT has been decided by the Norwegian authorities to replace the Jeloy short-wave transmitter by a completely new installation having a power of 5 kW. It

was originally decided merely to augment slightly the power of the existing station, and the decision to replace it by a new one of considerably greater output has been taken as the result of numerous requests received from listeners, many of whom are Norwegians resident abroad.

A Karachi firm has applied for permission to instal a short-wave transmitter in the city. This particular company has lately been carrying out a good deal of experimental work on the short waves. The transmitter which it is hoped to erect is of American design and is intended to work in the neighbourhood of 40 metres. It is hoped that it will provide a consistent service for the whole of the province of Sind.

Belgian Television

HITHERTO no great television activities have been reported from Belgium, but a definite move is being made and special premises for television have been set aside in the Brussels Radio House. An official delegation is now in Holland studying the television work being carried out in Dutch laboratories.

Lighthouse-Keepers Want Wireless

A CONGRESS of French lighthouse-keepers has passed a resolution asking that all lighthouses should be provided with a complete wireless transmitting and receiving installation in order that it may be possible to obtain assistance from the outside world in times of necessity.

N.Z. Amateurs Lead the World

THERE are 950 amateur transmitters in New Zealand, this being one per 1,500 of the population. This percentage of amateur transmitters to the population is said to be by far the greatest in the world. Even the U.S.A., with its large number of transmitters, cannot approach anywhere near to this percentage figure.

Wireless in Mongolia

THE Japanese military authorities in Mongolia have just completed a very efficient chain of wireless stations round the border of their sphere of influence in Mongolia. By this means the approach of marauding bands can be instantly notified to headquarters and the necessary reinforcements rushed up.

U.S. Wireless Trade Improving

TRADE figures just made available show that wireless is booming in the U.S.A. The Radio Corporation of America had a net income of over a million dollars during the third quarter of 1936, this being nearly a half a million dollars more than for the corresponding period last year. The income for the first nine months of 1936 shows an increase of forty-six thousand dollars over the same period of 1935. By far the greater part of the increase occurred in the third quarter.

Pensions for Wireless Workers

A PENSION and life assurance scheme, established for the employees of the Marconi Co. at their Chelmsford works and elsewhere, has the rather unusual feature that if an employee leaves the service of the company he can, if he so desires, still continue his contributions and obtain a pension at the normal retiring age.

India's Regional Scheme

ACTING on the recommendations of Mr. H. L. Kirke, of the B.B.C., who some time ago outlined a scheme for the development of broadcasting in India, the Government has decided to establish eight new stations at a total cost of four million rupees.

The scheme provides for 1 kW medium-wave stations at Trichinopoly, Dacca, Lahore and a place, not yet chosen, in



STATION DIRECTOR FOR TEN YEARS. Dr. Emile Notz has been with "Radio-Basle" since its foundation.

the United Provinces. 5 kW short-wave stations are to be erected in Calcutta and Delhi and, later, also at Bombay. Eventually Madras will also have a 5 kW station, although at present no decision has been made with regard to wavelength. A $\frac{1}{4}$ kW medium-wave station will also be installed at Peshawar.

An early start on these is likely to be made and already Mr. C. W. Goyder, the newly appointed Chief Engineer, is said to be taking the necessary steps to commence operations.

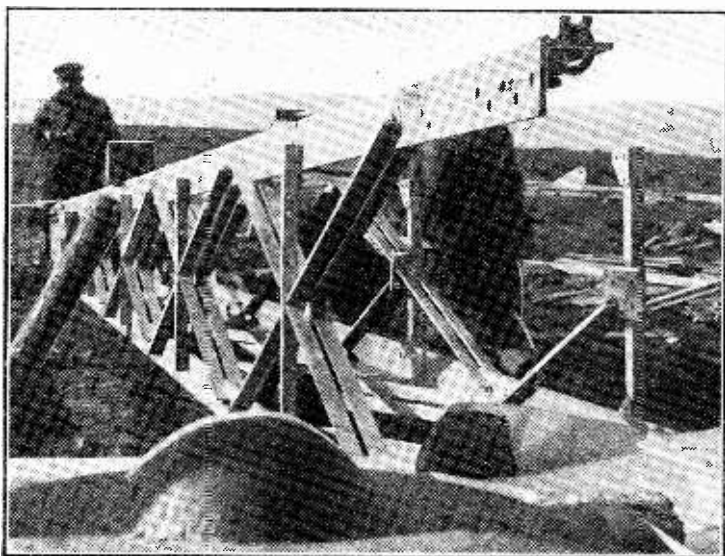
Television Figures

IN reply to a recent question asked in the House, the P.M.G. stated that the television plant acquired by the B.B.C. up to the end of October cost approximately £110,000. With regard to the total number of television viewers, the only method of ascertaining this was by the number of sets sold. The Television Advisory Committee had, therefore, approached the Radio Manufacturers' Association to arrange for them to supply from time to time confidential figures concerning their sales of receiving apparatus.

International Review of Broadcasting Problems

SEVERAL of the more momentous aspects of broadcasting are dealt with in the current issue of *Radiodiffusion*, the organ of the International Broadcasting Union. Arthur Burrows writes on "Broadcasting in the Cause of Peace," and Major Anderson on "Some Legal Aspects of Television." There are several articles of technical and semi-technical interest, including a description by Raymond Brillard, of the Observation Post at Brussels. The question "Should Radio Instruct or Amuse?" is debated at length.

Copies of *Radiodiffusion* may be bought from the B.B.C. Bookshop at 2s., or by post 2s. 3d.



RADIO-SOFIA IN THE MAKING. Work is now proceeding apace with the erection of a new 100 kW. transmitter in the Balkans. One of the 600ft. masts is seen in course of construction.

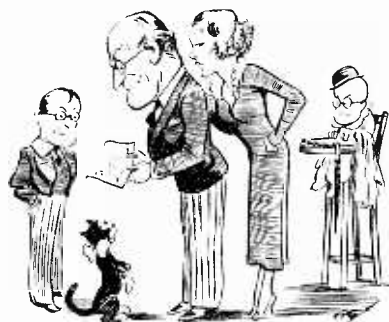
UNBIASED

By FREE GRID

Hush Money

IT is astonishing what a large number of people there are who are still under the impression that all the English programmes dished up by Continental stations for their benefit, more especially on Sundays, are first-hand instead of coming from gramophone records. I don't know what is the actual percentage which comes from records, but I rather fancy that if the truth were known it would be found that the figure would be as near a hundred as were the offensive portions of the curate's egg.

I must confess, however, that even I, accustomed as I am to the depravity of human nature, did not realise that the mechanising of these programmes was carried out as thoroughly as I have since found out to be the case, and I must congratulate those responsible for it, not, of course, for their depravity in taking advantage of the unsophisticated public, but for their ingenuity and thoroughness. Occasionally, as you know, these Continental stations break down for a few minutes, and after a brief interval of silence we get the same suave apology for a technical hitch



A substantial cheque.

as we do now and again in the case of the B.B.C. stations. I have always thought that a tame announcer—the same man who changes the records—was kept to do this odd job. To my amazement I have discovered that in the case of certain stations even this is all part of the programme. Even the records do not apparently have an attendant menial to change them, but are dealt with by an outsize in record changers.

My discovery of this state of affairs was due entirely to one of those odd turns of fate which, as some wretched poet once said, upsets some of the best-laid schemes of mice and men. I happened to be listening to one of these monotonous programmes one Sunday afternoon in order to settle an argument as to whether it was slightly more or slightly less soul-destroying than the B.B.C.'s Sabbath efforts, when suddenly the melancholy sounds which pass muster for music in these de-

generate days ceased, and we were granted a few moments' peaceful relief. I was absolutely dumbfounded, however, to hear the needle scratch still merrily continuing in spite of the sudden cessation of other sounds, and it was not until long after the announcer's voice had given the conventional apology that I realised that there had, of course, been no breakdown at all. Seizing pen and paper, I forthwith indited an epistle to the publicity manager of the firm whose products were being advertised at the time and demanded an explanation, as I could see neither rhyme nor reason in the interpolation into the programme of an imaginary breakdown.

If I had been astonished at discovering this state of affairs, I was completely flabbergasted when I received by return of post a substantial cheque from the firm in question with an explanatory letter stating that this "breakdown" had been staged in order to impart a sense of genuineness for the benefit of the listening public whose faith in the first-handedness of the programmes had been rudely shaken by an unfortunate contretemps of the previous Sunday when the record of the announcer's voice had got stuck in a damaged groove.

The cheque was, I learnt, partly a gratuity to me for pointing out the fact of the continuance of needle scratch during the supposed breakdown period which would, of course, give the game away. The chief purpose of the cheque, however, was as hush money. Needless to say, I returned it forthwith, in spite of Mrs. Free Grid's protestations about new hats and suchlike dross, together with a strong letter. Although I notice the scratch has now been hushed, I certainly have not, and that is why I have given you the full facts herewith.

An Unjust Imposition

THROUGHOUT a long and somewhat adventurous life, in which I have received with equanimity many of the hard knocks of fate, I have always prided myself on being as public-spirited and as conscious of my duties to my fellow-citizens as the next man. Not even in the face of the base ingratitude which has sometimes been my lot have I faltered in my set course through life, but just lately an incident, or rather a series of them, has occurred which has, to say the least of it, somewhat shaken my faith in human nature.

As one of the few people possessing a completely up-to-date television receiver, I naturally considered it my duty to fling



The eccentricity of their appearance.

open wide my doors to my less fortunate fellow-creatures. I had, of course, expected the house to be rather uncomfortably filled during the television sessions, and my expectations in this respect were amply fulfilled. In reply to Mrs. Free Grid's protestations about the mud left on her best carpet by my visitors, I felt compelled to draw her attention to the reply which Julius Cæsar had made to Calpurnia on a somewhat analogous occasion. Women are notorious for having the last word, however, and her next complaint concerned the type of person which, she alleged, the demonstrations appeared to attract. I pointed out, however, that all geniuses and great men of science have been noted for the eccentricity of their appearance.

I greatly regret to say, however, that I was reluctantly forced to come round to Mrs. Free Grid's way of thinking as the result of certain regrettable incidents which took place. To put it bluntly, certain small and portable articles of value were missed from my home after these demonstrations. I was convinced, and still am, that this did not indicate any lack of honesty among my guests, but merely pointed to the fact that they had allowed their enthusiasm for television to lead them away into borrowing these articles so that they could raise the wherewithal to buy sets of their own. But, nevertheless, I could not afford this constant drain on my resources. Accordingly, I commenced to charge a small entrance fee, this being graduated daily according to the losses sustained on the previous day.

This arrangement worked quite smoothly for some little time, when a thunderbolt arrived on my breakfast table in the form of a peremptory demand from the local Revenue Inspector for a large sum in respect of Entertainment Tax. I naturally protested, and pointed out that the money I charged the public was in reality not an entrance fee, but merely a levy to pay for the tobacco, beer and other articles which certain of my guests were accustomed to borrow. To my surprise this has resulted in the arrival of a summons for selling tobacco and alcoholic liquor without a licence.

I regret to say, therefore, that I have been compelled, temporarily at any rate, to close down my demonstrations, nor can I comment upon the circumstances in the manner in which I should like to do, since the matter is, of course, *sub judice*.

Automatic Tuning Control

By "CATHODE RAY"

SOME years ago—round about 1928, I believe—a broadcast receiver* was put on the market which had, if my memory serves me well, six tuned circuits with separate knobs for the listener to get right. If it had not been that some guidance as to wavelength was given, and that each circuit was purposely rather flat, the chance of tuning-in any station at all would have been as remote as that of opening a 6-dial safe without knowing the combination—for mortals, limited to a lifetime of some threescore years and ten, *nil*.

Until the last few years even the most grandmotherly listener was expected to be able to adjust at least two tuning controls correctly, and not always with much help from the scales provided. Then "one-knob tuning" was advertised with the air of having reached the ultimate in simplicity and foolproofness.

But each simplification introduced by the manufacturer causes the unskilfulness (or laziness) of the public to take another step forward, so that the one never overtakes the other. The next difficulty was that people insisted on turning the tuning knob only long enough to obtain some sort of sound, so that what issued from the loud speaker consisted mainly of side-band shriek. The consumer (as we must now call him, for he has long since become too lazy actually to *listen* to the programmes) was then provided with a tuning indicator. Although the ears, through long debauchery, had become incapable of indicating when a station was correctly tuned, it was thought that the march of civilisation had not yet deprived people of the use of their sight; and all sorts of coloured lights, pointers, shadows, glass tubes, winking eyes and the like were devised for showing when the set was in tune.

Added Responsibilities

There was still an obvious flaw. Not only does a tuning indicator require that attention be given to the process of tuning, but it also demands the possession and application of appreciable intelligence. To leave no remaining excuse for getting less than the best of which the set is capable, manufacturers are realising that they are responsible for correctly tuned sets, not with the co-operation of, but in spite of, their customers. Everything about a set has to be automatic—automatic volume control, automatic tone compensation, automatic selectivity con-

trol; and surely automatic tuning control, too. Although it may appear that I have been taking a cynical view of the public intelligence and outlook, I do think it is quite reasonable that receivers for general use should require no unnecessary effort or skill, however small, for operating them properly.

The effect of automatic tuning is that as soon as the fringe of one station is reached the set takes charge, pulls the tuning into the correct middle position, and keeps it there until the tuning

knob is turned so far as to get within the precincts of the next station. No matter how the user of the receiver may strive to do otherwise, there is always an expertly-tuned station or none at all.

This may seem very clever of the receiver; and so it is if it keeps on doing it without any visits from the service man. Unless the scheme has been soundly devised and carried out, an unfortunate possibility is that it may infallibly ensure the *incorrect* tuning of each and every station. How that may happen will be clearer when we have examined the method, or at least one of the methods.

We assume the superhet, in which the tuning *within the narrow band occupied*

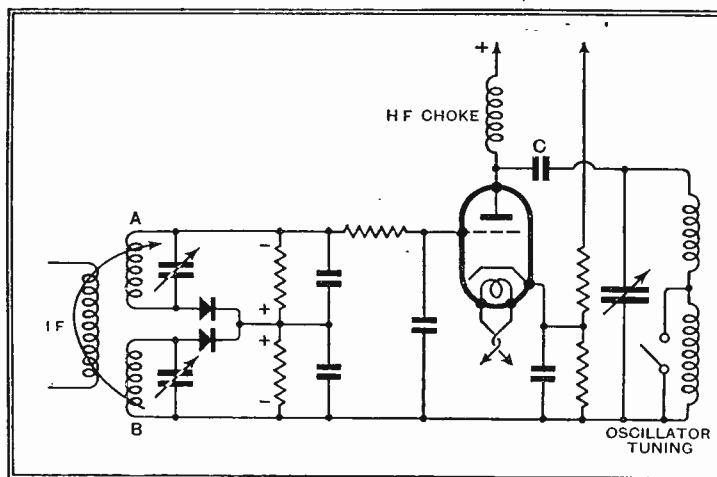
Control

might be, the set would always be slightly mistuned.)

The fairy comprises two halves, each consisting of a highly efficient tuned circuit (litz, iron core, etc.) feeding a rectifier. One tuned circuit A resonates at, say, 4kc/sec. below the intermediate frequency and the other B an equal amount above. Both are coupled to an IF circuit somewhere near the point where the second detector is also coupled. The rectifiers may be diodes or metal rectifiers, and the output resistances of each are connected in series in such a way that the rectified voltage due to one opposes that due to the other. Filters are interposed to cut out the IF component of voltage.

The two resistances form part of the grid circuit of a valve. The impedance of the valve depends, of course, on its grid bias, and therefore on the signals applied to A and B. Suppose there are no signals. Then there are no rectified voltages, and the grid bias of the valve is confined to

Schematic circuit diagram of one system of automatic tuning control.



that which may be arranged by means of the usual cathode resistor shown, which is chosen so that the condenser C is in series with a medium impedance. It therefore exerts less than its full effect on the oscillator frequency, which is then just in line with everything else, as it would (or should) be in an ordinary superhet.

by a station—9 kilocycles per second—is controlled mainly by that of the oscillator, and only to a minor degree by the pre-selector circuits. If then a very small variable condenser C were connected in parallel with the oscillator section of the main tuning condenser of the set, it would be possible for a good fairy to control this small condenser in such a way as to neutralise the slipshod tuning of the owner. (It would also be possible for a small demon using the same device to ensure that, however skilful the owner

Now assume that a station happens to be correctly tuned in. The circuits A and B, being adjusted to equal amounts above and below the frequency of the IF signal, are equally responsive and give rise to equal and opposite grid biases. These cancel out, and things remain as they were.

But now suppose that the receiver is slightly off tune, say, tuned to several kc/s high. The signal is too low in frequency for it, and circuit A is much more responsive than circuit B. The grid bias of the

* The Marconi "Straight Eight."

Automatic Tuning Control—

valve is made more negative, the impedance rises, the condenser C is therefore shut off from the oscillator circuit which now has less capacity and oscillates at a higher frequency, the frequency of the IF signal is thus raised and brought more nearly into tune. And vice versa throughout.

Although the tuning control by means of a valve in series with a condenser, as described, would work after a fashion, it is not the best method that has been devised; most practical ATC systems employ a rather more involved circuit in which, by feeding a signal to the grid of the control valve in different phase, an

artificial capacity of controllable amount is introduced into the oscillator tuning circuit.

If the receiver is mistuned so much as to be clear of that station, neither tuned circuit is very responsive, and the fairy does not work. It is open to be affected by any other station that it *does* happen to be near.

When a fairy loses its balance, so that A and B are not equally spaced from IF, it turns into a demon, and from the loud speaker all is wailing and gnashing of teeth. So people with screwdrivers who attempt to improve on the makers' adjustments may be given advice in the classic words, "Don't do it!"

on one set a station may be clear of serious interference while with the other it is almost blotted out.

World Broadcasts

ONE very important part of the work of the International Broadcasting Union has been the fostering of better understanding and better relations between nations. They began their task by promoting the exchange, by wireless or wired link, of concerts between various countries. At first the difficulties were very great. In Europe there were few "land lines" that would carry satisfactorily the big range of frequencies needed for music. This obstacle has been overcome by the pertinacity of the I.B.U., and there is now so wide a network of compensated and balanced lines that concerts can be relayed between almost any part of the Continent and any other. But mere European concerts were not enough. The radio link has now been so developed by mutual co-operation that world programmes are possible. We and other European countries have already exchanged programmes with the United States. During the next twelve months the I.B.U. sphere will become much wider. We are to have, for instance, concerts from the Argentine and the Dutch East Indies.

The Spoken Word

Music speaks an international language that is more or less intelligible to all listeners. But music, great though its influence may be, cannot go quite as far as one would wish in bringing about mutual understandings between the nations of the world. The spoken word is infinitely more potent. Unfortunately, no speaker, no matter what language he may use, can establish direct and intelligible contact with more than a fraction of the possible audience for a world broadcast. The language difficulty has for a long time seemed almost unsurmountable. The I.B.U. have been working for years on the problem, and they seem now to have found a possible solution. In future a big and representative man in some country is going to speak to the world each month. Translations of his speech into their own languages will be sent in advance to the broadcasting authorities in all countries interested. When the time for the talk arrives we shall hear parts of it direct from the speaker, and then the translation will be read from our stations. That seems to me something really big in the world aspect of broadcasting.

CLUB NEWS**The Croydon Radio Society**

An interesting lecture and demonstration on short-wave reception was recently given by Mr. H. L. Sulman at the Society's headquarters, St. Peter's Hall, Ledbury Road, South Croydon. Full details of the Society's activities can be obtained from Mr. E. L. Cumbers, 14, Campden Road, S. Croydon.

The Harco Radio Club

A radio club under the above title has been formed at Greenwich. Meetings are held every Thursday at 7.30 p.m. in the canteen lounge of G. A. Harvey and Co., Ltd., Woolwich Road, Charlton, S.E.7. The club has its own meeting rooms including a bar and also a car park. Trams No. 36, 38 and 40, and buses No. 53, 153 and 108 pass within a few yards. Morse instruction is given and the club is making arrangements to install its own transmitter and receiver. Intending members should get into touch with the Secretary at Department HRC, 124, River Way, Greenwich.

RANDOM RADIATIONS

A Television Suggestion

MORE than once the leading articles in the *Wireless World* have expressed regret that it should be found necessary to transmit by two quite different systems from the London Television Station. Both have already proved that they can provide reception of high entertainment value; then why continue this Siamese Twin experiment for two years? Here's an idea that occurred to me recently. A co-axial cable, all ready for television relays, has been installed between London and Birmingham. In the happiest event, as the Continental lottery circulars used to put it, it will take many months to build and install a new transmitting plant for Birmingham. London has two, either of which can fulfil all her needs. Then why should she "hog" both? Why not move one bodily to Birmingham? If this were done, the Midland television station could get under way pretty quickly.

The Aerial Question

NOT long ago I'd a word to say in these notes about people who handicapped good sets by using them with the poorest of indoor aerials. I've just been talking the matter over with a particularly live service man. He tells me that a very considerable proportion of his customers won't have outdoor aerials for one of two reasons or for both. The first is that they don't like the look of the mast and its halyards and wires; the second, that they jib at the expense of erecting the outdoor collector. There's probably a third reason, though he didn't mention it: not a few people are afraid of the outdoor aerial when thunder is about. It's quite unreasonable that they should be (I've found more than once that those who express such fears will ring you up on the telephone whilst the father and mother of a thunderstorm is raging overhead), but that's their feeling and there it is. In any event, we may take it as a solid fact that, for one reason or another, there's a very definite dislike of the outdoor aerial amongst ordinary listeners. Can anything be done to show them the error of their ways?

The N.B.C.'s Birthday Party

IT was good to hear "Uncle Arthur" Burrows speaking *via* the short waves from New York on the occasion of the National Broadcasting Company's tenth birthday. And some excellent jests he

By "DIALLIST"

made: "Twenty years ago I was writing on wireless; and I was able to do so with authority, because nobody knew anything about it," is a good sample. Ah, happy writers of yesteryear! To-day, if one drops inadvertently the smallest and most ethereal of bricks the postman arrives with a sackful of more-in-sorrow-than-in-anger letters from expert readers—and they've all got to be answered!

The broadcast of the N.B.C.'s birthday celebrations was a huge success. I listened to it almost from start to finish, and reception from W2XAD was remarkably strong and clear. M. Jardillier, the French Minister of Posts and Telegraphs, was the first speaker, and very good he was. He was introduced as the only Broadcasting Chief who conducts his own orchestra, and probably he is. But our Sir John Reith must have been one of the first to give a variety turn over the wireless. I wonder how many readers can tell me what the turn was, and when he did it! No prize is offered.

Comparative Tests

ONE of the most interesting experiences I know is to test out two sets against one another, using the same aerial and earth and working with a switching lay-out that enables you to go almost instantly from one to the other. In no other way can you see so readily the advantages and disadvantages of different circuits and other internal arrangements. A two-way switch-over system presents no great difficulties; you silence the set that you don't want to be in action at the moment by turning the volume control to its "minimum" position and leaving the valve heaters still in action if it's a mains receiver. Then it's only a matter of a couple of seconds to go over from one set to the other, both being tuned to the same station. The differences between various AVC systems, particularly on the short waves, are quite remarkable. Just before this note was written, for example, I was making odious comparisons between two sets in this way, W2XAD being the test station. With one, fading of the rather quick kind was much in evidence, with the other it was a comparatively steady signal. On all wavebands any differences in sensitivity and selectivity are brought out to the full in the way suggested. It's surprising, too, to find that

New Apparatus Reviewed

Recent Products of the Manufacturers

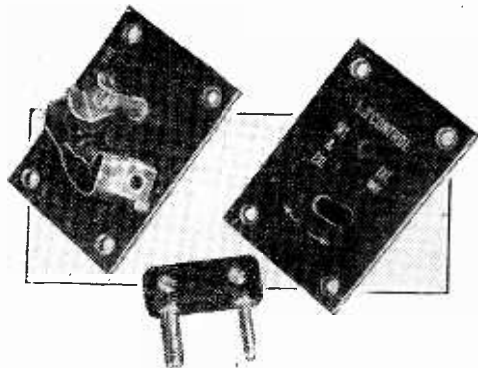
CLIX LS CONTROL PANEL

A USEFUL device for fitting to a receiver so that an external loud speaker may be used in conjunction with the internal one, or without it, or the internal loud speaker used alone, has been evolved by Lectro Linx, Ltd., 79a, Rochester Row, London, S.W.1.

It comprises a small socket panel in which a two-pin plug can be inserted, but, unlike the usual socket fitting, the plug can be turned a short distance to the left or to the right. One pin on the plug acts as the fulcrum about which the movement takes place.

Arranged behind this small panel is a set of contacts that open or close according to the position of the plug. They also close if the plug is withdrawn.

Thus by a slight alteration in the wiring of the receiver's loud speaker so as to include this switching device the various combinations of internal and external loud



Clix extension loud speaker fitting which embodies a switch.

speakers already mentioned become possible. The external loud speaker is connected to the two-pin plug. The price of this useful device is 1s.

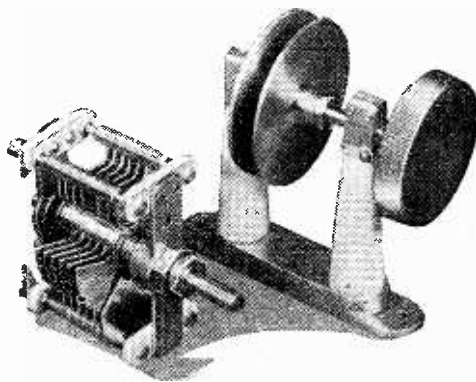
EDDYSTONE SHORT-WAVE CONDENSERS

THESE components, which are quite recent additions to the Eddystone range, are intended mainly for use in amateur transmitting apparatus, but as they are particularly well made and quite up to the standard of precision apparatus it will not be difficult to find many other uses for them.

The split stator condenser is in particular a most versatile component, as it provides the choice of three different maximum capacities, according to the way in which it is used.

Employed as a series-gap, or split stator condenser, its measured capacities are: minimum 3 m-mfds., and maximum 21 m-mfds. With a single section of the stator only in use it has capacities of 5 and 40 m-mfds. respectively. There was a small difference between the two sections, as the other side gave a minimum of 6 and a maximum of 41.5 m-mfds. Joining both stators together gives a condenser with a total capacity of 83.5 m-mfds. and a minimum of 11 m-mfds.

Both sets of fixed vanes are supported on Frequentite insulators, while the back bearing of the rotor is insulated from the brass cross-member, and contact is made to it by



Eddystone split stator and neutralising condensers.

a long enclosed pigtail. It is made of brass throughout, and all vanes are securely soldered. It is quite noiseless in use. The price is 12s. 6d.

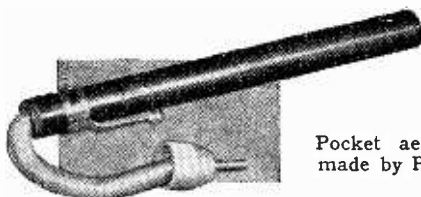
The other component is a small capacity condenser for neutralising RF power pentodes, or tetrodes, as used in short-wave transmitters. Two brass discs supported on insulating pillars form an air-spaced condenser with a capacity variation of from 2.6 to 12 m-mfds. One disc only is movable, and this is supported in a split bearing that is entirely free from backlash.

It costs 12s. 6d., and the makers are Stratton & Co., Ltd., Eddystone Works, Bromsgrove Street, Birmingham, 5.

PYE POCKET AERIAL

THIS aerial has been evolved for those who require something really portable and at the same time quickly and simply erected. It is, of course, equally suitable for a semi-permanent installation.

The aerial is a spiral of thin wire that is normally housed in an ebonite tube fitted with a screw-on cap to which is attached a split plug joined to one end of the aerial. It is anchored at the other end to the inside of the tube, and when fully extended will stretch to about 16ft. A clip for securing the tube to any convenient object is fitted.



Pocket aerial made by Pye.

This Pye aerial is as efficient as any other type of equivalent length, and the ease with which it can be erected and dismantled will be a great advantage whenever a portable set is taken from place to place. Though it has been opened out to its full extent several

times the wire has always returned easily and accurately to its holder on releasing the tension.

This useful device is made by Pye Radio Ltd., Radio Works, Cambridge, and it costs 2s. 6d.

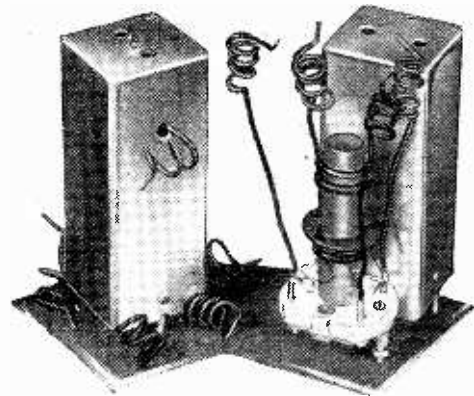
RAYMART VARIABLE SELECTIVITY IF TRANSFORMERS

MEANS for varying the selectivity, or band width, of the IF amplifier is a valuable feature in any superheterodyne receiver, as it enables high quality reproduction to be obtained from the local and other stations when the adjacent channels are not occupied by high-powered broadcasters.

High selectivity is also needed on the short waves, yet there are times when a wider band width could be tolerated with the advantage of improved quality in reproduction.

This variable feature is sometimes obtained by using transformers having one coil movable by a mechanical device, but it can also be achieved by an electrical change in the constants of the transformer.

The latter system is adopted in the Raymart IF Transformer Kit. This consists of two units, one a fixed-coupled pair for a frequency of 465 kc/s and the other a variable selectivity unit in which the band width can be changed from narrow to wide by a simple switching arrangement. This is effected by inserting a small coupling coil in series with the secondary circuit, but winding it over the primary coil. It is brought in, or removed from, the circuit by the switch.



Raymart Variable-selectivity IF kit.

Tests made with this kit show that the high-selectivity condition provides adequate sharpness of tuning for all normal requirements on the broadcast and short wavebands.

The low-selectivity position of the switch approximately doubles the frequency response of the IF amplifier and allows reproduction up to 10 kc/s off resonance without an appreciable reduction in the output. Of course, the overall selectivity of the set will be governed by the "goodness" of any RF stages that may be used, but our tests were concerned only with the IF units.

A point of interest regarding the variable-selectivity unit is that, in the low-selectivity position, the response band opened out symmetrically about the resonant frequency.

The design of these transformers is based on American practice. They are obtainable from the Raymart Manufacturing Co., 44, Holloway Head, Birmingham, and cost 15s. the pair.

South Africa Receives Alexandra Palace

ONCE again the seemingly impossible in radio has happened. We publish on this page a report from Mr. Pleass, of Johannesburg—in response to our cable—giving definite evidence of his reception (briefly reported in *The Morning Post* recently) of the sound transmissions from Alexandra Palace on 41.5 megacycles (6.67 metres).

It is true that carefully guarded statements issued by the B.B.C. have, quite rightly, stressed that the "guaranteed" service area of the television transmission would be limited to a circle having a radius of 25 miles from the Alexandra Palace, owing to the quasi-optical nature of direct ray transmissions on these high frequencies.

Only a few enthusiasts, however, seem to have envisaged that under suitable conditions and in certain directions indirect-ray propagation might be possible, and this latter possibility is now substantially proved.

Not only is indirect-ray transmission on 41.5 megacycles to Africa proved to be possible but consistently possible, more especially so when one remembers that a 7½-year-old three-valve straight receiver, without R.F. stages, and a 3 kW omni-directional transmitter are being used. True, we are still a long way from transmitting television pictures to South Africa, but all things must have a beginning.

The two greatest difficulties in the way of the establishment of an indirect-ray tele-

vision service are, of course, fading and multiple-ray reception, the first causing synchronisation difficulties and the second ghost images (and possibly further synchronisation troubles).

The work of T. L. Eckersley, of the Marconi Company, on the transmission of high-speed facsimile pictures (first cousin to television) to Cape Town has shown, on the other hand, that results become progressively better as the carrier frequency is increased. It is also possible, of course, on these high frequencies to build arrays for both transmission and reception, which provide very large power gains and have very sharp diagrams on both vertical and horizontal planes. It would also appear to be a not insuperable difficulty to provide time bases which will maintain their stability during short fade periods.

Theoretical considerations show that Africa is very favourably placed for ultra-high-frequency reception from England during the noon and afternoon period, and, what is still more fascinating, it is also favourably placed for retransmission on the ultra-high frequencies to other parts of the Empire.

Therefore, looking firmly ahead with truly Wellsian courage, we see in South Africa a future centre of activity retransmitting scenes of daily events in the Empire's capital to members of the British Commonwealth of Nations in the remotest parts of the earth.

"harmonics" from commercial stations and local experimenters. Eventually I overheard music and a lady's voice saying: "Good morning, everybody; this is the B.B.C., Alexandra Palace, London." This was at 11.03 G.M.T. on October 13th, and the announcement was followed by talks on (1) Poems, (2) Dartboards—red elm wood being mentioned as suitable. In the description of the latter mention was made of the "divisions being corded with wire, circular and V-shaped. The scoring numbers being fixed by his (the constructor's) expert fingers in a minute and a half."

On October 15th I again listened about 12.00 G.M.T. and heard quite clear music, which apparently was used as a background as speech was heard also, reference being made to the Armada and Dutch War. Later a remark "about coolies loading ships—a mighty work dedicated to seamanship—over two million tons of fruit being imported—the docks at Southampton being framed in forty miles of railway—conveying express and goods trains," etc.

At 12.09 G.M.T. a lady spoke and mentioned "the Baird system and that the station was closing down until three o'clock for further transmission. Good-bye until then."

On October 20th I was listening on the 5-metre band and was astonished at the "harmonics" in evidence. CW signals were recorded at 14.42 G.M.T. "CQ DX de ZU6C" 20-metre fundamental. At 15.03 G.M.T. "CQ de ZU6P" (10-metre fundamental), and at 15.57 G.M.T. "CQ de ZS6D"

(40-metre fundamental). The tit-bit of the afternoon was a call ZS2P de W.6 IRD at 15.40 G.M.T. (California on 5 metres!). I have received confirmation that the latter station was on 20 metres. Such signals can only come under the term "freaks," but it only goes to show what is going on around us.

On October 22nd at 11.38 G.M.T. the London Television sound transmitting station was again in evidence and an aeroplane flight was being broadcast. The announcer mentioned about the lovely hills and valleys being flown over, and mentioned San Francisco. Music was, as usual, in the background. At 11.58 G.M.T. a lady spoke about damsels and favourite smokes; also about "well-shaped shoulders before the winter is out." I could not follow this item too clearly owing to QSC. This was followed by a record of a championship fight with "the champion doing all the attacking." The shouts of the spectators could be clearly heard in the background. Mention was then made about a shipping disaster and that there was "no suggestion of a collision." Then followed an announcement that at Portsmouth the celebration had taken place of the greatest naval victory in history—with the H.M.S. Victory.

On October 23rd, at 15.15 G.M.T., Mr. Seymour Marks was introduced. A talk dealing with china ornaments—dragons, etc., was heard, this being from Leicester Square.

On October 26th, at 12.10 G.M.T., two piano solos were received. The sharp staccato notes of the piano were noticeably strong. Very little speech was recordable at this transmission. The "carrier" was erratic and appeared to be creeping and fluctuating, due possibly to conditions between the transmitter and receiving stations.

On October 27th speech was fairly clear, and mention was made about the highest mountain in the world. An aeroplane flight by the Royal Air Force, Karachi, over the Himalayas was described. Mention was also made regarding the weight of the machine; "40 lbs. under guarantee," "splendid," said one speaker. He mentioned "that the plane was still climbing and well above —." "The second stage of the flight now begins, and for the first time man is to look around on the face of the earth." "Yes," continued the speaker, "they must be pretty near it now—battling against adverse winds at one hundred miles per hour." What sounded like a propeller revolving was heard occasionally and a voice, muffled, shouting out orders, but I could not quite follow the remarks in this transmission.

At 11.50 G.M.T. the following remark was clearly heard, and was the best recorded by me to date: "Wales is supposed to have the prettiest milkmaids." "Do you agree with the judges?" The carrier continued until 12.09, but without modulation, and ceased at this time.

Conditions were unfavourable on October 28th and faint music only could be heard at 11.50 G.M.T. (My aerial was noisy—strong winds.)

The foregoing, although not what can be called "technical," indicates more or less the items picked up on my Pilot Wasp.

I should esteem it a favour if you would convey the broadcasted items to the B.B.C. Alexandra Palace for their information. Thank you.

S. C. PLEASS (ZT6K),
"Pinecote," Bramley, Johannesburg.

October 29th, 1936.

LOG OF RECEPTION

The Report is presented just as it was received from Mr. Pleass

YOUR cable of October 27th was duly received.

I note you ask for full "technical" story. There is none. I have simply adapted the "Pilot Wasp" receiver (0-V-2), battery model, with home-made coils to oscillate on the higher frequencies, in the neighbourhood of 56 Mc/s. The receiver in question was purchased locally about seven and a half years ago, and has, and is, serving me faithfully in my experimental work. Actually the coils supplied with the set covered wavelengths from 17 to 500 metres, but it was not at all a difficult matter to obtain oscillation at 28 Mc/s (10 metres). I have, in fact, worked all continents (WAC) on 10 metres. Having succeeded in getting good phone and CW signals on 10 metres I set about making coils in an endeavour to record CW on the 56 Mc/s (5 metres) band. This I achieved on April 29th, 1934—ZT6C (O. M. Owen) of this city put out a message on CW which I copied solid.

From the foregoing you will understand that having logged 5- and 10-metre signals it should not be difficult to intercept anything going on 7 metres.

A few weeks ago I began making coils to cover the latter frequency, and in the absence of a wavemeter had to rely on

Wayfarer Major Portable

THE original "Wayfarer" reviewed in this journal on October 11th, 1935, was a severely practical instrument with no great pretence to good looks. Its performance, however, was undoubtedly good, and it is gratifying to know that its salient technical features, with one or two notable additions, have been retained in the new Major model.

The set is housed in a well-proportioned cabinet of the "vertical" type, and the ornamentation of the loud speaker grille is both simple and effective. The controls are concealed under a lid on the top of the cabinet, and a lock has been provided, with an ingenious safety catch designed to prevent the removal of the back panel, to prevent unauthorised interference with any part of the set.

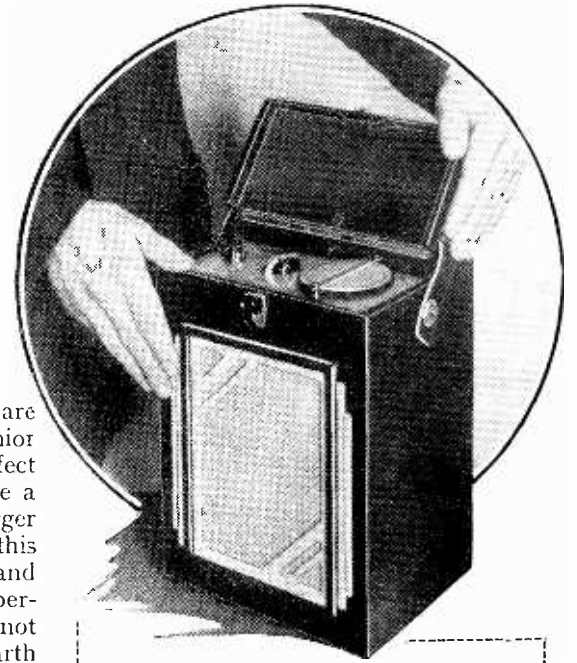
Instead of the independent solid dielectric tuning condensers operated by concentric controls used in the original model, there is an air dielectric two-gang condenser controlled by a 3-inch knurled disc which carries on its face the wavelength-calibrated scales and station names. This dial is bridged by a celluloid cursor which is very easy to read. The two remaining controls are volume (reaction) and the combined waverange and on-off switch.

The dimensions of the cabinet are appreciably larger than that of the Junior model, and this is not without its effect upon the performance of the set, since a frame aerial of correspondingly larger area is possible. The advantage of this is most apparent on the long waves, and on this range there is nothing in the performance to indicate that the set is not working on an outdoor aerial and earth system. In Central London stations such as Hilversum, Radio-Paris and Luxembourg were received at full strength with the volume control in the minimum position, and in the case of Droitwich use had to be made of the directional properties of the frame to

prevent overloading of the output stage. With slight reaction the Air Ministry weather reports came in exceptionally clearly, and by rotating the set into the

position of minimum signal strength from Droitwich the Deutschlandsender was satisfactorily received without having to call on critical adjustment of the reaction control. On the medium waveband the directional properties of the frame had once again to be called into use as a volume control in the case of the London Regional transmitter, but the National programme required slight reaction to

A Four-valve Battery Receiver with Moving-coil Loud Speaker



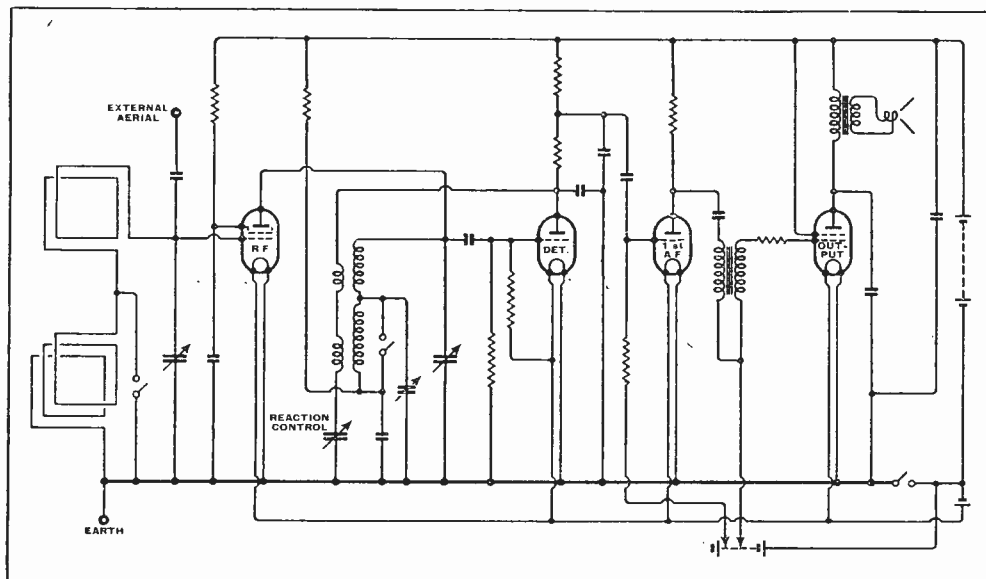
FEATURES.— **Circuit.**— Screened-grid RF amplifier—triode grid detector with reaction—triode AF amplifier—tetrode output valve. **Controls.**—(1) Tuning. (2) Volume (reaction). (3) Wave-range and on-off switch. **Price.**— 7 guineas. **Makers.**— London Electric Appliances Ltd., 62, Glengall Road, Old Kent Road, London, S.E.15.

bring the volume up to the level required for best results from the moving-coil loud speaker. One or two Continental stations were successfully tuned-in on the medium waveband during daylight, but for long-distance reception there is little doubt that the long waves provide the best results under daylight conditions.

The output with the HT voltage available is rated by the makers at 150 milliwatts, so that the volume must be kept at a moderate level if distortion is to be avoided. On certain types of transmission, however, a considerably higher volume level can be employed without audible evidence of overloading.

A Straightforward Circuit

In its earlier stages the circuit follows closely the arrangement of the original "Wayfarer." A screened-grid RF amplifier with tuned anode coupling precedes a leaky grid triode rectifier. In the latter stage dual grid leaks are now provided to fix the mean grid potential at a point mid-way between positive and negative LT. Another alteration is to be found in the substitution of a resistance for the HF choke previously employed in the anode circuit. The first AF amplifier is a triode, resistance-coupled to the detector, and it is followed by parallel-fed transformer coupling to the output stage. The valve employed here is a tetrode, in which pentode characteristics have been achieved by critical spacing of the electrodes.

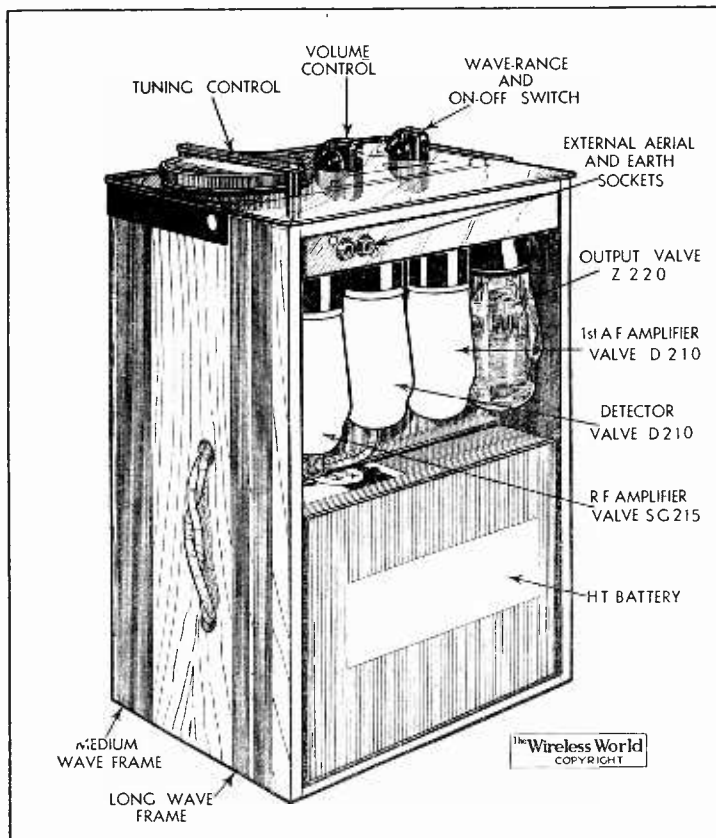


The circuit is notable for the use of a Harries tetrode valve in the output stage.

Wayfarer Major Portable—

It will be seen from the sketch of the chassis that the valves are inverted, but there is little chance of their being displaced as the valve-holder sockets maintain an exceptionally firm grip on the pins. The medium- and long-wave aerial windings are well separated, and the turns of the medium-wave coil are space-wound. To obtain access to the LT accumulator it is necessary first of all to remove the HT battery. In the particular model tested this battery was rather a tight fit in the case and some scheme might well have been adopted to facilitate withdrawal. The user is not, however, troubled with HT plugs and sockets as spring contacts are provided to

Removal of the HT battery, which is provided with spring contacts, gives access to the LT and grid bias batteries.



was reduced to 6 mA. by increasing the bias to $-4\frac{1}{2}$ v. with a barely perceptible deterioration in quality at the optimum output level. The LT accumulator is a really useful size, having a capacity of 15 ampere-hours, and as the measured LT

consumption was a fraction over 0.5 amp. the service on a single charge should be very little less than thirty hours.

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connect with the terminal strips on the specially designed battery when this is pushed fully home. The HT battery, incidentally, is of standard capacity and has a rated voltage of 70.

The measured HT consumption with the makers' recommended bias for the output stage of -3 v. was 8.5 mA., but this

consumption was a fraction over 0.5 amp. the service on a single charge should be very little less than thirty hours.

The total weight of the set is only 14 lb., and the dimensions of the case are $12\frac{1}{4}$ in. high, $8\frac{1}{2}$ in. wide and $6\frac{3}{4}$ in. deep. The leather cloth covering material is available in a choice of seven colours, the standard being black with cream loud-speaker fret.

Letters to the Editor

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

What is a Wireless Engineer?

AS one who has been concerned with the education and training of the wireless engineer and technician for the past fifteen years, I was interested in your recent editorial dealing with technical education and with your query, "What is a Wireless Engineer?"

It is, unfortunately, true that in the past there has been considerable confusion as to the necessary training and desirable qualifications for the radio engineer, and in particular for the radio service man. I think we may say to-day, however, that very excellent courses of training exist for all branches of the radio industry, not excepting radio service work, and that nationally recognised qualifications are obtainable, and as these do not seem to be generally known, you, Sir, and your readers may be interested in a brief outline.

For the young man who can afford the

time and who has been educated to the School Certificate standard, the best proposition is to take a full-time course in telecommunications extending over a period of three years, in which time he is prepared for the National Diploma in Radio Engineering and/or for the B.Sc. degree in engineering. In the latter case he must have matriculated before entering on the course. The National Diploma is awarded by the Institution of Electrical Engineers in conjunction with the Board of Education, and the examination papers in all subjects at the end of the course, although set by the technical institution at which the student is receiving his training, are approved by external assessors, as is also the marking of the papers.

In this manner uniformity is secured throughout the country and the prospective employer is assured that the trainee has at least reached a definite minimum stan-

me that these qualifying letters could be obtained by people who did *not* know what they were talking about and, having a conscience, I felt that I could not go on with it and, therefore, dropped them.

At the other extreme, there are two well-known institutions, both of which fall under your adjectival description, "die-hards," and, although it is some time ago since I made an attempt to fill up their application forms, I found that it was practically impossible for me to do so, one reason being the war years, for which it is difficult to obtain continuity. In one particular case, you may be surprised to learn that I ran round for a whole week in the evenings of summer days some years ago trying to get corporate members of one institution to propose and second me, but while I could get signatures underneath I could get nobody to take the risk of putting their name at the top.

There must be hundreds like myself who came out of the Army, Navy and Air Force, where they were trained or partly trained as wireless engineers, and entered the industry and have worked in it since, that, like me, have no qualifications of a standard available to other professions, which is a guarantee of their status.

Having worked, therefore, in wireless since I was twenty, I should like to be considered a wireless engineer before I die, so that if such a standard is set and agreed amongst the instructional bodies I should seriously consider taking the examination if it were in my power.

Staines, Middlesex. FRANK BOYCE.

MAY one quite individual answer be suggested? He is first of all a physicist, understands a little mathematics, something about crowd psychology, and, lastly, a man of practical experience in one or more definite branches of radio communication. Those with the final qualification are easily distinguishable, and they can, to a certain extent, look after themselves. The most that examination results can demonstrate is that the student is on sound lines and intends to devote his life (to use an Americanism) to the Radio Art; it is only fair to show him the right track. One supposes that those actively engaged in the industry know the type of man they need as an assistant; wish, in spite of keen competition, to make his remuneration sufficiently attractive, and progress themselves, leaving vacancies for the juniors. They will, therefore, fit themselves for higher posts. The success of the older-established engineering institutes has been partly due to the able administration of those who have given their time and experience unstintingly to the training of future generations. Those public-spirited wireless engineers who now come forward—as they will—to organise the professional personnel of the industry will not only be encouraging a much-needed reform, but will by example show that these are men worthy of high administrative posts in the ranks of radio engineers. Automatically they will be entitled to occupy those top positions to the exclusion of all other claimants, even, one dares to say, those of the sales department. It is our English way to do things slowly, almost to pretend that we are not doing them at all. I believe the work is going on, and we should be grateful for the acceleration. You, Sir, will give by your characteristically generous appreciation of the problem.

Ware, Herts. GERALD SAYERS.

Television Aerials

IN reply to Mr. Gordon Finlay's letter in your issue of November 13th, I must thank him for his discussion concerning the tendency for an inversion of equatorial polar characteristics of a horizontal dipole when presented to vertically polarised transmissions.

It is unfortunate, however, that the suggestion put forward by your correspondent does not account for the phenomenon.

The feeder used was a 75-ohm twin pair which we have specially developed for

centre-fed dipoles. This feeder was terminated on a two-turn centre tapped coil and balanced to earth for any asymmetrical field.

To test for the accuracy of balance the aerial end of the feeder was disconnected from the aerial proper, and connected to a small 75-ohm Eric resistor, substantially non-inductive). In these circumstances the pick-up of either the vision or sound channel was negligible, and had the effect noted been due to any asymmetric behaviour on the part of the feeder, the voltage thus picked up would have been of sufficient magnitude to have been added directly to the normal polar pattern, and thus give the inverted pattern.

I believe that the effect is due to the formation of earth images, and in the case where the wave front is slightly tilted it will produce the effect we have noted.

I am working on this theory and will possibly be able to give the results in a further letter.

BELLING & LEE, LTD.
F. R. W. Stafford,
Chief Research Engineer.

Television Programmes

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

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

FRIDAY, NOVEMBER 27th.
(Marconi-E.M.I.)

- 3.5, Two Animal Shows: Bird and Aquaria Show and Cat Club. 3.25, Movietone Magic Carpets: "Diamonds in the Rough." 3.40, Draper and Shires: exponents of the dance.
- 9.5, Two Animal Shows. 9.25, Movietone Magic Carpets: "Happy Days in the Tyrol." 9.40, Geraldine and Joe: juvenile dancers, and Van Deck: comedy quick-fire cartoonist.

SATURDAY, NOVEMBER 28th.
(Marconi-E.M.I.)

- 3.5, The Handyman: repairing a broken window. 3.20, Movietone Magic Carpets: "Happy Days in the Tyrol." 3.30, Fifteen-foot model of Coronation Procession. 3.45, Cabaret: the Avlon Four (skaters).
- 9.5, Tap Dancers. 9.20, Movietone Magic Carpets: "Diamonds in the Rough." 9.30, The Handyman. 9.45, Coronation Procession.

MONDAY, NOVEMBER 30th.
(Baird.)

- 3.5, James McPhee (tenor) and pipers of The London Scottish. 3.20, Movietone Magic Carpets: "All is Safely Gathered In." 3.35, Scenes from the Royalty Theatre production of "Marigold."
- 9.5, Repetition of 3.5 programme. 9.20, British Movietone News. 9.30, Scenes from "Marigold."

TUESDAY, DECEMBER 1st.
(Baird.)

- 3.5, Hand-sewn Shoes—demonstration of shoe-making. 3.25, British Movietone News. 3.40, Stories of the Canadian West told by "Snowshoe." 3.45, Bowyer and Ravol: ballroom and acrobatic dancers.
- 9.5, Repetition of 3.5 programme. 9.25, Film: "All is Safely Gathered In." 9.40, Repetition of 3.40 programme. 9.45, Anne Ziegler and Gilbert Webster (xylophone).

WEDNESDAY, DECEMBER 2nd.
(Baird.)

- 3.5, The Two Leslies. 3.20, Film: "All is Safely Gathered In." 3.35, Ninth Picture Page: the Switchboard Girl.
- 9.5, Physical Training Display: Instructors of the Army School of Physical Training. 9.25, British Movietone News. 9.40, Stories of the Canadian West. 9.45, Albert Sandler.

THURSDAY, DECEMBER 3rd.
(Baird.)

- 3.5, The Crown Jewels: Display of Duplicates of Collection in the Tower of London. 3.20, British Movietone News. 3.30, Ballet.
- 9.5, The Crown Jewels. 9.20, Film: "All is Safely Gathered In." 9.30, Ballet.

Multi-valve Receivers

LARGE receivers of the American type will never have much sale while the prices of valves remain as at present.

The cost of replacement of the eighteen valves in a certain U.S.A. receiver is £6 2s. 6d., as given by the London branch. The cost of eighteen English valves is somewhere in the neighbourhood of £16.

Chichester, Sussex.
W. W. WOODMAN.

Hong Kong S.W. Transmitter

IT may be of interest to your many readers in various parts of the world to know that a new modern short-wave broadcast transmitter has been installed and is now operating in Hong Kong.

The new transmitter is of 2.0 to 2.6 kW aerial power and replaces a small experimental transmitter of only 0.5 kW aerial power, but which was, nevertheless, heard well even in countries most distant from Hong Kong.

The new transmitter is designed to transmit on any one of four defined frequencies. The selection of these will be governed by seasonal conditions, and the particular frequency in use will be indicated by the call-sign as follows:—

ZBW2	..	6,090 kc/s	..	49.26 m.
ZBW3	..	9,525 "	..	31.49 m.
ZBW4	..	15,190 "	..	19.75 m.
ZBW5	..	17,755 "	..	16.90 m.

The hours of transmission are (H.K. time):—

- Mon., 12.30-2.15 p.m., 5-11 p.m.
- Tues., 12.30-2.15 p.m., 4-11 p.m.
- Wed., 12.30-2.15 p.m., 4-11 p.m.
- Thurs., 12.30-2.15 p.m., 5-11 p.m.
- Fri., 12.30-2.15 p.m., 4-11 p.m.
- Sat., 12.30-2.15 p.m., 4-12 p.m.
- Sun., 10.00 a.m.-2.30 p.m., 4-10.30 p.m.

Both European and Chinese programmes are broadcast.

Hong Kong time is eight hours ahead of G.M.T., and our evening transmissions are, therefore, at an awkward time for European reception, but if any of your readers there or elsewhere pick us up, their reports, either direct or through the medium of your pages, would be appreciated.

Hong Kong. W. J. CARRIE,
Postmaster-General.

Listeners' Guide for

Outstanding Broadcasts at Home and Abroad



DICKENSIAN. Albert Coates, the composer of the opera "Pickwick," running through the score with William Parsons who takes the name role. This new opera comes into the National programme on Monday.

DEDICATED to "Lovers of Dickens all over the world," Albert Coates' new three-act opera, "Pickwick," which had its première under the patronage of His Royal Highness the Duke of Kent at the Royal Opera House, Covent Garden, on November 20th, provides a relay for National listeners on Monday at 8. This new work has been described as *The Pickwick Papers* set to music, for every word of the libretto is taken from that famous work of Dickens. It is a happy coincidence that it should be first produced in the centenary year of the publication of the *Papers*.

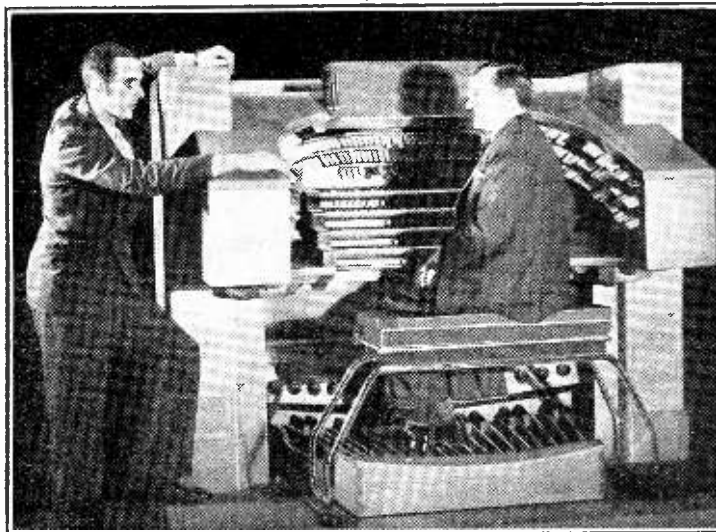
The first act, which is the only one being broadcast, opens with the Pickwickians at the Rochester manoeuvres. Then follows the visit to Wardle's home, Dingley Dell, Jingle's elopement with Rachel and ends with Sam Weller's appearance at the George Inn.

The new British Music Drama Opera Company are producing this, and among the principals are William Parsons (Pickwick), Dennis Noble (Sam Weller), Samuel Worthington (Wardle) and Enid Cruickshank (Aunt Rachel). Albert Coates will conduct the London Symphony Orchestra.

WHITEHALL ONE-TWO-ONE-TWO

LAURENCE GILLIAM, who is in charge of feature programmes, will produce another in the series depicting public services. He has already given us, among others, "Underground," "G a l e Warning" and "Cable Ship," and now, as no doubt you have guessed from the head-

ing, he is to deal with life in the police force with special reference to Scotland Yard. The programme, which will be broadcast at 9.40 on Sunday (Nat.) and 8 on Tuesday (Reg.), is divided into four sections, namely, the history of the Metropolitan Police; sound picture of methods by which a recruit for the Metropolitan Police is trained; examples of the varied nature of modern police work, including recordings and descriptions of the work of the mounted and river police, the C.I.D., and the Flying Squad, and the final section will depict the London policeman off duty.



REGINALD FOORT at the console of the Theatre Organ in conversation with Eric Maschwitz, Director of Variety. The organ's effects will be demonstrated by Reginald Foort in the variety programme at 8.15 (Reg.) on Wednesday.

PIANOFORTE

It is a good test for quality in a receiver for it to faithfully reproduce pianoforte music and ample opportunity for such tests are afforded this week.

In the Special Recital Series for the current week Busoni's

Pianoforte Music will be played by Egon Petri. These recitals are to be given on Sunday at 4 (Reg.), and Nationally on Tuesday at 6.25, Wednesday at 10.45, Thursday at 6.40 and Friday, December 4th.

During the recital by Pierre Bernac (tenor) and Francis Poulncé (piano) on Tuesday at 9.55 (Nat.), the latter will give a first performance of his new work, "Les Soirées de Nazelles."

The seventh Sunday Studio Orchestral Concert will be conducted by Julian Clifford and Solomon will play the Mozart Pianoforte Concerto No. 17.

CONCERTS

ELGAR'S "The Dream of Gerontius," which has not been broadcast in London since 1931, will fill the programme of the fifth B.B.C. Symphony Concert at the Queen's Hall on Wednesday. The work will be conducted by Adrian Boult and sung by the B.B.C. Choral Society, the soloists being Muriel Brun-

Thursday at 7.30 and 8.40 (Reg.). The programme includes Elgar's Overture "Cockaigne" and the suite "Façade" by William Walton.

FROM SEASIDE CONCERT PARTIES

THE theatre organ will, for the first time, be used to accompany a variety show on Wednesday, when Harry S. Pepper and John Watt produce a programme at 8.15 (Reg.) featuring concert party artistes discovered by Harry Pepper and Davy Burnaby during their tours for the series "From the Seaside."

John Watt will introduce each artiste, telling how and where he or she was discovered.

For the inaugural broadcast of the theatre organ, John Watt and Reginald Foort were to have combined in demonstrating the multitudinous effects of the organ, but this had to be cut out of the programme. It will be introduced into this show with John Watt telling a heartrending story, while Reginald Foort does his best to produce the effects at the organ.

ST. ANDREW'S DAY

THE spirit of St. Andrew's Day is to be maintained in the programmes on Monday when Edwin Muir, the distinguished Scottish writer, gives expression to his thoughts in a personal way on what Scotland means to him. He has compiled from literature, linking the passages with his own poetry, a document that should impress listeners in a way which has probably never been done before on St. Andrew's Day.

On Sunday a Scottish service from St. Columba's, Pont Street, will be broadcast at 3, when the Rev. Archibald Fleming will preach and the lesson will be read by the Rt. Hon. W. S. Morrison.

Details of the week's Television programmes will be found on p. 579.

the Week

GUARDS' BANDS

LOVERS of military band music will want to tune to the National wavelength on Saturday at 8.15 to hear the massed bands of His Majesty's Coldstream, Scots, Irish and Welsh Guards from the concert at the Alexandra Palace. The last item in the programme is Tchaikovsky's 1812 Overture.



PEELERS. Many changes in the Police Force have taken place since policemen wore a uniform with toppers like this. On the left 20th century policemen are making an arrest during disturbances at the Ministry of Labour. The programme featuring the Police Force should be well worth tuning in.

OPERA FROM ABROAD

OPERA lovers have a wide choice of productions from the Continent. To-night, from the State Opera, Prague relays a Czech opera evening at 6.30 with one-act opéras-comiques, "The Pig-headed Peasants" (Dvorák) and "In the Well" (Blodek).

From Paris PTT and other French Regional stations will be heard on Friday at 8.30 Schiller's great trilogy "I Piccolomini," "Wallenstein's Camp" and "Wallenstein's Death," performed by the Comédie Française Players. In its entirety this work would take about eight hours, but it has been compressed into about two-and-a-half hours for broadcasting.

Saturday's principal opera broadcast consists of Verdi's "Aïda" from Rome at 7.45. From Radio Paris at 8.45 on the same evening comes "Antar" by Gabriel Dupont, a French composer who died

in 1914. This sumptuous work, full of life and colour, was his swan song.

A matinée performance of Puccini's immortal "La Bohème" will be given by Paris PTT from 1.30 to 4.45 on Sunday. The same day brings Humperdinck's fairy opera, "Hansel and Gretel," from Berlin (Funkstunde) at 7 and Wagner's "Valkyrie," relayed from the Dresden Opera by Leipzig, at 5. Busoni's "Turandot" comes from Milan at 7.45 on Sunday, and from Rome at the same time on Tuesday. Thursday brings Puccini's tragic opera "La Tosca" from Milan at 8.

BERLIN RESTAURANTS

THE bands of five different Berlin restaurants are to be included in a special series of relays to be broadcast from Berlin from 7.10 to 9 on Thursday. This will afford a good opportunity to hear a

HIGHLIGHTS OF THE WEEK

FRIDAY, NOVEMBER 27th.

Nat., 6.25, Violin Recital: Max Rostal. 7.20, Scottish Dance Music: The Strings of the B.B.C. Scottish Orchestra. 8 The Kentucky Minstrels.

Reg., 6, The B.B.C. Dance Orchestra. 8, G. D. Cunningham at the B.B.C. Concert Organ. 8.45, "The Vagabond King."

Abroad.

Leipzig, 7.5, Winter Relief Fund Concert, by the Dresden Philharmonic.

SATURDAY, NOVEMBER 28th.

Nat., 6.45, Mantovani and his Dance Orchestra. 7.30, "In Town Tonight." 8.15, Massed Bands from the Alexandra Palace. 9.20, Music Hall.

Reg., 2.30, "La Bohème" from Sadler's Wells. 4.15, Kentucky Minstrels. 6, The Walford Hyden Magyar Orchestra. 8.20, The British Women's Symphony Orchestra.

Abroad.

Brussels 1, 8, Concert by the "Musique des Guides" from the Conservatoire.

SUNDAY, NOVEMBER 29th.

Nat. 4.20, Eugene Pini and his Tango Orchestra. 5.20, Comic Opera in Beethoven's Time presented by the Opera Group. 8, The Archbishop of Canterbury at Concert Hall Service. 9.40, Scotland Yard Feature Programme.

Reg., 5, B.B.C. Military Band and Mischel Cherniavsky (cello). 6.20, Concert from Prague. 9.5 Sunday Orchestral Concert. 7.

Abroad.

Leipzig, 5, "The Valkyrie" from the State Opera, Dresden.

MONDAY, NOVEMBER 30th.

Nat., 6.40, B.B.C. Singers (A) and Albert Boorsanger (violin). 7.20, Entertainment Parade. 5, "Savoy Orpheans. 9.35, St. Andrew's Day Programme.

Reg., 6, Reginald King and his Orchestra. 8, "Pickwick" from Covent Garden. "B.B.C. Theatre Orchestra and the Gresham Singers.

Abroad.

Kalundborg, 8, Mozart. Schubert, Rimsky-Korsakov Concert.

TUESDAY, DECEMBER 1st.

Nat., 8, Van Phillips and his Two Orchestras. 8.30, Guitar Recital: Emilio Pujol and Matilde Cuevas.

Reg., 6, B.B.C. Military Band and Samuel Worthington. 7.30, Esta Stein's Yiddish Chauve Souris Company and Jewish Male Choir. 8, Scotland Yard Feature Programme.

Abroad.

Paris PTT, 8.30, Ravel Concert from the Salle Gaveau.

WEDNESDAY, DECEMBER 2nd.

Nat., 7 Violin Recital: Alfredo Campoli. "Jack Hylton and his Band. 8.15 and 9.20, Symphony Concert from the Queen's Hall.

Reg. 3.15, International Football Match: England v. Hungary. 7.20, Students' Songs. 8.15, Variety.

Abroad.

Brussels 1, 8, Prokofiev Concert.

THURSDAY, DECEMBER 3rd.

Nat., 5.15, Harry Roy and his Band. 6.20, This Way Out: John Hilton. "Away to the Hills": Musical Play.

Reg., 6, B.B.C. Dance Orchestra. 6.40, From the London Theatre. 7.30 and 8.40, Hallé Concert from Manchester. "The Alfredo Campoli Trio.

Abroad.

Bucharest, 7.15, Bucharest Philharmonic from the Atheneum (relayed by Brasov).

representative programme by German dance bands.

SAXOPHONE

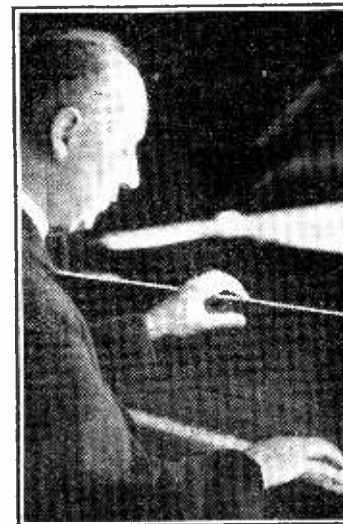
THE famous Danish exponent of classical music on the saxophone, Sigurd M. Rascher, who was heard from the Proms. in September, will play from 8 to 8.25 in the Kalundborg programme on Sunday.

NORTHERN MUSIC

WORKS of famous Finnish, Swedish and Norwegian composers will be combined in a special concert from Hamburg on Wednesday at 7.45.

THURSDAY CONCERT

THE seventh Thursday Concert from the State Broadcasting Building to be broadcast by Kalundborg at 7.10 includes works by Paganini and excerpts from Lalo's Symphonie Espagnole played by Nathan Milstein (violin). The



EGON PETRI, the eminent German pianist, who was heard in the Symphony Concert last Wednesday, will play Busoni's pianoforte music this week. He was one of the famous composer's pupils.

augmented Wireless Symphony Orchestra will be conducted by Fritz Busch.

THE AUDITOR.

In Other Fields

AFTER dealing with such special-purpose valves as voltmeter and electrometer triodes, the author now goes on to describe gas-filled valves of various types and their applications for non-radio purposes.

(Concluded from page 527, November 20th issue)

THE development of gas- or vapour-filled valves of the hot-cathode type for industrial purposes is restricted to diodes for rectification of AC supply, although of recent years the gas-filled relay, which includes a control electrode, or grid, has made its appearance for various applications.

The soft diode may be roughly divided into two groups: first, that which contains

included as a branch of heavy electrical engineering), are now available for dealing with a very wide range of working voltages.

Illustration, Fig. 8 (a), shows the GU2 type, which is capable of giving an output of 2 amps. at 3,000 volts in a bi-phase half-wave circuit; and Fig. 8 (b) illustrates a similar valve of type GU8. Six valves type GU8 in a three-phase full-wave circuit will deliver an output of 20,000 volts 12 amps. DC.

With all gas-filled, or mercury vapour-filled, valves the current flowing through the valve, while still limited as to its maximum permissible value by the saturation emission of the cathode, is not limited by space charge, and thus anode voltages of 10 to 20 volts produce the full saturation current of the cathode. A small anode potential (10-15 V.) will give the electrons emitted from the cathode sufficient energy to provide ions by collision with the atoms of the gas. The conduction of current is thus accompanied by a discharge which appears as a glow in the tube. Owing to the low impedance of the gas-filled valve under conditions of ionisation, the actual current passing through it will depend only upon circuit conditions, and it is therefore important that the external circuit should always contain sufficient resistance to limit the current to the manufacturer's rating of the valve.

A further extremely important characteristic of the mercury vapour valve is the necessity for the cathode to be heated to its normal emitting temperature before any anode current is allowed to pass. This, however, is not likely to prove such a big disadvantage in large types used for industrial purposes than perhaps is the case with the smaller types subjected to more frequent switching on and off.

In mercury vapour-filled valves, particularly where used in high-voltage circuits, it is usually important to maintain the ambient temperature between certain limits, and with large valves it is common practice for the temperature of the sur-

Valves and Gas-filled Relays in Science and Industry

By F. E. HENDERSON, A.M.I.E.E.

(Osram Valve Dept., The General Electric Co., Ltd.)

rounding air to be thermostatically controlled. Not only must the ambient air temperature be kept below the maximum value permitted, but these valves are very human in their reaction to draughts, which are likely to prove fatal by causing condensation of the mercury above the anode, or by lowering the temperature to a dangerous level.

In addition to the advantage of increased current-carrying capacity by the use of a low pressure of gas instead of a vacuum, there is the possibility of using various devices to increase the efficiency of the cathode which are not feasible in the high-vacuum rectifier. Such, for instance, is an improved cathode known as a "heat-shielded" cathode, which allows the introduction of indirect heating and almost totally encloses the electron-emitting surfaces, with less risk of contamination of other parts of the valve with particles of loosened emissive coating.

An illustration of an indirectly heated heat-shielded cathode is given in Fig. 9. The cathode consists of a number of vanes of thin nickel mounted radially on a nickel cylinder, these being surrounded by an outer nickel cylinder. The spaces enclosed between the vanes are coated with the emitting material, and the whole is heated internally

by a tungsten heater mounted inside the inner cylinder. Heat-shielded cathodes of this type can be made to give very high emission efficiencies, even up to about 3 amps. peak emission per watt, which compares with 0.1 amp. peak per watt for a simple straight oxide-coated filament.

The importance of observing the

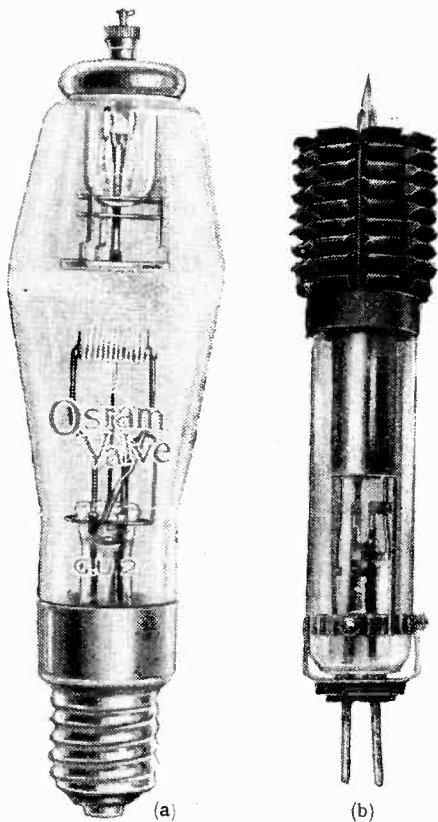


Fig. 8.—(a) A high voltage mercury-vapour rectifier, Type GU2, giving an output up to 2 amps. and (b) a GU8 rectifier, similar to Type GU2, but giving a larger output.

an inert gas such as argon, the valves in this group being intended for rectification of currents from 1 to 100 amperes at comparatively low voltage; and, secondly, a group normally containing mercury vapour and intended for the rectification of higher voltages.

The principal application of the low-voltage high-current type is to battery-charging apparatus, where it is fairly extensively employed. Mercury vapour-filled rectifiers in the form of a thermionic valve, as distinct from the mercury arc rectifying equipments (which are properly

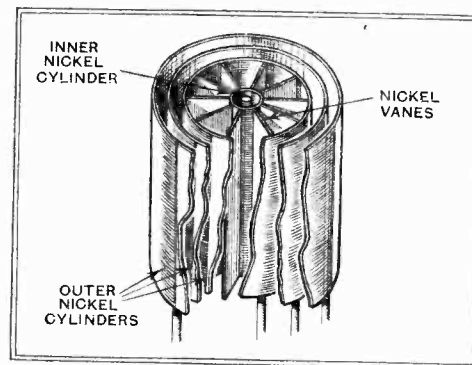


Fig. 9.—An indirectly heated heat-shielded cathode; the outermost cylinders act entirely as heat shields.

In Other Fields—

cathode pre-heating time is increased with such a cathode, and, with a cathode rated at 100 watts, this may be of the order of fifteen minutes.

The development of gas-filled relays has received a good deal of attention both in America and in this country, and the applications of this device in industry are possibly only just being appreciated by electrical engineers. The principle of the gas-filled relay has already been described in these pages¹ and consists of the introduction of a control electrode (which might be called the grid) into an inert gas- or mercury-vapour-filled rectifier, the introduction of this electrode serving to prevent the discharge, so long as the voltage applied to the grid is kept more negative than a certain value dependent on the anode voltage.

Typical gas-filled relays developed in this country commercially cover a range of anode current from 1.0 amp. peak to

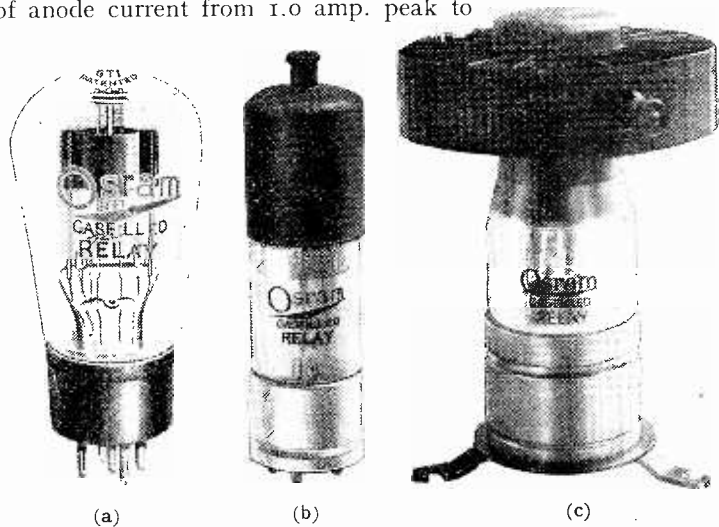


Fig. 10.—Typical gas-filled relays: (a) Type GT1; (b) Type GT5E; (c) GT25E.

25 amps. peak, or from 0.3 amp. average value to 8.0 amps.

Illustrations of gas-filled relays included in this range are given in Fig. 10 (a) GT1, Fig. 10 (b) GT5E, Fig. 10 (c) GT25E.

The GT1 is designed with an indirectly heated cathode containing a heater of 5.2 watts, and will withstand an anode voltage of 1,000 peak with an RMS value of anode current up to 0.5 amp. The GT5E has an indirectly heated cathode with an air-cooled anode, and is fitted with a heater rated at 20 watts. This tube is capable of withstanding an anode voltage of 1,000 watts peak, with a maximum current of 2.5 amps. RMS.

A 12-amp. Output

The GT25E is a larger tube, also employing the air-cooled anode but designed with a heat-shielded cathode as previously described. The heater in this relay is rated at 40 watts, and a maximum anode current of the order of 12.5 amps. RMS for an anode voltage of 1,500 peak.

The simplest application of the gas-filled relay is as a trigger device, where a

small variation of grid voltage is used to cause the starting of a steady anode current. So used, the relay will provide a permanent indication of a single transient effect of any kind which can be converted into a voltage variation, however short in duration. The anode current may be made to perform various functions, such as working an alarm, starting up a motor or operating a relay, or, for instance, it may be used in conjunction with a contactor to open a circuit in the event of an overload occurring in that circuit.

With DC applied to the anode it is necessary to reset the relay each time it is operated by removing the anode voltage momentarily and thus allowing the grid to regain control.

A common application of the relay as a simple trigger device is in conjunction with the photo-electric cell, together with an electro-magnetic relay, so that the gas-filled relay is made to break its own anode circuit after a cathode discharge. This method is applicable to counting mechanisms, and, as such, is employed to some extent by industrial concerns.

As it is capable of carrying large currents without excessive internal dissipation, the relay is able to perform the function of a contactor, switching on heavy currents under the control of a small grid voltage change. The power necessary to control a current of several amperes may be only a few milliwatts.

In an inverter to change DC to AC voltage, two gas-filled relays are normally employed; the method has been adequately described elsewhere. The inverter can be made self-excited, and then provides a convenient source of AC supply (not necessarily of sinusoidal wave form) of any voltage or wattage, dependent upon the size of relays employed, from a DC source without the introduction of any mechanical moving parts. The employment of gas-filled relays in inverter circuits should enable efficiencies of 90 per cent. or over to be realised with high-voltage DC supplies. Special precautions in the design of the inverter circuit are necessary in order to deal with loads of poor power factor and to make the circuit proof against accidental short-circuits.

By the application of an AC voltage to the anode the relay is automatically self-resetting during each cycle of the anode supply voltage, and in this case, by means of a variable applied grid bias, the average anode current can be controlled continuously from zero to that corresponding to current flowing during the whole half-cycle

in which the anode voltage wave is positive. With an AC voltage applied also to the grid, the flow of anode current can be controlled by the phase relationship between the anode and grid voltages, the average rectified current passing through the tube changing from zero to its maximum value.

Typical applications of this may be found in furnace temperature control, DC motor speed control, or voltage control of a generator by variation of field excitation.

A further application which may have a promising future is that of dimming lighting circuits, in which the amount of light given by an installation may be varied from zero to full brilliance remotely controlled by means of a small potentiometer. Very beautiful effects may be obtained in this way by combining and changing the value of illumination given by a number of lamps of different colours, such as in stage lighting, etc.

The capabilities of the gas-filled relay have already been successfully demonstrated, and there is little doubt that it will ultimately take its place with other devices as a standard piece of electrical equipment.

Mention has not been made here of the application of standard amplifying triodes, etc., to industrial use, though these are becoming increasingly employed, particularly for public address work, and as electrical "call-boys" in hotels, etc.

The scope of thermionic valves applied in one form or other to traffic control is unlimited, and such experiments as have already been conducted on these lines indicate the possibilities in this direction.

The Radio Industry

HIS MAJESTY THE KING has granted his Patronage to the Electrical Industries Benevolent Association.

We have received from the London office of the Leipzig Fair (First Avenue House, 45, High Holborn, London, W.C.1) a leaflet describing the general scope of the Fair and also a technical report (No. 13) containing a general survey of German manufacturing activities in the fields of broadcasting and television. Free copies of these publications are available to any reader who may be interested.

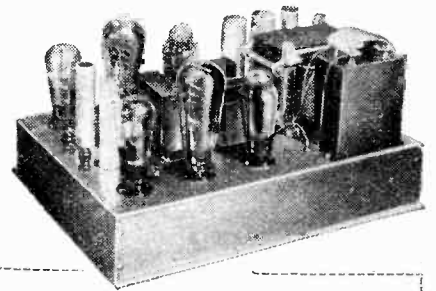
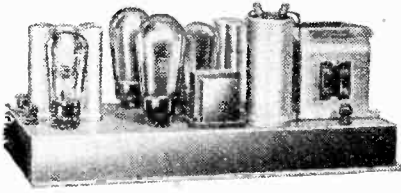
In preparation for the Coronation festivities, the bells of Manchester Town Hall are being re-cast. But this fact did not prevent the new Lord Mayor of Manchester from being rung into office in the traditional manner; loud speakers fitted behind the louvres of the bell tower were used to reproduce gramophone records of appropriate peals specially prepared for the occasion. This novel "relay" was carried out by Holiday and Hemmerlinger.

The General Electric Company has just produced a high-impedance moving-coil loud speaker for use with G.E.C. and other sets fitted with high-impedance extension speaker sockets. Three impedances (3,000, 6,000 and 9,000 ohms) are provided, and the unit, which has a nickel-aluminium permanent magnet, is housed in a walnut cabinet. The price is 52s. 6d.

British Television Supplies, Ltd., Faraday House, 8-10, Charing Cross Road, London, W.C.2, have issued a booklet describing ten circuits (short-wave and all-wave sets, etc.) in which B.T.S. coils are employed.

¹ *The Wireless World*, January 13th, 1932.

Resistance-Coupled Amplifiers



Part IV.—VALVE CAPACITIES

THE earlier articles of this series have dealt with the isolated stage of amplification. In this article it is shown that the following stage can modify the performance because of feed-back through the grid-anode valve capacity.

IT has already been shown that the response of an amplifier at high frequencies is limited by the circuit capacity, and for a given degree of amplification, the lower the capacity the higher the frequency to which uniform amplification can be maintained. This capacity is represented in Fig. 11 by the condenser C_i , but it usually has no physical existence as such, for it is made up of the sum of the various unavoidable capacities existing between different parts of the circuit.

The first component of C_i is the anode to cathode capacity existing in the valve V_1 ; the value of this depends on the construction of the valve, but with ordinary small triodes it is some 2-8 $\mu\mu\text{F}$. The second component consists of the stray wiring capacities and the valveholder capacities of V_1 and V_2 ; the value of this depends on the method of construction and upon the components employed, but it need not generally exceed 10 $\mu\mu\text{F}$. The third component is the grid to cathode capacity of V_2 under static conditions,

by C_{ga} . The value of C_i depends upon the value of C_{ga} , the characteristics of the valve and upon the nature and magnitude of the anode circuit load impedance which are represented in Fig. 11 by a resistance R_L and a reactance X_L in parallel.

The Input Capacity

When the load impedance of V_2 is a resistance coupling the components making up the load will be similar to those used for the coupling between V_1 and V_2 , consequently we can use the same reference letters for them, but distinguish them by the addition of a double primer (""). Thus $R_L = R'' = R_1''R_2''/(R_1'' + R_2'')$ and $X_L = 1/\omega C_1''$. The input capacity of V_2 is then given accurately by

$$C_i = C''_{ga} \left\{ \frac{1 + g''r'' + \omega^2 C_1''^2 r''^2 (1 + \frac{C''_{ga}/C_1''}{C''_{ga}/C_1''^2})}{1 + \omega^2 C_1''^2 r''^2 (1 + \frac{C''_{ga}/C_1''}{C''_{ga}/C_1''^2})} \right\} \dots \dots \dots (5)$$

Under two particular conditions this equation can be simplified. The first is when $\omega C_1'' r''$ is much smaller than unity; then

$$C_i = C''_{ga} (1 + g''r'') \dots \dots \dots (6)$$

and the second is when C_1'' is much larger than C_{ga} ; then

$$C_i = C''_{ga} \left(1 + \frac{g''r''}{1 + \omega^2 C_1''^2 r''^2} \right) \dots \dots \dots (7)$$

As an example, suppose that V_2 is an MHL4 valve having $\mu = 20$, $R_a = 10,000\Omega$, so that $g'' = 2 \text{ mA/V.}$, and it is used with $R_2'' = 0.25 \text{ M}\Omega$ and $R_1'' = 25,000\Omega$ while $C_1'' = 50 \mu\mu\text{F}$. Let $C''_{ga} = 7 \mu\mu\text{F}$, including stray capacities.

We see that $C''_{ga}/C_1 = 7/50 = 0.14$ while $r'' = 6920\Omega$ ($1/r'' = 1/R_a + 1/R_1'' + 1/R_2''$). At 10,000 c/s, therefore, $\omega C_1'' r'' = 6.28 \times 10^4 \times 5 \times 10^{-11} \times 6.92 \times 10^3 = 0.0217$; this is sufficiently smaller than unity to permit equation (6) to be used for all frequencies lower than 10,000 c/s. We thus find that $C_i = 7 \times 10^{-12} (1 + 2 \times 10^{-3} \times 6.92 \times 10^3)$

$$= 1.038 \times 10^{-10} \text{ F.} = 103.8 \mu\mu\text{F.}$$

This is quite an appreciable capacity and its importance can be understood. In estimating, for estimation is all that is usually possible, the capacity C_i of the

first stage, we thus tabulate the various components as follows:—

Anode-cathode capacity of V_1	= say	2 $\mu\mu\text{F}$.
Stray wiring capacities	= say	10 $\mu\mu\text{F}$.
Grid-cathode capacity of V_2	= say	4.5 $\mu\mu\text{F}$.
Input capacity of V_2 due to feed-back ..	= say	104 $\mu\mu\text{F}$.
Total	=	$C_i = 120.5 \mu\mu\text{F}$.

The circuit values can then be determined in accordance with the rules given in Part III. It should be noted that there is no harm in overestimating the value of C_i , for it will only mean that the actual response curve of the amplifier will be better than the calculated. If it is underestimated, then the high-frequency response will be poorer than that required.

The calculation of the response curve and the input capacity is quite straightforward except in the case of the output stage. One requires to know the input capacity of this valve in order to design the coupling preceding it. It cannot be calculated from the equations already given, however, for its anode circuit load being the impedance of a loud speaker it cannot be represented by a resistance and a capacity in parallel. It is not difficult to calculate it if the impedance of the loud speaker is known, or rather its effective resistance and reactance, but it rarely is. The best approximation for ordinary purposes, therefore, is probably to assume that the valve works into a resistance load, and to use equation (6) taking r'' as equal to the resistance of the output valve in parallel with its load resistance.

Kellys Engineering Trades Directory, 1936.

THE twenty-second edition of this famous directory of the engineering and allied trades has made its appearance. It contains, among other things, a classified list of the many trades associated with the engineering industry, the names of the various firms being arranged alphabetically under their respective trades.

In addition, there is another section in which can be found the names and addresses of firms listed under their respective towns and villages, these latter being classified under their counties. The directory may be obtained from Kellys Directories, Ltd., 186, Strand, London, W.C.2, price 50s.

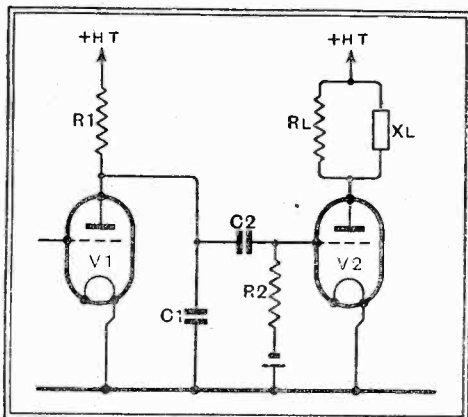


Fig. 11.—The effects of feed-back through the valve capacity can be represented by an alteration in the value of the condenser C_i .

perhaps 3-8 $\mu\mu\text{F}$. The fourth component is a fictitious capacity which represents the effect of feed-back through the grid to anode capacity of V_2 —it may be negligible or very important.

This fictitious capacity we shall for brevity denote by the symbol C_i , just as we shall denote the grid-anode capacity

Broadcast Brevities

NEWS FROM PORTLAND PLACE

Letters in Demand

THE idea has gained ground in some quarters that the B.B.C. no longer requires letters of praise or criticism, having acquired enough experience in fourteen years of broadcasting to know the public's likes and dislikes without any prompting.

Actually, Portland Place was never more eager to receive listeners' letters than to-day.

What One Letter May Do

The contents of the daily post-bag are scrutinised with the greatest eagerness. Many a correspondent, living perhaps in an obscure village or small town, would be surprised if he discovered what a commotion his humble communication sets up amongst the mandarins at Broadcasting House. Committees have been known to sit in conclave over a single letter and to re-shape programme plans accordingly.

Moral: Don't hesitate to give the B.B.C. your point of view. At least you will get a courteous acknowledgment; quite possibly you may set whole departments buzzing along new lines of activity.

Unknown Benefactor

HELPFUL criticism is always valued at Broadcasting House. Last week an envelope addressed to a well-known vocal ensemble contained nothing but a throat lozenge.

On Christmas Day

C. DENIS FREEMAN and M. H. Allen have again collaborated to produce a special feature on December 25th—"The Christmas Journey: A Masque of the Nativity," with music by Frederick Stevens. This will be heard at 8.30 by Regional listeners.

When the Cap Doesn't Fit

WHEN issuing warnings to unlicensed listeners, the B.B.C. is faced with a difficult situation, as is obvious from complaints received from certain sensitive listeners in the Belfast area.

Apparently the Northern Irish listener resents pointed microphone references to the fact that "no wireless receiving apparatus may be worked without a licence," the implication being that listeners in that district are not honest.

How to avoid offending tender susceptibilities is a problem. The B.B.C. recommends that honest listeners should turn a deaf ear to the warnings: it certainly cannot undertake to drop the ex-

hortations, neither can it fall in with one listener's suggestion that a buzzer be sounded three times before a licence warning is issued.

A Television Christmas?

BRIGHT and original plans for a television party in Alexandra Palace studios on Christmas Day have been knocked on the head. Sober reflection has persuaded producers and everybody else concerned that you can't "produce" a spontaneous party like an ordinary television show; besides, there is a general feeling that ordered conviviality isn't easy in the glare of several dozens of kilowatts. In sound broadcasting, where you can't be seen, it is another matter!

But there will be television on Christmas Day. If there is no show late at night, owners of

broadcast waves, these ultra-short waves are revealing a London which simply bristles with traps and gins for the unwary.

Patchy Reception

Field strength cars patrolling the streets from Barnet to Balham and from Ealing to East Ham have revealed that conditions of reception vary tremendously even over a small area. Hills, or even slight declivities which are scarcely noticed in a town, account for a remarkable falling-off in signal strength in certain districts; in other places the influence of steel-framed buildings is severely felt.

Sound No Criterion

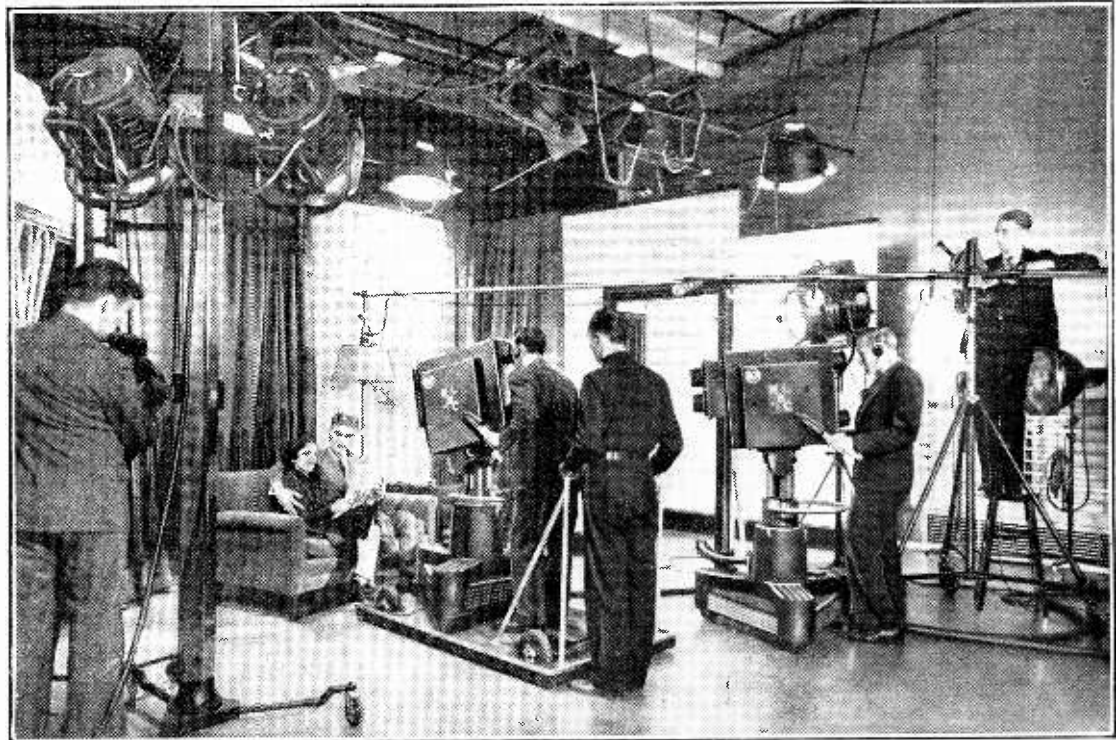
Reports of the reception of sound signals from Alexandra Palace have been received from

at Alexandra Palace last week could have doubted that something new was "on the air." An adaptation of the Farnsworth camera, the new instrument calls for studio technique closely resembling that required for the Emitron, a fact which was obvious to televisioners familiar with the Marconi-E.M.I. methods of production.

Television by Searchlight

QUITE the most ambitious effort in television "O.B.s." will be made on December 12, when two anti-aircraft guns are to be seen at night in Alexandra Park, illuminated by searchlights. Cecil Lewis has arranged this programme, in which the 61st (11th London) Anti-Aircraft Brigade will show how team work goes to the successful operation of a battery. Searchlights—there will be three—are being brought by the 36th Anti-Aircraft Battalion of the "R.E.s."

The whole production will call for some smart work with the Emitron camera, as an attempt



AMERICAN TELEVISION. This picture, taken in the N.B.C. television studio during an experimental transmission, shows an R.C.A. Iconoscope camera at work. The second camera, seen on the right, is fitted with twin lenses and comes into action for "close-ups" only.

television sets will be feasted with a special production in the afternoon, perhaps running to two hours instead of one.

A.P.'s Signal Strength

THE task of measuring television signal strength around London is likely to keep the B.B.C. engineers somewhat impatiently employed for some time to come. "Impatiently," because the whole job is a singularly tantalising one.

Unlike common or garden

many distant parts of the country, but it is difficult to interpret these in the terms of a reliable television service. In other words, the only satisfactory way in which the ordinary man can test the value of a television signal is to see it as a picture.

The Electron Camera

ALTHOUGH no preliminary announcement was made, no one who saw the first transmissions with the Electron camera from the Baird studios

will be made to stage a dummy attack by hostile aircraft.

Gun Drill

In the afternoon transmission on the same day the guns and searchlights will be seen, but this item will, of course, lack the glamour of the night scene. Televisioners will, however, see how gun drill is carried out, how the range predictor is worked, and how the "listening" squad gauge the speed and direction of approaching aircraft.

Recent Inventions

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2; price 1/- each. A selection of patents issued in U.S.A. is also included.

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

PIEZO-ELECTRIC CRYSTALS
THE ordinary quartz crystal will oscillate at constant frequency at a given temperature, though this frequency will tend to "drift" above or below the standard value with any rise or fall in the surrounding temperature.

It is, however, possible to cut a slab of crystal from the mother quartz so that it has a "zero" temperature coefficient; that is to say it will oscillate at the same frequency at all temperatures within a given range.

According to the invention the required result is secured by cutting a thin slab so that its flat side lies at a certain angle to the electrical and optical axes of the mother crystal. The crystal is then energised so that it oscillates transversely, and not in the direction of its thickness.

Telefunken Co. Convention date (Germany) August 10th, 1934. No. 452236.

o o o o

SOUND AND PICTURE PROGRAMMES

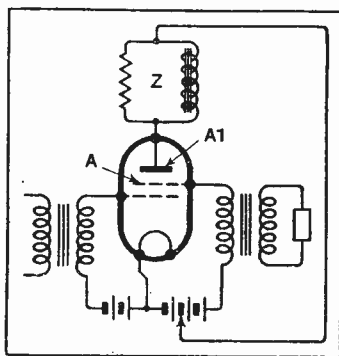
A COMBINED sound and picture programme is radiated on two carrier-waves which are separated in frequency by approximately two per cent. Both carriers are received on the same aerial and are fed to a single local-oscillator, which also functions as an anode-bend detector. The two resulting intermediate-frequencies are fed to a first amplifier-stage, where they are separated out by filter circuits in the anode circuit, and are then passed on for independent amplification.

Radio-Akt. D. S. Loewe. Convention dates (Germany) February 9th and April 28th, 1934. No. 451670.

o o o o

THERMIONIC AMPLIFIERS

DISTORTION due to valve curvature is avoided by inserting, beyond a perforated anode A, a further electrode A1 which is connected through an external circuit to an impedance Z which influences its potential. For a particular value of grid voltage, the anode current at first falls, as the poten-



Valve and circuit for reducing distortion due to non-linear relation between grid volts and anode current.

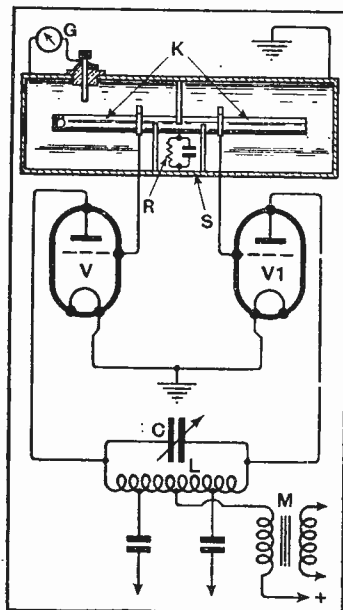
tial on A1 increases, owing to the greater number of electrons which are drawn through the perforations of the anode. But as the potential of A1 rises still further, secondary emission takes place from it, and some of the secondary electrons return back to the anode A, and so increase the anode current. This interaction is utilised to secure a linear relation between grid voltage and anode current.

Standard Telephones and Cables, Ltd., W. T. Gibson, D. H. Black, and W. Lawrence. Application date February 8th, 1935. No. 451661.

o o o o

SHORT-WAVE OSCILLATORS

TWO valves, V, V1, arranged in push-pull, feed high-frequency oscillations to a tuned output circuit L, C, signal modulation being effected at M. The generated carrier-frequency is controlled or stabilised by a low-loss conductor K, which is connected symmetric-



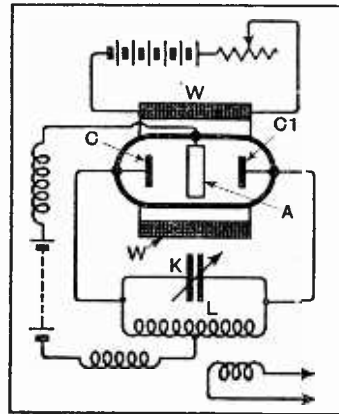
Simplified form of resonant line for control of short- and ultra-short-wave oscillator.

ally across the grids of the two valves. The conductor K is half the working wavelength or an odd multiple of that length. The cathodes are earthed directly, and the mid-point of the conductor K is earthed indirectly through a shunted resistance R and the shield S, the system oscillating through the inter-electrode capacities. A thermo-galvanometer G indicates when the system is operating properly.

Marconi's Wireless Telegraph Co., Ltd. (assignees of N. E. Lindenblad). Convention date (U.S.A.) February 16th, 1935. No. 451568.

COLD-CATHODE OSCILLATORS

THE so-called "electron multiplier" is a cold-cathode tube in which electrons-emitted, say, by the action of light, from one electrode are caused to impact against a second electrode with



Method of generating RF oscillations in a cold-cathode valve.

such velocity that secondary electrons are produced to swell the original stock. By repeating this process a number of times, very high amplification is obtained. The present invention is concerned with a method of producing sustained RF oscillations in such a tube.

As shown in the Figure the electron-multiplier consists of two cold cathodes C, C1 and a central ring-anode A, the tube being surrounded by a winding W to produce an intense magnetic field, which focuses the electrons into a stream so that they pass to and fro through the ring-anode A. Each cathode is coated with an emissive layer of caesium-silver hydride. The main oscillatory circuit L, K is branched across the two cathodes, the coil L being connected at its mid-point to the ring-anode A. The output is taken off where shown.

In operation the electrons emitted, say, from the cathode C produce a current in the coil L, and the resulting voltage accelerates the stream through the tube so that it reaches the second cathode C1 with sufficient speed to produce secondary electrons, which are then similarly accelerated back to the first cathode C. The process is repeated until the oscillations build up to the saturation limit of the tube.

Farnsworth Television Inc. Convention date (U.S.A.) July 5th, 1934. No. 451724.

o o o o

TELEVISION

WITH spot-light scanning, it is usual to employ either a single photo-electric cell, or a bank of cells, all of which pick up the reflected light from the object to be televised. When a single cell

is used it is difficult to obtain a uniform "pick-up" over the whole of the field of view, whilst when several cells are employed simultaneously the distribution of light and shade is not satisfactory.

According to the invention several cells are arranged so that one (or more) is always in circuit, but not all of them at any one time. The cells are arranged at different points around the object to be transmitted, and are cut in and out of circuit, as the circumstances require, by means of a suitable commutator interposed between them and the common amplifier.

Marconi's Wireless Telegraph Co., Ltd., and H. M. Dowsett. Application date January 16th, 1935. No. 450413.

o o o o

ENLARGING THE PICTURE

IN order to provide an inexpensive lens arrangement for enlarging the picture produced on the fluorescent screen of a cathode-ray tube, the end of the tube is either made as, or is backed by, a lens, which has a plane surface facing the picture and a concave surface facing the viewing screen on to which the enlarged picture is to be projected. Interposed between the plane-concave lens and the final screen is a simple convex lens or objective. The combination automatically corrects for field curvature even when projecting on to a comparatively large screen.

Telefunken Ges. fur drahtlose Telegraphie m.b.h. Convention date (Germany) January 30th, 1935. No. 453943.

o o o o

CATHODE-RAY TUBES

A PROBLEM which arises in connection with highly-evacuated tubes is the tendency for electric charges to accumulate on the fluorescent screen, and by their action on the electron stream to distort the built-up picture. It has been proposed to overcome this by interposing between the "gun" and the screen a metallic layer which acts as a Lenard window, so that the picture can be seen from the other or far side. It is not easy, however, to discover a suitable metal for this purpose.

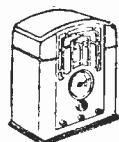
According to the invention a metal of "low electron withdrawal energy" is employed. That is to say, a metal having secondary emitting properties of the order of those of potassium, caesium, and magnesium. A small bead of the metal is initially placed inside a small branch formed in the side-wall of the cathode ray tube, and is "pointed" towards the fluorescent screen, so that when heated a very thin layer is deposited over the screen. The operation serves at the same time to "getter" or increase the degree of vacuum inside the bulb by driving out residual molecules of gas.

Telefunken Ges. fur Drahtlose Telegraphie. Convention date (Germany) February 2nd, 1934. No. 451590.

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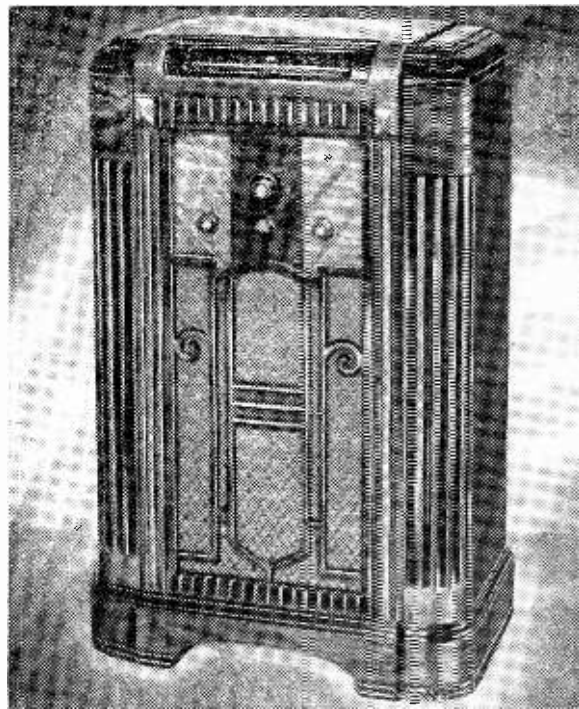
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NEW RECEIVERS AND AMPLIFIERS

DEGALLIER'S, Ltd., the Firm for Reliable Short Wave Radio (1937), have on show in London the largest selection of fully guaranteed brand new all-wave receivers; callers invited to handle all at their leisure without obligation to purchase; all S.W. receivers guaranteed to get stations on the low bands, including the Americas, etc. Hours of business, 11 a.m.-7 p.m., Saturdays 9 p.m. Early closing day Mondays. All goods cash with order or c.o.d.; handsomely illustrated catalogues available; send large stamped addressed envelope with all enquiries.

WE Guarantee to Receive the American Transmissions at full programme strength after 3 p.m. daily; those interested welcomed without obligation.

6/6 Each.—Valves, "never before such a bargain," every one a first, no throw-outs or seconds, metal, metal glass, glass counterparts and glass; 1a6, 1b5/25s, 1c6, 1v, 2a3, 2a5, 2a6, 2a7, 2b7, 5y3, 5z4, 6a6, 6a8, 6b5, 6b7, 6c5, 6c6, 6d6, 6e5, 6e6, 6f5, 6f6, 6f7, 6h6, 6j7, 6k7, 6l6, 6l7, 6R7, 6Q7, 6X5, 6Z5, 12Z5, 10, 12a, 12a5, 12a7, 12z3, 15, 18, 19, 22, 24a, 25A6, 25y3, 25z5, 26, 27, 30, 31, 32, 33, 34, 35/51, 36, 37, 38, 39/44, 41, 42, 43, 45, 46, 47, 48, 49, 50, 53, 55, 56, 57, 58, 59, 71a, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 89, 6r7, 25a6, 25z5, 6n7, 6X5, 5W4, line cords for American Midgets, 4/9.

£3/10—5-valve Midget T.R.F., medium and long carriage 1/4.

£8—"Challenger" Table Grand Model 6-valve superhet, "Mono-vision" tuning control, A.C. 200-250 volts, 3 bands 18-55, 190-550, 800-2,000 metres, 3 1/2 watts output, tone control, delayed A.V.C.; carriage 4/6; (16 1/2 x 16 x 8).

£9—"Challenger" Table Model 6-valve superhet, 3 bands, 16-52, 190-550, 900-2,000 metres, A.V.C., tone control, P.U. terminals (17 x 15 x 9), A.C./D.C., 200-250 volts; carriage 4/2; also available in A.C., same price.

13 Guineas.—The new Challenger 8 (type 800) table model de luxe, 22 x 18 x 12 high fidelity 8-valve superhet, A.C. 200-250 volts, wave band coverage 11-2,050 metres, simplified centralised tuning, super Vernier, slow-fast tuning self-contained control panel, perfect tone quality at low volume, new type 10 inch M.C. speaker, from a whisper to 8 watts pure undistorted tone, no overloading at full volume, oscillator fundamental without use of harmonics, persistent oscillator of highest output, isolating filters eliminate oscillation and motor-boating, fully delayed A.V.C. bias, absolute minimum of noise and sensitivity control for noise suppression, A.V.C. re-enforced capacitors prevent drift, pre-aged intermediate frequency transformers, I.F. barrier, discs, anchor coil leads, plug in loud speaker, also provision for external speaker, moisture sealed out by tropical zone impregnation, self healing electrolytic condensers, one complete chassis of dural might construction, moderate voltages assure full valve life, economical to operate (consumption 65 watts), long life eliminates repairs, correct valve selection, no compromise, no hum, full weight transformers, true push pull, stabilised high tension supply, stabilised biases, ceramic coil insulation, fully loaded plate coils give maximum gain, pre-balanced coil assembly, matched sets of individual coils, no taps, sealed insulation, thin laminations of special silicon steel, 7 K.C. selectivity, fractional

(This advertisement continued in third column.)



"How happy could I be with either, were t'other dear Charmer away."

"COLOURATION"

When you have made all the usual measurements on a speaker, there are still some unknown factors. A response curve may prove that all frequencies are adequately but not excessively reproduced; amplitude tests show that it handles its rated input without distortion; polar diagrams indicate how the output is spread over the surrounding space.

But all these measurements together still leave something not accounted for, and that something can only be appraised by a skilled ear on actual music. Such perception evaluates the certain something as that which ranks the speaker as either a good speaker or the other thing.

Usually we describe the quality as "colouration." There seems to be no such thing as a speaker entirely without "colour," nor is a precise description to be found. But the big difference between our P.M. and the Duode speaker is just this matter of colour.

True, there is also the fact that the Duode has a far better response in the extreme treble. Yet to most ears on most programmes the "colour" is more important.

The outstanding feature of the P.M. speaker has always been its "dry" tone, as one musician happily described it. It is exceedingly truthful, but entirely free from any artificial roundness of tone.

Now the result of this is that if there is any lack of body in the transmission, the standard speaker reveals it.

The Duode is a "kinder" speaker. Although measurements show no reason why, it has a richer, rounder quality. Not the "roundness" due to lack of top, for its top is better than the standard; but rather a gracious smoothness (not to be defined) especially noticeable on transmissions which the P.M. speaker shows up as not quite perfect.

Each speaker has its own place; and both, to speak fairly, are far in advance of the usual speaker of the present day. Only by hearing them can you decide which it is you need—you really ought to have one or the other, if you are in this world to enjoy the good things of life.

You who know our present speaker but who have not heard the Duode, would be well advised to hear it right away. The prices are:—

Permanent Magnet, standard cone	...	...	£5.0.0
" " " " twin cone	...	...	£6.0.0
Duode D.C. Model...	...	...	£6.0.0
" " " " A.C.	...	...	£7.5.0

(In all cases, transformer to suit your valves, £1.0.0)

We can demonstrate at any time by day, or by appointment in the evening. Telephone, and we will tell you just how to get here—we are only 45 minutes by road or Underground from Central London. Lots of people come a long, long way, and are gladdened by the experience... at the time and thereafter



HARTLEY TURNER RADIO LTD.,
THORNBURY ROAD,
ISLEWORTH, MIDDLESEX.
Telephone: HOUnslow 4488

NUMBERED ADDRESSES

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes: in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."

DEPOSIT SYSTEM

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Stamford Street, London, S.E.1, and cheques and money orders should be made payable to Illiffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post. When sending remittances direct to an advertiser, stamp for return should also be included for use in the event of the application proving unsuccessful.

NEW RECEIVERS AND AMPLIFIERS

(This advertisement continued from first column.)

microvolt sensitivity, shielded switching, permits high-gain, positive silver-plated contacts, eliminates switch noises, audio frequency range 30-8,000 cycles, diode detection, prismatone high fidelity R.F. preselector stages on all bands, carriage 6/7; for experimenters, less cabinet deduct 15/-; if public address, Rola 12in. G.12 supplied in place of standard speaker, add £2.

£17/17—Challenger 8 Console 800C, height 3 feet 6 inches, width 24 inches, depth 12 1/2 inches, chassis as incorporated in 800 model but incorporating the G.12 high fidelity 12in. speaker; carriage and crate 10/7.

29 Guineas.—"Challenger 800 R.C." radiogram with automatic record changer; measurements, height 2 feet 8 inches, width 3 feet, depth 21 inches; this also incorporates the G.12; carriage and crate 15/-.
NOTE.—The Challenger 800 is available for A.C./D.C. 200-250 volts, employing 11 valves, at an additional cost of 20/- on each model.

CHALLENGER Model 381, with refinements over the 800 series, 8 valves, 13-2,060 metres, Polychromatic dial scale, improved vision master, beam power output valve, 10 watts undistorted, band spread Magna dials and second-hand, magic eye tuning, full range, tone control, automatic band indicator, high image frequency suppression, hair line selectivity, ultra sensitivity; the price will be: table model, 14 guineas; or in chassis form for the experimenter, chassis, dials and speaker, £13/18; the 381 is available in A.C. only; we would point out that this receiver does not in any way replace the 800 model.

£16—Challenger 12 A.C./D.C. 200-250 volts, 4 bands have been added to get 10 watts undistorted from their speaker, which is a large 12in. R. type Rola, triple parallel rectification, push-pull parallel, four pentode output, carriage and crate 7/6; chassis, valves and speaker alone, £15.

£37/10—V.T.18 Midwest 18 valve chassis, valves and speaker, 6 bands, 4 1/2-2,400 metres A.C., 100-250 volts; this receiver has many improvements over the 1936 model; carriage paid; available in various console cabinets.

£50—Midwest Royale 24-valve chassis, valves and speaker, 3 speakers, carriage paid.

£50—Challenger "Model 5240" 24-valve superhet, twin chassis, valve and "2" Public address speakers, with 60 watts undistorted output, sensitivity 1/4 microvolt absolute, tuned H.F. stages on all bands, 3 I.F. stages, the last one being used for selectivity only, frequency response at the speakers within 2db over whole range, wave band coverage 5-2,050 metres in 5 bands, Magic-eye tuning, variable selectivity, receiver chassis heavily shielded and chromium plated, Centro-Master automatic control unit, dual rectifiers, signal channel separate from A.V.C. system linear diode detection, separate rectifier to provide A.V.C. voltage, radio frequency pre-amplifier stages eliminate repeat points and whistles, and provide maximum signal to noise ratio, beam power output valves, polychromatic dial scale, prismatone high fidelity, uni-control 2-speed free wheeling tuning, band spread Magna dial and second-hand, automatic band indicator, automatic inter-station noise suppression, separate bass boosting amplifier, automatic frequency control, iron core I.F. transformers, code interference filters, automatic volume control, beat frequency oscillator; carriage 18/-; also available in various gramophone and console cabinets.

DEGALLIER'S, Ltd., 18, Connaught St., Marble Arch London, W.2, Paddington 2745. [3202]

"Radio Data Charts," A Series of Abacs Post free 4/10

NEW RECEIVERS AND AMPLIFIERS

No. 14

AIR KING Introduces Sensational Models for 1937, featuring
BEAM Tuning Exclusive to Air King Receivers.
MAGIC Edge Illuminated Dials Enabling Station Names to be Clearly Read.
CATHODE Ray Magic Eye Tuning Indicator on all Models.
LATEST G Type Octal Base Valves, which are interchangeable with the metal prototype.
SPECIAL Output Valves for A.C./D.C. Models, giving undistorted output equivalent to that of an A.C.
CUT Out that Interference with an Air King All-wave Doublet Aerial, doubles signal strength and increases reception range, especially on short waves; price 15/-.
ALL the Latest Type American Glass and Metal Valves Stocked.

TRADe Enquiries Invited.

CALL, write or 'phone for further particulars to:-

AIR KING RADIO, 115, Shaftesbury Avenue, Cambridge Circus, W.C.2 (1st floor above Barclays Bank). 'Phone: Temple Bar 4875 (two lines). All receivers assembled in England. [2702]

A.
£3/9/6—Freed-Eiseman compact midget 1937 receivers.
£13/13—American-Bosch 1937 all-wave receivers.

£7/7—Car radio receivers; keenest prices for Raytheon receiving and transmitting valves.

THE HARMOUR RADIO Co., Ltd., 8, Clifford St., London, W.1. [0499]

ALERT RADIO Co.

ALL-WAVE Receivers at £7/7, £9/9, and £13/13. A.C. or A.C./D.C.; Midget and other receivers up to 23 valves; for DX work we can supply the latest communication models.—21, East Rd., N.1. Clerkenwell 4871. [3220]

ROYAL RADIO Co.,

ESTABLISHED 1908.

DIRECT Importers of All the Latest Short Wave and Other Receivers with Magic Eye Tuning.

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

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

LATEST 6-valve Car Radio, A.V.C., remote control, no suppressors required.

A FULL Range of the World Famous Fergusson and Pilot Models Stocked.

ALL Sets Fully Guaranteed by Ourselves.

ALL Types of American Valves Stocked.

ANY Make of Set Serviced by Our Qualified Radio Engineers at Reasonable Charges.

PAY Us a Visit Any Time, or send for full range catalogue; 1/2d. stamp will be appreciated.

ROYAL RADIO Co., 5, Buckingham Rd., South Woodford, London, E.18. 'Phone: Buckhurst 2736. [3223]

"SERVICE With a Smile."

HENRY FORD RADIO, Ltd.,

ELECTRONIC House, 22, Howland St., Tottenham Court Rd., W.1. Museum 5675. [0511]

EVRIZONE RADIO and TELEVISION Co., Ltd.,

2, Southlands Rd., Bromley, Kent, manufacture special wireless receivers and amplifiers for the trade; enquiries invited.—'Phone: Ravensbourne 1957. [3191]

SOLD Out of Hallicrafters, fresh delivery 30/11/36.

THE Greatest Value Ever Offered in Professional Type Radios.

BOOK Your Order Now; send for illustrated leaflets.

SKYBODY 5-tube Superhet., £8/10; Super Skyrider with crystal, 11 tubes £28/10

ULTRA Skyrider with Crystal, 11 tubes; £32/15.

HAMMARLUND Comet Pro with Crystal; £40.

HAMMARLUND Super Pro with Crystal and Speaker; £75.

A.C./D.C. Compact 4-valve, 2 bands; £2/9/6.

A.C./D.C. Compact 4-valve Portable; £3/5.

A.C./D.C. 6-valve All-wave Superhet.; £5/19/6.

A.C. 8-valve All-wave, 4 bands, 11-2,050 metres; £13/13.

A.C. 6-valve All-wave, 3 bands, 15-2,050 metres; £8/8.

ALL Goods Carriage Paid.

SATISFACTION or Money Refunded Guarantee.

VALVES Guaranteed 6 Months; write for catalogue.

RADIOGRAPHIC, Ltd., 66, Osborne St., Glasgow, C.1. [3286]

Notes

on the Suppression of Electrical Interference with Broadcast Reception

What is the best possible anti-interference installation?

This is a question that is often asked. The answer is simple and the carrying out of our recommendations in most cases presents no difficulties.

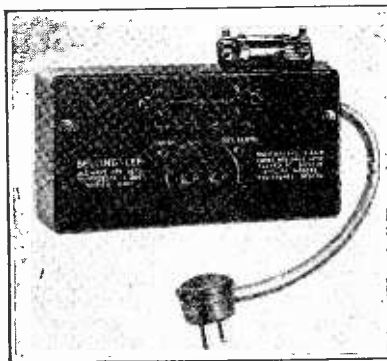
You must prevent radiated interference from reaching any part of the aerial installation, and any conducted interference from reaching the receiver via its mains lead.

The aerial must consist of a "collector" situated outside the field of interference, either remote in a horizontal plane or high above surrounding conductors, the actual signal being conveyed to the receiver via a transmission line screened to prevent this part of the system from picking up interference (or signal). Of course it is the screening of the lead-in which makes it necessary to increase the active part of the aerial or collector.

With the popularity of all-wave reception, it is necessary to ensure that an anti-interference aerial will maintain its properties on all useful wave channels.

The "Eliminoise" system (35/-; cable extra, per yard 8d.) is the only known system using a screened lead-in which gives satisfaction down to 10 metres without switching, and it is as easy to erect as an ordinary aerial. It is not logical to expect a doublet to have anti-interference properties on 10 metres, and on the long wave band. It just cannot be done.

Now regarding Set Lead Suppression for all-wave receivers, our type 300 (21/-) is the only solution. This is an all-wave job which we claim to be effective to 10 metres and know to clear up the residual snowstorm effect on television (7 metres).



A new all-wave Set Lead Suppressor, Belling-Lee type 300, price 21s. Exceedingly efficient down to 10 metres.

When considering set lead suppression on sets not incorporating the short wave feature, type 1211, 1/2-amp. 17/6, or type 1256, 1-amp. 19/6., will be found quite satisfactory. Any of these Set Lead Suppressors are just plugged in, that's all, and this range is sent C.O.D. on 7 days' trial, but please see if your dealer will lend you one before you write to us.

* Trade Mark



Belling & Lee Ltd.
 Cambridge Arterial Road,
 Enfield, Middx.

NEW RECEIVERS AND AMPLIFIERS

ARMSTRONG COMPANY Manufacture 8 Radio Receivers in Chassis Form, briefly described hereunder.

ARMSTRONG 6-valve All-wave Superheterodyne Radiogram Chassis, for A.C. mains, complete with Rola speaker; £27/10. (See displayed advertisement.)

ARMSTRONG 8-valve 4 Wave-band Radiogram Chassis, with phase-reversed push-pull output; £29/17/6.

ARMSTRONG 6-valve 4 Wave-band Radiogram Chassis, with large triode output; £8/17/6.

ARMSTRONG 8-valve 4 Wave-band Radiogram Chassis, with radio-frequency stage and push-pull output; £11/11.

ARMSTRONG 7-valve 4 Wave-band Radiogram Chassis, with radio-frequency stage and single triode output; £10/10.

ARMSTRONG 8-valve 2 Wave-band Radiogram Chassis, with 8 watt push-pull output; £8/10.

ARMSTRONG 6-valve 2 Wave-band Radiogram Chassis, with single large triode output; £7/10.

ARMSTRONG 10-watt Amplifier, fitted with microphone pre-stage, complete with Rola G.12 speaker; 10/2 guineas.

ARMSTRONG Chassis Carry 12 months' Guarantee; no charge for material, labour or carriage for 12 months (valves carry makers' guarantee).

ARMSTRONG Chassis are Sent 7 Days' Trial, carriage, packing, and crate free.

ARMSTRONG MANUFACTURING Co., 100, King's Rd., Camden Town, N.W.1. [3217]

ROUND the World Receivers, Pilot, Ferguson, Ace, Stewart, Warner, Zenith, etc.; all American valves; traders only.—Perseus Radio, Burton-on-Trent. [3171]

TRANS-ATLANTIC RADIO Lead for Value! Send for lists; 5-valve A.C./D.C. compacts, attractive colours or walnut, £3/10; all-wave superhets, from £6/15.

TRANS-ATLANTIC RADIO CO., 15, Percy St., W.1. Museum 3096. "Philco" agents. American radio service. [3281]

SPECIALIST.—Car radio only. Expert fitting and repairs. Sets from £7/10 to 40 guineas.—St. John Chesney, 38, Hugh St., London, S.W.1. Victoria 0780. [0534]

FOR the Finest Value in All-wave Rectifiers, see McCarthy advertisement on page 5.—McCarthy Radio, Ltd., 44a, Westbourne Grove, London, W.2. Telephone: Bayswater 3201. [0510]

AMERICAN "World" 10-valve Superhet Receiver, 2 6B5's in output stage, giving undistorted output of 18 watts, Magic Eye tuning, 3 wavebands, 16-2,000 metres; 12 guineas. Full details on application.

SIX-VALVE Superhet, Chassis, with A.V.C. 3.5-watts pentode output, at £6/5.

SIX-VALVE All-Wave A.C. Superhet. Receivers, with cabinet and speaker, 3.5-watts pentode output, station marked dial, A.V.C. waves ranges 16.5, 50, 200 to 600, and 1,000 to 2,000 metres; price £9.

WE Can Supply Kits of Specified Parts with Valves for any "Wireless World" Receiver or Amplifier, including the "1936 Monodial A.C. Super Receiver," "Quality Amplifier," Imperial Short Waves Six and All-Wave Super-Seven. Hire purchase terms can be arranged on the above goods and any other radio equipment; details upon application.

WARD, 46, Farringdon St., London, E.C.4 Tel.: Holborn 9703. [0458]

PILOT, Belmont, Pegasus and Air King all-waves lead the field; our deliveries are prompt in original cartons with full guarantees; your trade card will bring our wholesale catalogue from the authorised distributors.—Leonard Heys, 36, Henry St., Blackpool. [0530]

RECEIVERS AND AMPLIFIERS

CLEARANCE, SURPLUS, ETC.

HENRY'S.

1936 Regentone 5-valve Superhet., thermometer tuning, unused and boxed; list price £11/11, A.C. model £5/10, Universal A.C./D.C. £5/15.

1936 Regentone 5-valve Console, thermometer tuning, unused and boxed; list price £10/10, A.C. model £4/15, Universal A.C./D.C. £5.

1936 Regentone Battery Set, list £7/10/6, var.Mu., S.G., det. and pentode output, P.M. speaker, thermometer tuning, unused and boxed; £3.

HENRY'S, 72, Wellington Av., London, N.15. Stamford Hill 2907. [3247]

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

POWERFUL All-wave A.C.5 Superhet. £5; battery all-wave Four superhet, £3.—Box 41, c/o The Wireless World. [3279]

SEND for Bargain List of Brand New Decontrolled Receivers; amazing prices.—P. A. C. Ltd., 54, Lamb's Conduit St., W.C.1. [2243]

1937 Radios, below wholesale prices, discontinued agency; 1/2d. stamp with enquiries.—W. 5, Marine Terrace, Folkestone. [3284]

75/- for Brand New 9-guineas Table Grand, 1935 model, guaranteed, A.C., moving coil speaker, magnificent walnut modernistic cabinet; send for list of similar bargains.—Kay, 1, Old Church Lane, N.W.9, Col. 8266. [0535]

PUBLIC ADDRESS EQUIPMENT

PUBLIC Address Work Undertaken.

P.A. Vans for Hire, stationary equipment for fetes, conferences, etc., portable equipments for small dances, etc.

ROSS and ROBINSON, Ltd., 8, Western Circus, W.3. [0521]

PUBLIC ADDRESS EQUIPMENT

SPECIAL Offer!!!
8½ Guineas Assembled; Vortexion 20 watt 4-stage P.A. amplifier, in steel case, 8in. x 10in. x 9in. high, with carrying handle, input with controls for microphone and pick-up and tone control, output for 7½ and 15 ohm speakers, weight 25lb.; only 8½ guineas, with valves.
4 Input Model, with mixers; £10.
HEVY Duty Model, as fitted to cinemas and dance halls; £15.
CALL and Hear the Rumble of an Organ as Never Before on our Wide Frequency Range Models, the best yet.
VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. See also New Mains Equipment. [3127]
STANDARD Trade Handbook on Practical P.A.—The Partridge P.A. Manual. Contents include:
FOUR Constructional Amplifiers; pre-amplifier design and operation; microphone technique; audio frequency lines; impedance matching; speaker grouping; notes on mains and audio transformers, etc.—Free, trade only, from:
N. PARTRIDGE, B.Sc., A.M.I.E.E., King's Buildings, Dean Stanley St., London, S.W.1. [3068]

USED SETS FOR SALE AND WANTED
HAMMARLUND SUPER PRO

HAMMARLUND Super Pro Crystal Gate and Speaker, quite new; bargain price £55.—Lownds The Cottage, Old Lenton, Nottingham. [3294]

INTERNATIONAL KADETTE

INTERNATIONAL Kadette (U.S.A.), 6-valve, AC/D.C., 120-240v., used few hours only, extremely selective; approx. 15in. x 10in. x 6in.; cost £6/10; best offer.—Box 9907, c/o *The Wireless World*. [3183]

MONODIAL

MONODIAL Radiogram, 1933, handsome oak cabinet, Garrard motor, Magnavox, dual L.S., requires re-ganging only; what offers?—Doren-Ditch, New Court, Uckfield. [3235]

A.C. Monodial Super, as Radiogram, 2 large separate auditorium speakers, 18 months old, cost over £60, wonderful set, very powerful; others.—Box 9998, c/o *The Wireless World*. [3248]

POCKET PHONE

AS New, 3-valve Pocket Phone, G.L.; 35/—Jarvis, 68, Northumberland St., London, E.14. [3292]

PYE

PYE Battery Supplet, Model T.P./B. Portable, as new; must sell, owner going abroad, what offers?—Box 14, c/o *The Wireless World*. [3253]

R.G.D.

45 Guinea R.G.D. All-wave Autogram, fortnight old, perfect; accept 37 guineas; consider modern receiver part.—Gordon Brown, Eign St., Hereford. [3274]

W.W. MONODIAL

FOR Sale, 1936 Monodial, receiver portion with new valves, specified components, requires trimming; £7; cost £15/10; wanted, Q.A. receiver.—Johnson, 4, Branksome Rd., Norwich. [3257]

W.W. SHORT WAVE RECEIVER.

"**W**IRELESS World" 1935 A.C. Short Wave Receiver, 12.70 metres, complete to specification, with valves as new; £5/10.—G., 203, Gunnersbury Park, W.5. [3269]

EXCHANGE OR WANTED

WANTED, R.G.D. all-wave table or console.—160, Oakdale Rd., Carlton, Nottingham. [3272]

MISCELLANEOUS

"**W**IRELESS World" 1935 A.C. Short-wave Receiver, £4; also P.P. Quality Amplifier, £5.—Box 32, c/o *The Wireless World*. [3261]

1937 Ferguson 8-valve Console, cost 22 guineas, owner going D.C. district, set month old; £15, no offers, no snags.—Box 48, c/o *The Wireless World*. [3235]

WONDERFUL Bargain.—Voigt Corner Cabinet, speaker, 40-watt field, £25, cost £40; Sound Sales, 12-watt amplifier, £12/10, cost £17/10; Q.A.-W.W. receiver; £5, cost £15; perfect order, month old; offer.—35, Ochiltree Rd., Hastings. [3275]

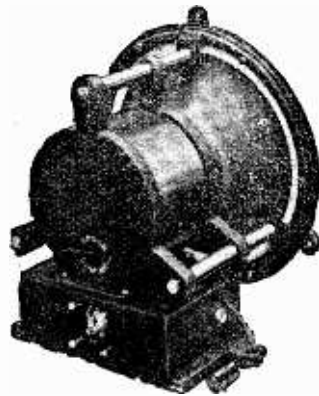
1935-36 Receivers, guaranteed perfect; Ekco A.C. 86, £8; A.C. 76, £7; Lissen A.C. 8111, £7; G.E.C. A.C. 4, £7; nearest seconds, A.C. Quality H.T. unit, output suitable 4v., 4a. and P.X.25.—Smith, 20a, Lower Stone St., Maidstone. [3255]

1936 Monodial, receiver only, Hammarlund I.F. (adapted to work into I.F. of above), range 5-105 metres, television sound excellent, £7; corner bun cabinet, in walnut, with 2 matched speakers, £8.—Davies, 32, Chovelly Av., Hendon N.W.9. Telephone: Colndale 6604. [3250]

EPOCH

REPRODUCERS & MICROPHONES

HAVE YOU HEARD AN EPOCH SPEAKER?



Maybe you have, but if you have or haven't here is an opportunity to hear one working with your own receiver, giving you that practically perfect quality that only EPOCH can. Making radio realistic and giving each note its true and individual characteristic without overdoing or overemphasising it. You can always hear EPOCH Speakers working at our showroom in Aldwych House, but you can also have a speaker sent to you to try with your own receiver without any obligation. Use the coupon below for full details of this offer, and introduce yourself to realistic radio reception, FREE OF CHARGE.

RADIO DEVELOPMENT CO.

(Prop.: EPOCH Reproducers Ltd.)
 Aldwych House, Aldwych, London, W.G.2
 Telephone: Holborn 9111 (2 lines).

COUPON

Please send me your latest catalogue of **EPOCH MOVING COIL REPRODUCERS AND MICROPHONES** and details of your **FREE TRIAL** offer.

Name

Address

To Radio Development Co.,
 Aldwych House, Aldwych, London, W.G.2

W.W.1

NEW MAINS EQUIPMENT

V V

VORTEXION Lead Again.
VORTEXION Supply the B.B.C., G.P.O., I.P.T.B., and Borough Councils, etc., so why not you?
FOR the Best Reproduction it is Possible to Obtain, see also advert. under Public Address Equipment.
ALL Fitted Screened Primaries and Tapped 200-250v., with centre tapped filaments, guaranteed one year.
250-0.250 60 m.a., 4v. 1-2a., 4v. 2-4a.; 10/- open, 12/6 shrouded.
350-0.350v. 60 m.a., 4v. 1-2a., 4v. 2-4a.; 12/6 open, 15/- shrouded.
350-0.350v. 120 m.a., 4v. 2.5a., 4v. 2-4a., 4v. 2-5a.; 14/6 open, 16/6 shrouded.
425-0.425v., 120-160 m.a., 4v. 5-10a., 4v. 2.5, 4v. 1-2, 4v. 1-2, supershrouded model, 2½% regulation; 26/-.
500-0.500v. 120 m.a., I.T.'s, as above; 19/- open, 23/- shrouded; 400 or 450, same price.
500-0.500v. 150 m.a., 3x, 4v. 2a., 4v. 2.5a., 4v. 4a., 26/- open, 30/- shrouded; 400 or 450, same price.
CHOKES, 30h. 60 m.a. 5/6; 7-13h., 10/6; 30h., 150 m.a., 12/6; regulation, 7/6.
OUTPUT Transformers, 4-10 watt, W.W. Q.A., 17/6; 20-watt super shrouded, 30/-.
AUTO Transformers, 100-120 to 200-240v., 60 watt, 9/-; 120 watt, 12/6; 200 watt, 16/6; 500 watt, 30/-.
TELEVISION, 4,000v., 5-10 m.a., and 2.5-4v.; 27/-.

QUOTATIONS for Specials by Return.
VORTEXION, Ltd., 182, The Broadway, S.W.19. Tel.: Lib. 2814. [3128]

ALL POWER

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

250-0.250v. 60 m.a., 4v. 1-2a., 4v. 2-4a., 12/6, post 7d.; extra filament, 4v. 1a., 12/6.
350-0.350v. 60 m.a., 4v. 2-3a., 4v. 2-4a., 15/-, post 8d.; extra filament, 4v. 1a., 16/-.

350-0.350v. 120 m.a., 4v. 2-3a., 4v. 4-6a., 4v. 1-2a., 19/-, post 1/-; extra filament, 20/-.

WRITE for List; special quotations by return.
ALL POWER TRANSFORMERS Ltd, 8a, Gladstone Rd, Wimbledon, S.W.19. Tel.: Liberty 3303. [2771]

PARAMOUNT Mains Transformers.
PARAMOUNT in Quality, lowest in price; example, 250v. 60 m.a., 4v. 1a., 4v. 4a., open type 9/-, shrouded 11/-, post 9d.; 350v. 75 m.a., 4v. 2.5a., 4v. 4a., open type 12/-, shrouded 14/-, post 9d.

WRITE for List, "Paramount Mains Transformers"—R. H. Salter, 66, Hartfield Rd., Wimbledon, S.W.19. 'Phone: Liberty 3226. [3303]

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

CABINETS

MANUFACTURER'S Clearance.
"ULTRA" Tiger Radiogram Cabinets, 35x21x16, 35/-; undrilled (reconditioned).

HALCYON Radiogram Cabinets, rich, dark, figured walnut, 33x23x19½, 45/-; many others, 30/- upwards; photos for selection sent on request.

"ULTRA" Table Cabinets, 20x16½x9½ (undrilled), 10/6; many others from 4/6.
SPEAKER Cabinets; 4/6 upwards.

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

H. L. SMITH and Co., Ltd., 287-9, Edgware Rd., London, W.2. Tel.: Padd. 5891. [0485]

DYNAMOS, MOTORS, ETC.

1h.p. A.C. B.T.H. Motors, 1,425 revs., self starting, all 4 voltages; 53/-.—Masco, 18, Brixton Rd., S.W.9. [0455]

ROTARY Converter, 230 v. input, smoothing and silent, 90 watts; £6.—Miller, 8, Wanstead Lane, Ilford. [3264]

JANETTE Rotary Converter, with smoothing and case, D.C. 230 v. to A.C. 230 v., 1.1 amps., new condition; £5/17.
RADIO and ENGINEERING SUPPLIES, 88, Edgware Rd., London, W.2. 'Phone: Paddington 6652. [3291]

G.E.C. Rotary Converter, 200-250 D.C. to 200-250 A.C. 500 watts, complete with smoothing equipment, in steel silence cabinet; worth £40; accept £8/10.—Johnson Engineering, 86 Great Portland St., W.1. Museum 7852. [3271]

ELECTRO Dynamic Rotary Converters, complete with smoothing and silence cabinet, input 200-240 D.C. output 220 volts A.C. 50 cycles, 90 watts, in new condition, £6; similar machine, with 65 watts output, £4/18, carriage forward; many other converters in stock; send for details.

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

RADIOMART SHORTWAVE SPECIALISTS

MICROVARIABLES.—All brass construction; latest ceramic insulation. The finest condensers made; 15 mmfd., 1/4; 40 mmfd., 1/7; 100 mmfd., 1/10. **Transmitting Type.**—070 in. spacing, 15 mmfd. (neutralising), 2/9. 40 mmfd. Tuning, 3/6. These are quality.

SHORTWAVE COILS.—(RD4) CA 11-25, CB 20-45 metres, 2/6. CC 44-100 metres, 2/9. Standard 6-pin types, CA6, CB6, 2/9 each, CC6, 3/-; Same range as 4-pin.

COILFORMS.—Moulded in RD4 natural loloos material, hollow resilient pins 1 1/2 in. diameter ribbed; identification disc in top. Four types, 4-pin, 1/6; 6-pin (standard or to fit 7-pin valveholders), 1/9; 7-pin (for bandspread tap), 1/10; Machine threading, 2d. extra.

AMERICAN Mains Transformers, 230 v., fully shrouded, 350-350, 6.3 v., 5 v., 6/11; Majestic, 250-250, 2.5 v., 5 v., 4/11. Pilot 260-260, 2.5 VCT, 5 VCT, 5/11.

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

UTILITY 8/6, Microdisc Dials, 3/11; Radiophone, 0.00016 Shortwave Condensers, 3/6; series gap, twin, 3/9. Shortwav: HF Chokes 5-100 metres, 9d.

465 KC. IF Transformers, 4/11; Telsen Ace, 1/11; RG4 Radiogrand, 2/9; Telsen HF Chokes, 1/11.

LISSEN 3-gang Superhet Kit Coils, two IFs, ganged Condenser, ditto Bandpass, ditto 2-gang All-wave. Any of the above kits, 10/- each.

ELECTROLYTICS. 8+8+4 500v., wkg., 3/6; 6+6+62/6; 8+8 3/-; 8 mf., 500 v., 2.3; 4 mf., 1/6; 50 mf., 50 v., 1.3; 25 mf., 25 v., 1/-; 2 mfd., 300 v., 9d.

FAMOUS CONTINENTAL A.C. Valves, 4/6; Battery types from 2/3; American Duotron, etc., all types, 3/6; All types of RCA Licensed first grade tubes, metal and glass, in stock from 5 s.

FEATHERWEIGHT Headphones, 2/6. Varley Bitocal Iron-cored Coils, 2/6; matched pair, 4/6.

SMOOTHING CHOKES, 20 hy., 120 m.a., 3/11; 100 m.a., 2/11; 40 m.a., 1/11. Centralab Pots all sizes, 1/6; switched, 2/-; Tubular glass tubes, 2d.

SPECIAL OFFER, worth 30/-. Class B Kit, comprising Driver Transformer, Valve and Holder, 5/-.

TRADER! Monster Bargain Parcels, value 4/10/0, for 10/-; also 5/- parcels. State battery or mains. Telsen Screened Dual Range Coils, 2/6; per pair, 4/6; Milliammeters 25 m.a. upwards, 5/9; super, 6/9.

PUSHBACK Wire, 6 yds. 6d.; heavy, 9d.; 2 gross Solder Tags, 6d.; Resin-cored Solder, 6ft. 6d.; Screened Flex, single, 6d. yd.; twin, 9d. yd.

UTILITY straight line Wavelength Dials, 3/11; Utility 2-gang Uniknob .0005 and Dial, 3/11.

Order 5/- post free. Get our Bargain Catalogue, 1 1/2d. post free. All enquiries and requests for catalogue must send 1 1/2d. stamp.

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48 Pages of practical circuits and data on Shortwave Receivers, transmitters, modulators, transceivers, etc., including information on transmitting licences, "class B" modulation, aerials, etc. Price with Catalogue 6d. or 7 1/2d. post free.



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TELE.: MWID 3254

NEW LOUD-SPEAKERS

HULBERT for Quality Surplus Speakers.

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

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

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

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

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

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11/6 Only; extension permanent magnet speaker, 8in. cone, complete with large cabinet, suitable for low impedance outputs.

2/9 Only; brand new cabinets.

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

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

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VAUXHALL.—Best quality speakers; see other column. —Vauxhall Utilities, 163a, Strand. [0520]

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SECOND-HAND, CLEARANCE, SURPLUS, ETC.

FERRANTI M.1 Speaker, as new; £5.—Gill, Desborough Rd. High Wycombe. [3259]

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VAUXHALL.—Magnavox permanent magnets universal, suitable for Class "B" power or pentode, 7in. cone, 16/6; 10in. cone, 22/-.

VAUXHALL.—American Rolas, 2,500, 8in. 15/-, 9 1/2 in. 19/6. Permanent magnets, 8in. 19/6, 9 1/2 in. 24/6.

VAUXHALL.—Above, fully guaranteed, complete with humbucking coils; state power or pentode transformer; unused manufacturers' stock.

VAUXHALL.—Immediate delivery, carriage paid; lists free; cash with order or c.o.d.—Vauxhall Utilities, 163a, Strand W.C.2. Temple Bar 9338. [0456]

ROLA G.12s, stripped, 1,250 ohms, complete transformer, push-pull triodes or pentodes; 58/6; c.o.d. paid; unused set manufacturers' stock, guaranteed.—Bergman Radio, 58, West India Dock Rd., E.14. [3254]

MAGNAVOX D.C. 152 (9in. cone), 22/6; Magnavox 154 (6 1/2 in. cone), 16/3; all with humbucking coils, power or pentode transformers, and 2,500 or 6,500-ohm fields; Magnavox P.M.254, 18/-; Magnavox P.M.252, 22/6.

ATTENTION to All Orders Within 48 Hours; carriage paid; cash with order or c.o.d.; send for list.

WARD, 48, Farringdon St., London, E.C.4. Tel.: Holborn 9703 [0451]

MOVING Coil Loudspeakers, manufacturer's type, 6 1/2 in. cones, tested and guaranteed, permanent magnet, W.B., 11/6; W.B. new type magnet, 13/6; Rola, 15/6; mains energised, W.B., 6/6; Rola, 10/6; state whether for power or pentode; cabinet for same, 2/6; c.o.d. or c.w.o. sent by return post; postage 1/-.

H. L. SMITH and Co., Ltd., 287-289, Edgware Rd., London, W.2. [3107]

TELEVISION APPARATUS

EDISWAN Cathode Ray Tube and Mains H.T. Unit for Same, double time base and H.T. unit for same, complete with all valves, had five hours' use only; £10; may be viewed by appointment.—Iles "Hill Top," Stock Rd., Billericay, Essex. [3258]

VALVES

ANDERSON.

ALL Types of American Valves, fully guaranteed first grade Raytheon, Sylvania, Philco, Triad Impex; 5/- each; also line cords, American type condensers and replacements for American sets; stamp for list.

J. F. ANDERSON, 35, Lansdowne Rd., Walthamstow, E.17. Telephone: Walthamstow 0827. [2947]

AMERICAN Valves, first grade, in all types; trade supplied—Metropolitan Radio Service Co., 1021, Finchley Rd., N.W.11. Speedwell 3000. [0436]

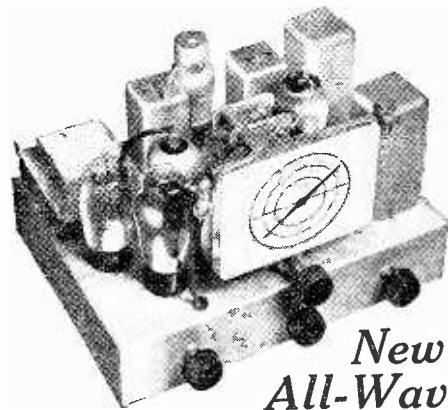
HIVAC, TENGSRAM, and all Reliable Americans, a complete service to traders; orders c.o.d. or send for lists.—Leonard Heys, 36, Henry St., Blackpool. [0529]

3/- Each.—American valves, all popular types, 90-day guarantee; full range in stock, National Union, Hytron, Triad, metal, glass and MG.; send for lists.

RADIOGRAPHIC, Ltd., 66, Osborne St., Glasgow, C.1. [3239]

AMERICAN Valves, all normal types, 4/-, fully guaranteed; also National Union at various prices.—E. M. Fellows, 94, Ferney Rd., East Barnet, Herts. [3209]

MCCARTHY LATEST!



New
All-Wave
SUPERHETERODYNE
for
£6.15 (complete with B.V.A. Valves)

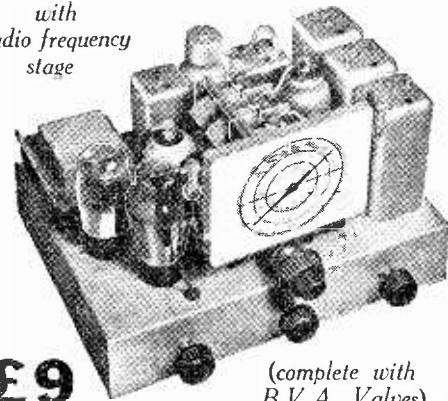
Though employing only 5 valves, the performance of this new McCarthy receiver on all 3 wavebands is comparable with that of many larger receivers at considerably higher prices.

Illuminated "Airplane" dial with principal station names. Wave ranges covered: 17-50, 200-550, 800-2000 metres. Built on heavy cadmium-plated steel chassis. Employs Varley iron-cored I.F. coils.

Circuit comprises: Pre-selector circuit coupled to triode-hexode frequency changer, transformer coupled to high efficiency H.F. pentode I.F. amplifier, I.F. transformer coupled to double diode-triode detector (D.A.V.C. applied to preceding valves), R.C. coupled to steep-slope output pentode giving approximately 3 watts, 4-position wave-range switch provides for gramophone reproduction. Volume control and variable tone control operate on radio and gramophone.

"De Luxe" Model MCCARTHY ALL-WAVE SIX

with
radio frequency
stage



£9 (complete with B.V.A. Valves)

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

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

All McCarthy receivers supplied complete with valves, knobs, pilot lamps, leads, mains cable and plug. 12 months' guarantee. Deferred terms on application, or through London Radio Supply Co., 11, Oat Lane, E.C.2. Cash with order on 7 days' approval. Also write for illustrated catalogue of complete range of all McCarthy receivers

MCCARTHY RADIO LTD.

44a, Westbourne Grove, London, W.2

Telephone: Bayswater 3201/2.

VALVES

ALL Types of American Valves in Stock of Raytheon, Sylvania, and Arcotrus makes, at competitive prices, guaranteed for six months; send for full list; 350 ohms line cords, 2/8.
WARD, 46, Farrington St., London, E.C.4. Tel.: Holborn 9703. [0452]
NOTHING Better Available; six months' guarantee; complete range of battery, A.C. mains, rectifiers, always in stock; 2-volt det., H.F., L.F., 2/3; power, 2/9; screen grid, pentode, H.F. pentode, 5/-; American types, fully guaranteed, 5/6 each; Nos. 80, 42, 43, 57, 58, 77, 78, 6C6, 6D6, 25Y5, 25Z5.—Write for other prices to Dulci Electrical Co., Ltd., 7, Lizard St., London, E.C.1. [0501]

METERS, ETC.

AVO Oscillator, new April, recently overhauled by makers, as new; £2/15.—Jay's, 380, Commercial Rd., E.1. [3251]
SIGNAL Generator, all wave, Readrite, 15-3,000 metres, magnificent instrument in beautiful carrying case, brand new, guaranteed; £6/6.
OUTPUT Meter, Readrite, 0-100, for same or separate; £2/2.
INSTRUMENTS You Will be Proud to Own: cash with order or c.o.d., on appro. if desired.—Kay, 1, Old Church Lane, N.W.9. Col. 8266. [0540]

NEW COMPONENTS

ALL Standard Makes, wholesale only; write for lists.—Leonard Heys, 36, Henry St., Blackpool. [0528]
"WIRELESS World" Transverse Current Microphones, in parts; original model 8/6, improved 10/-, complete.
A HINDERLICH, 2, Bridge Rd., London, N.W.10. [3276]

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

VAUXILIARY.—Polar Midget 3-gang condensers, straight or superhet., 8/9; Polar full vision, horizontal or Arcuate dial and drives, 5/-.
VAUXILIARY.—J.B. drives with station-named scale, latest type, com. etc, 5/6; T.C.C. tubular, 0.25 mfd., 9d.
VAUXILIARY.—Flat, sheet aluminium, hard rolled, 18 gauge 12in.x12in., 3/-; 18x18, 5/6; other sizes pro rata.
VAUXILIARY.—Hivac, Tungram valves, full range; full discounts allowed from new prices.
VAUXILIARY.—Polar station-named scales, for horizontal dials, latest settings; 1/9 each.
VAUXILIARY.—Polar, two-gang condenser, 6/8; Colvern twin-gang iron cored coils, on base with switch, 20/-.
VAUXILIARY.—Shortwave superhet. converter unit, mains or battery, complete kit with dual ratio drive, full directions, well known makers; 40/6.
VAUXILIARY.—T.C.C. electrolytic condensers, 8 mfd. and 4 mfd., 55c velt. 3/-; 500 volt, 2/6; 450 volt, 2/5.
VAUXILIARY.—T.C.C. condensers, tubular, non-inductive, 0.1, 6d.; 50 mfd., 50v. working, 1/6; 50 mfd., 15v., 1/3; 0.05, 6d.; 0.002, 0.0002, 0.001, 0.0001, 4d. each.
VAUXILIARY.—T.C.C. mica, 0.002, 2,000 volt test, 10d.; 0.001, 4d.; 0.001, 1/-; 1 mfd. Mansbridge, 1/3.
VAUXILIARY.—Resistances by well-known manufacturers, 1-watt type, 6d. each; all values.
VAUXILIARY.—Centre tapped iron cored I.F. transformers, bases, terminals, 110 k/c; 6/6, guaranteed.
VAUXILIARY.—Set manufacturers' surplus, skeleton type Westinghouse rectifiers, H.T.8, 9/6; H.T.9, H.T.10, 10/-; complete with fixing brackets.
VAUXILIARY.—Colvern coils, G1, G2, G3, or G1, G2 and G3, superhet. type, 30/-; Colpaks, £2/4; Polar drives, 5/-.
VAUXILIARY.—Volume controls, Erie, Colvern, Centralab, 2/-; with switch, 3/-; all values, from 2,000 to 2 meg.
VAUXILIARY.—Pushback wire, four colours, 6 yds. 6d.; G.B.A. screws or nuts, 4d. dozen.
VAUXILIARY.—Collaro 32 model, 32/6; Universal model, 47/6; complete unit, A.C., 200-250v., first quality pick-ups and volume control, 48/-.
VAUXILIARY.—T.C.C., 200 mfd., 10-volt, 3/-; Continental valve holders for Universal valves, with terminals, 3d.
VAUXILIARY.—Chix valve holders, terminals, 7-pin 9d., 5-pin 7d., W.B. 5-pin 4½d.; baseboard mounting, 6d.; post paid 2/6 or over or c.o.d.
VAUXILIARY UTILITIES, 163a, Strand, W.C.2, over Denny's, the Booksellers, Temple Bar 9338. Send postcard for lists free. [0453]
HYAMS RADIO, 23, Lisle St., W.C.2.
KOLSTER Brandes Energised Speakers, 2,500 and 10,000 ohms, universal transformer; 10/6.
B.T.H. Universal Gramo. Motors, slow speed, armature type, with mains resistance; 27/6, less turntable.
ROLA Energised Speakers, 2,000 ohms, fitted pentode transformer, 7in. cone, new and boxed; 9/-.
HYAMS RADIO, 23, Lisle St., W.C.2. Ger. 2969. [3246]
COILS, condensers, transformers, chokes, etc.; stamp for list of bargains.—H. Thackray, 10, Belvedere Terrace, Leeds, 11. [3268]
FERRANTI A.F.5, A.F.6, O.P.M.2 (c.), 15/-; A.F.5 (c.c.), 18/6; guaranteed 12 months.—Grigg, 70, Peel Rd., Wealdstone, Middlesex. [3270]

PARTLY IN RETROSPECT

Last week we had the pleasure of drawing your attention to our S.S. ALL WAVE SEVEN chassis, the new S.S. SUPER AUDITORIUM DUAL SUSPENSION SPEAKER and the S.S.4-12 watt QUALITY AMPLIFIER.

No doubt you noticed all these items described in our half-page advertisement? A great many people did; but quite a number who appreciate "QUALITY" of reproduction seem to think that this is all very well if you have money available. As far as our products are concerned it is not so much a question of "Are they expensive?"; but the whole thing hinges on the financial position of the would-be owners.

In spite of this our more expensive equipments represent a greater proportion of our sales; but we would remind you that you can get S.S. QUALITY EQUIPMENT comprising H.F. Tuner Unit, 4-6 watt Amplifier and Auditorium speaker for £20. The cheaper equipment mentioned is in every way a quality equipment and will be subject matter of a half-page advertisement shortly.

May we send YOU further particulars?

SOUND SALES

MARLBOROUGH RD. (Contractors to the
 UPPER HOLLOWAY G.P.O., etc.)
 LONDON, N.19. LIMITED. Tel.: Archway 1661/2/3.

ARMSTRONG 6-Valve SUPERHETERODYNE RADIOGRAM Chassis with ROLA F.6 SPEAKER

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

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

7 days' trial, carriage paid.

ARMSTRONG 12 months' guarantee.

Price £7.10.0
 Ready to switch on.

ARMSTRONG MANUFACTURING CO.,
 100, KING'S ROAD, CAMDEN TOWN, N.W. 1.
 Phone: GULliver 3105.

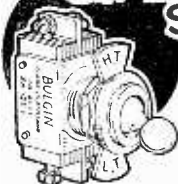
COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

RADIO CLEARANCE
63, High Holborn, W.C.1. Holborn 4631.
LISSEN 4-valve Bandpass Receiver, a splendid job, fitted in handsome walnut cabinet complete with energised moving coil speaker, connection for pick-up; listed at 9 guineas; sent out, aerial tested by our own engineers, 70/-
LISSEN 100 Station Set, B.A. speaker, complete with 3 valves, S.G. detector, pentode, slightly shop soiled; 30/-
AS Above, with P.M. moving coil speaker; 35/-
EXCLUSIVE British Rights Held by Us for Constructed Short Wave Kits: all kits supplied valves free, 5 interchangeable coils, covering a range from 15-600 metres; complete set, not a converter.
1-VALVE Battery Kit; 29/6.
2-VALVE Battery Kit; 32/6.
1-VALVE A.C./D.C. Kit; 37/6.
3-VALVE A.C./D.C. Kit; 50/-.
EVER-READY 5-valve Battery Superhet: an up-to-the-minute modern receiver, fitted 5 ring valves, etc., A.V.C., provision for extension speaker and pick-up, latest square type dial calibrated in metres and station names, listed 12 guineas; last few to clear, £5/10, carriage paid.
LISSEN Battery Band Pass 3, a handsome receiver in walnut cabinet of upright design, complete with valves as follows: var. mu screen grid, detector, pentode output; sent out aerial tested and guaranteed; 57/6.
BRUCE Mains Transformers and Chokes, standard for the season, finest made, British and guaranteed.
250 0-250, 80 m.a., 2-0-2 volts 2.5 amp., 2-0-2 volts 4 amp.; 8/6.
350 0-350, 120 m.a., 2-0-2 volts 2.5 amp., 2-0-2 volts 4 amp.; 10/6.
350 0-350, 150 m.a., 2-0-2 volts 2.5 amp., 2-0-2 volts 4 amp., 2-0-2 volts 2 amp.; 12/6.
500 0-500, 150 m.a., 2-0-2 volts 2.5 amp., 2-0-2 volts 6 amp., 2-0-2 volts 2 amp., 2-0-2 volts 2 amp.; 17/6.
H.T.8 Transformer, 250 volts, 60 m.a., 2-0-2 volts 4 amp., 8/6; ditto, with H.T.8 metal rectifier, 17/6.
ALL Transformers are Fully Shrouded.
BRUCE Mains Chokes:—
40 m.a. 30 hys. 500 ohms; 4/6.
60 m.a. 40 hys. 500 ohms; 6/-.
150 m.a. 40 hys. 200 ohms; 10/6.
250 m.a. 15 hys. 200 ohms; 21/-.
60 m.a. 80 hys. 2,500 ohms, for speaker replacement, etc.; 6/-.
SPECIAL Clearance Choke, 250 m.a. 12 hys. 100 ohms, heavy duty type, interleaved windings, etc., cannot be repeated; 11/-.
TRIAL American Valves, highest quality, all types, 5/6 each, as follows: 01A, 24A, 27, 30, 31, 37, 38, 39, 41, 45, 46, 47, 53, 55, 56, 57, 58, 59, 71A, 75, 78, 80, 6A6, 1C6, 6F7, 2A3, 5Z3, 12A7, 6A7, 6C6, 6D6, 12Z3, 25Z5.
ALL These Valves Carry a 90-day Guarantee and free replacement, provided that the filament or heater is intact, and the glass is not broken when returned to us.
AMERICAN 5-6-7-pin Valve Holder, chassis type; 6d.
CENTRALAB Volume Control, with switch, 5,000, 25,000, 10,000, and 50,000 ohms; 2/6.
LISSEN All-wave Coils, complete with circuit, switching etc., sent out in matched pairs, covering 2 short bands, medium and long; 8/-.
DITTO, single coils; 4/6.
LISSEN 126 kc/s Iron Cored Oscillator Coils, screened; 1/-.
8 mfd. and 4 mfd. Electrolytics, 450 volt working, 500 volt peak; 2/6.
8+8 Cardboard, wire ends, electrolytics, 450 volt working, 500 surge, well known manufacturer; 3/6.
50 mfd., 12 volt working condensers, well known manufacturer; 1/-.
50 mfd., 50 volt working condensers, well known manufacturer; 1/6.
50 mfd., 25 volt working condensers, well known manufacturer; 1/3.
25 mfd., 50 volt working condensers well known manufacturer; 1/-.
8+8+4 Electrolytic Cardboard Condensers, wire ends, 450 volt working; 3/11.
14+8, 450 volt working, electrolytic condensers, metal case, wire ends, by well known manufacturer; 2/6.
25 Volt 25 mfd. Electrolytic Condensers, tubular type, well known manufacturer; 1/-.
P.M. Moving Coil Speaker, 7½in. cone, by well known manufacturer; 8/11.
P.M. Moving Coil Speaker, 6in. cone, by well known manufacturer; 7/8.
MULTI Purpose Valves, suitable for H.F. pentode, listed 21/-; 3/6.
LISSEN Interval Chokes, brand new, boxed; 1/-.
LISSEN Class B 1-1 Hyvernuk Transformers, boxed, brand new, as from makers; 2/6.
LISSEN H.F. Chokes, brand new, boxed, disc type; 1/-.
ENQUIRIES 1½d. Stamp if Reply Expected.
HOURS of Business 9 a.m. to 7 p.m. Saturdays 9 a.m. to 1 p.m.
ALL Orders value 5/- and over Post Free; orders under 5/- must be accompanied by a reasonable amount for postage.
C.O.D. Orders Under 5/- Cannot be Executed.
RADIO CLEARANCE, 63, High Holborn, W.C.1. Holborn 4631. [3187]

BULGIN

RADIO COMPONENTS

S.P.D.T. TOGGLE SWITCHES

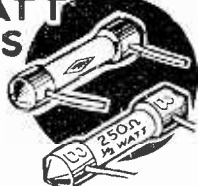


For 15 years The House of Bulgin has been famous for radio switches. All types from S.P. On-Off to Multi-pole multi-way are made. The single-pole, double-throw toggle switch is useful for radio-gramo or H.T.-L.T. switching, etc. Fitted with indication plates Rating 2-A., 250-V.

List No. S.81 Screw Connections.....Price 1/9 each.
List No. S.81-T Solder Tags.....Price 1/6 each.

HALF - WATT RESISTORS

Small, accurate, extremely reliable and of outstanding utility Bulgin 1/2-watt resistors have been used in ten's of thousands of sets. You can use them practically any where.



Available in the following values:—
Price 6d. each.

Ω	1,000	4,000	10,000	30,000	200,000	1 meg.
100	1,500	5,000	12,500	40,000	250,000	2 meg.
150	2,000	6,000	15,000	50,000	300,000	3 meg.
200	2,500	7,000	17,500	75,000	400,000	5 meg.
250	3,000	8,000	20,000	100,000	500,000	All
500	3,500	9,000	25,000	150,000	750,000	Coded

LOW-VALUE POWER RESISTORS



Ideal for meter shunts, pilot-lamp shunts, etc., these ten-watt resistors are accurate to approximately ± 5 per cent. Wound on special compound asbestos toroids and fitted with bands, soldering tabs and terminals.

1/8 Dia. 2" Long

Ten-watt Power Resistors.

List No.	OHMS.	Price	List No.	OHMS.	Price
A.R.2	2	1/-	A.R.100	100	1/-
A.R.5	5		A.R.200	200	
A.R.10	10		A.R.250	250	
A.R.20	20		A.R.300	300	
A.R.30	30		A.R.500	500	
A.R.50	50	EACH.	A.R.1K.	1000	EACH.
*A.R.80	80				

*Special "W.V." value.



THE BULGIN FUSEPLUG

The original fuse-plug mains connector. When it was first produced it was hailed as the finest safety component on the market. It is the best, surest and easiest method of connecting all sets, eliminators and household appliances to the supply mains, and automatically providing fuses.

The Bulgin "Fuse-plug" is supplied complete with two internal 1 amp. fuses (1 amp. unless otherwise specified). Moulded in bakelite. It fits all standard 5-amp. sockets. The fuses cannot be handled while the plug is "live".

List No. P.25 Walnut } 2/- each.
List No. P.27 Mahogany..... }

COUPON

To A. F. BULGIN & CO., LTD.,
Abbey Road, Barking, Essex.

Please forward me post free a copy of your 110-page Catalogue No. 156, for which I enclose gd. in stamps.

Name.....

Address.....



(PLEASE USE BLOCK LETTERS)

Send this Coupon Now

Adv. of A. F. BULGIN & Co. LTD., ABBEY ROAD, BARKING.
Telephone: RIFLEWAY 2471 (3 lines).
Showrooms: 64, HOLBORN VIADUCT, LONDON, E.C.1.

COMPONENTS—SECOND-HAND. CLEARANCE, SURPLUS, ETC.

ALL Lines Advertised in Last Week's Issue Still Available.

WARD, 46 Farringdon St. Telephone: Holborn 9703. [0450

SOUTHERN RADIO'S Wireless Bargains; all goods guaranteed and sent post paid.

G.E.C. 3-valve Battery Sets, "Battery Compact Three," with 5 Osram valves, moving coil speaker in beautiful bakelite cabinet, brand new, in sealed cartons, fully guaranteed; 50/- each (dist £5/10).

SPEAKERS.—Celestion Soundex permanent magnet, 10"; Telsens permanent magnet, with 10-ratio transformer to suit any receiver, 12/6; Telsens loud speaker units, 2/6; all brand new and in sealed cartons.

COILS.—Telsens, iron core, W349, Midget size, 4/-; Type W478 (twin), 9/- pair; W477 (triple), 16/- set; Type W476 (triple superhet) selector and oscillator, 16/- set, all ganged coils complete on base with switch; Telsens I.P. transformer coils, W482, 5/-; Telsens dual range aerial coils, with aerial series condenser incorporated, W76, 4/-; Telsens aerial series condensers, with shorting switch, 2/-; Telsens I.P. transformers, Type R.G.4 (4 to 1), 3/-; all brand new, in sealed cartons.

MICROPHONES.—Ace (P.O.) microphones, complete with transformer, ready for use with any receiver, 4/6 each; Ace concert microphone, complete on chromium stand with volume control, ready for use with any receiver and amplifier, 11/-.

RESISTANCES.—Tru-ohm 1-watt, colour coded and marked, 36 assorted capacities on card; 6/- per card.

POTENTIAL Dividers.—Lissen wire wound 3-section, 60-watt, 4,500 ohms, 5,000 ohms and 2,000 ohms; 3-section, 5-watt, 20,000, 20,000, and 20,000 ohms; 2-section, 5-watt, 50,000 and 30,000 ohms; 1-section, 5-watt, 8,000 ohms, all at 1/3 each; brand new and guaranteed.

AMERICAN Valves.—A full range of valves for all American receivers; 6/- each.

HEADPHONES.—Lightweight headphones, double pole type, 4,000 ohms each ear piece; 3/- pair.

WE Have Purchased the Complete Component Stock of a Well-known Radio Dealer and Manufacturer, and we are offering the complete stock in parcel lots as under:—

5/- Parcel, containing components to the value of at least 20/-, comprising chokes, resistances, coils, switches, condensers, wire and circuits, 5/- per parcel.

10/- Parcel, containing components to value of at least 45/-, comprising variable condensers, screened chokes, switches, resistances, screen coil, wire, circuits, etc., etc.; 10/- per parcel.

ALL Articles Included in These Parcels are Brand New and Modern.

SOUTHERN RADIO.—Branches at 271-275, High Rd., Willesden Green, N.W.10; 46, Lisle St., London, W.C.2. All mail orders to 323, Euston Rd., London, N.W.1.

SOUTHERN RADIO, 323, Euston Rd., London, N.W.1 (near Warren Street Tube). Phone: Euston 3775. [3287

MAINS RADIO'S Superb Bargains are now Displayed on page 11. Don't miss them.

MAINS RADIO DEVELOPMENT COMPANY, 4-6, Muswell Hill Rd., London, N.6 Tudor 4046. [2914

OLIVERS Offer Erie Resistances, 1-watt colour coded, all values, 3/4d. each, 3/- dozen; 2/6 dozen in 3-dozen lots.

COLLARO Gramo Motors, A.C. 110-250v., 50 cycles, unit-plate, auto start and stop, turntable, regulator, etc., bronze, 23/6; ditto in radiogram unit, complete with rectangular unit-plate, 14in. x 16in., and standard pick-up incorporating volume control, 38/- complete.

ROLA Manufacturer's Type Energised Speakers, 2,000 ohms and 2,500 ohms, with power or pentode transformer, brand new, 10/6; Plessey Jensen, P.M. speakers, 10/6

WESTINGHOUSE Metal Rectifiers, H.T.8, 8/6; H.T.9, 9/-; H.T.10, 9/6; aluminium chassis, 18 gauge, 16in. x 10in. x 5in., undrilled, 5/-; ditto in 16 gauge aluminium, 7/6.

CLIX Chassis Mounting Valve Holders, 5-pin, 3/-; 7-pin, 4/-; fuse bulbs, 7/4d. dozen; tubular glass fuses, 3/4d. each.

CENTRALAB Volume Controls, standard type, with switch only, 2/- each; Hunt's cardboard case electrolytics, 4mfd., 1/6; 8mfd., 1/9; 50mfd., 50v., 1/6; 8mfd. plus 4mfd., 2/5; 8mfd. plus 8mfd., 2/9; 4mfd. plus 4mfd., 2/-; metal case electrolytics, B.I. and T.C.C., 8mfd., 2/4; 4mfd., 2/1; Dubilier 8mfd., 2/6; Wego smoothing condensers, 4mfd., 800v. working, metal cased, 8/6 each.

OLIVERS, 676, Christchurch Rd., Boscombe, Hants. All orders under 5/6 postage extra. All enquiries invited, lists free. [3265

SHAFTESBURY SUPPLIES.—Bargains offered on page 12 in last week's issue still available. Additional offers:—

500 Brand New Electric Clocks (30/- models), wall or table type, walnut or coloured cellulose finish; exceptional offer, 14/6; 12 months' guarantee with every clock.

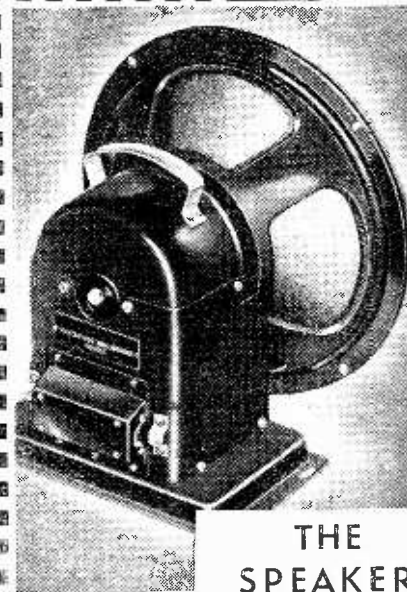
1hp. A.C. Motor 1,425 r.p.m. Brand new; 50/-.

55/-—Shaftesbury "Bio-Tran" world famous transverse current microphone, as shown on our stand, 1936 Radiolympia, and supplied the world over, chromium plated (el. floor stand, 27/6; big range of stands available from 9/11.

BRITAIN'S Foremost Mail Order House.

SHAFTESBURY SUPPLIES, 224, Shaftesbury Av., London, W.C.2. Tem Bar 4175. [3290

POINTS OF IMPORTANCE in the Rola G.12



THE SPEAKER THAT GUARANTEES THE SET

A G.12 speaker in any receiver is a guarantee of the quality of the whole set. The G.12 is the finest speaker which any manufacturer can install. Its presence in a receiver affords conclusive evidence of the fact that none of the components has been bought on a price basis. Whenever you purchase a new receiver make quite sure that it is G.12 equipped. When you need a new speaker ask your dealer to demonstrate the Rola G.12. You will realise then what high fidelity really means.

G.12 D.C. (as illustrated) complete with Transformer, Mounting Stand, Handle and Base	£5 5 0
G.12 D.C. with Mounting Stand, Handle and Base, but without Transformer	£4 16 0
G.12 D.C. Stripped, but with Transformer	£4 4 0
G.12 D.C. Stripped and without Transformer	£3 15 0
(When ordering please state Field Resistance and Impedance of Transformer required.)	
G.12 P.M. less Transformer	£4 16 0
G.12 P.M. with Transformer	£5 5 0

For Public Address work both the P.M. and Energised Models can be supplied with a 15 ohm Voice Coil at an additional charge of 3/-.

Write for Folder A.

OVER 7 MILLION IN USE

ROLA

The World's Finest Reproducers

THE BRITISH ROLA CO. LTD.
MINERVA ROAD, PARK ROYAL, N.W.10.
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PREMIER SUPPLY STORES

THE LARGEST RADIO MAIL ORDER HOUSE IN THE WORLD

Offer the following Set Manufacturers' Brand New Surplus Goods at a Fraction of the Original Cost; all goods guaranteed perfect; carr. paid over 5/-; under 5/- postage 6d. extra. Orders under 5/- cannot be sent C.O.D.

ALL POST ORDERS TO JUBILEE WORKS, 167, LOWER CLAPTON RD., LONDON, E.5

CALLERS, AS USUAL, TO 20-22, HIGH ST., CLAPHAM, S.W.4 (Macaulay 2381) 'Phone: Amherst 4723
 And 165 & 165a, FLEET ST., E.C.4 (Next door to Anderton's Hotel.) Central 2833.

MAINS VALVES.

MAINS VALVES, famous Europa 4 v. A.C. types, 4/6 each. H.L., L., S.G., Var.-Mu-S.G., H.F.-Pens., Var.-Mu-H.F. Pens. 1, 3 and 4-watt A.C. directly-heated output Pentodes. Full-wave rectifiers, 250 v. 60 m.a. A.C./D.C. types. 20-volt. 18 amp. S.G., Var.-Mu-S.G., H., H.L., Power. Following Types all 5/6 each. Full-wave rectifiers, 350 v. 120 m.a. and 500 v. 120 m.a. 2½ watt indirectly-heated Pentodes.

Frequency Changers, Octodes and Heptodes.

BATTERY VALVES, 2 volts, H.F., L.F., 2/3. Power Super-Power, 2/9. S.G., Var.-Mu-S.G., 4- or 5-pin Pentodes, H.F. Pens., V.-Mu-H.F. Pens., 5/- Class B, 3/6.

AMERICAN VALVES. Genuine American **HYTRON** and **TRIAD** first-grade Valves. 3 months guarantee. All types in stock, 5/6 each. 210 and 250, 8/6 each. New Metal-Glass Valves, all types, 6/6 each. Genuine American **DUOTRON** Valves, all types, 3/6 each. Valve holders for all above types, 6d. each. Metal bases, 9d. each.

SHORT WAVES

SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, 1/9 each, with circuit. Special set of 3 S.W. Coils, 14-150 metres, 4/- set, with circuit. Premier 3-band S.W. Coil, 11-25, 19-43, 38-86 metres. Simplifies S.W. receiver construction, suitable any type circuit, 2/6.

COIL FORMERS, in finest plastic material, 1½ in. low-loss ribbed, 4- or 6-pin, 1/- each.

SUPER CERAMIC CONDENSERS, S.L.F. .00016, .0001, 2/9 each; double-spaced, .00005, .00025, .00015, 3/- each. All brass with integral slow motion, .00015 tuning, 3/9; .00015 reaction, 2/9. British Radiophone 2-gang .00016, 5/6.

H.F. CHOKES. S.W. 10-200 metres, 9d.; S.W. screened, 1/6; standard screened 180-2,000 metres, 1/6.

CERAMIC S.W. VALVE HOLDERS, 4-, 5- or 7-pin. Chassis type, 6d.; B.B. type, 8d.

GLASS AERIAL INSULATORS, 4d. each.

BEEHIVE STAND-OFF, 6d. each.

SCREENED FLEX, single, 3d. yd. twin, 4d. yfd.

PREMIER AMPLIFIER KITS

3-WATT A.C. AMPLIFIER, 2-stage, for mike or pick-up. Complete kit of parts with 3 valves, 40/-.
7-WATT A.C./D.C. AMPLIFIER. 3-stage, high-gain, push-pull output. Complete kit of parts with 5 specially matched valves, 24 4s.
10-WATT 3-stage A.C. Amplifier Kit with 5-valves, 25 5s.
20-WATT 3-stage A.C. Amplifier Kit with 5 valves, 28 5s.
ELECTROLYTICS. U.S.A., 4, 8 or 12 mfd. 530 v. peak, 1/9 each. Dablier, 4 or 8 mfd. 500 v., 3/-; 50 mfd. 50 v., 1/9; 12 mfd. 20 v., 6d.; 25 mfd. 25 v., 1/-; T.C.C. 4 or 8 mfd. 550 v., 4/-; 15 mfd. 50 or 100 v., 1/-; 50 mfd. 12 v., 1/-.
Paper Condensers. W.E., 250v. working 4 mf., 2/-; 2 mf. 1/-; 1 mf. 6d.; 350 v. working 4 mf., 2/6; 2 mf., 1/6. Dablier 500 v. working 4 mf. 4/-; 800 v. 4 mf. 6/-; Wego 450 v. working 1 mf., 1/-; 2 mf. 1/9, 4 mf. 3/-; 700 v. working 2 mf. 2/-, 4 mf., 3/-.
COSMOCORD PICK-UPS, with tonearm and volume control, 10/6 each.
PICK-UP HEADS only, 4/6 each.

MAINS TRANSFORMERS

PREMIER wire-end type with screened primaries, tapped 200-250 v. Centre-tapped Filaments. Guaranteed one year H.T. 8 & 9 or H.T. 10 with 4 v. 4 a. C.T. and 4 v. 1 a. C.T., 8/6. 250-250 v. 60 m.a., 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T., 8/6. 350-350 v. 120 m.a., 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T., 10/6. Any of these transformers with engraved panel and N.P. terminals, 1/6 extra. 500-500 v. 150 m.a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 17/6.

AUTO TRANSFORMERS, step up or down, 60 watts, 7/6; 100 watts, 10/-. Super Model, 19/6.

FILAMENT TRANSFORMERS, Tapped Primaries, 200-250 v. All secondaries C.T. 4 v. 3 a., 7/6; 4 v. 5 a., 8/6; 7.5 v. 3 a., 7/6; 6 v. 3 a., 7/6; 2.5 v. 8 a., 7/6; 6.3 v. 3 a., 7/6; 5 v. 3 a., 7/6.

SMOOTHING CHOKES, 25 m.a., 2/9; 40 m.a., 4/-; 60 m.a., 5/6; 150 m.a., 10/6. 2,500 ohms, 60 m.a. Speaker Replacement Chokes, 5/6.

MILLIAMMETERS, moving-iron, flush 2½ in., all ranges from 0-10, m.a., 5/9. Visual tuning, 6 or 12 m.a., 5/9. Moving-coil

PREMIER (Reisz Pattern) Transverse-current MIKE, High Output, Straight Line Response, 30/-. Transformer, 5/-, Table Stand, 7/6.

2½ in. 0-1 m.a., 18/6; 3½ in. 0-1 m.a., 22/6. Multipliers 1/- each.

AMPMETERS, all ranges from 0-1 amp., 5/9.

TRANSFORMERS, latest type Telsen R.G.4 (list 12/6), 2/9. Lissen Hypernik Q.P.P. (list 12/6), 3/6.

OUTPUT TRANSFORMERS for Power, Pentode and Push-Pull, 2/6; Multi-Ratio, 4/6; Push-Pull Input Transformers by prominent manufacturer, 4/6 each.

ELIMINATOR KITS for A.C. mains, 120 v. 20 m.a., or 150 v. 25 m.a., 15/-, tapped S.G. det. and output. Complete Kit with long-life valve rectifier (replacement cost only 2/-).

PREMIER L.T. CHARGER KITS for A.C. mains, including Westinghouse Rectifiers and Tapped Mains Transformers, 8 volts at ½ amp., 14/6; 8 volts 1 a., 17/6; 15 volts 1 a., 19/-; 15+15 volts 1 a., 37/6; 15+15+15 volts 1 a., 50/-; 8 volts 2 a., 29/6.

TELSEN iron-cored screened coils, W.340, 4/- each.

Electric SOLDERING IRONS, 200-250 v., A.C./D.C., 2/3.

LOTUS JACKS (and Jack-switches), all types, 1/- each. Lotus Plugs, 1/- each.

PREMIER H.T. KITS, all with Westinghouse rectifiers; tapped transformers and adequate smoothing. All Kits absolutely complete. 120 v. 20 ma., 20/-; with ½ a. L.T. Charger, 28/-; 150 v. 30 m.a., 25/-; with ½ a. L.T. Charger, 31/6. 250 v. 60 m.a., with 4 v. 3 a. C.T., 30/-.

SHORT WAVE KITS

SHORT-WAVE KIT for 1-valve receiver or adaptor, complete with chassis, 4 coils, 14-150 metres, condensers, circuit and all parts, 12/6. **VALVE GIVEN FREE! DE LUXE MODEL, 17/6.** SUPERHET CONVERTER KIT, 13/6. **S.W. SUPERHET CONVERTER**, or A.C. Mains Receivers, 20/-, A.C. Valve given FREE!

2-VALVE S.W. KIT, 19/6. VALVE GIVEN FREE!
3-VALVE S.W. KIT, S.G. Det. and Pen., 42/-. **VALVE GIVEN FREE!**

ALL-WAVE "ALL-WORLD RANGE" 3-valve Kit 12-2,000 metres in 4 wavebands without coil changing, complete kit of parts with 3 valves, S.G., H.F., S.G. det. and pentode (2 volts); 50/-, Q.P.P. Model, 6/6 extra.

BAND-PASS TUNING PACK, comprising set of Telsen 3-gang iron-cored coils with switching mounted on steel chassis with 3-gang condenser, illuminated disc-drive and 4 valve holders. 25/- the lot. All Mains or Battery circuit. FREE!

LISSEN ALL-WAVE COILS, 12-2,000 metres, complete with switching and wiring diagram, 12/6.

3 VALVE BAND-PASS KIT, 200-2,000 metres. Complete kit of parts, including chassis, all components, valves, M.C. speaker and wiring diagram. Battery Model 50/-, A.C. Mains Model, 70/-.

MOVING COIL SPEAKERS

MAGNAVOX. Mains energised. 154, 7 in. cone, 2,500 ohms 4 watts, 12/6; 152, 9 in. cone, 2,500 ohms, 17/6; 152 Magna, 9 in. cone, 2,500 ohms, 0 watts, 37/6. **Magnavox P.M.s.**-154, 7 in. cone, 16/6; 252, 9 in. cone, 22/6. Reliable P.M.s., 10/6.

ROLA latest type P.M.s., 18/6. **KB** 7 in. mains energised, 1,500 or 2,500 ohms, 7/9. **GOODMANS'** 8 in. mains energised, 1,000 ohms field, 10/3 each.

DIALS—Clarion Illuminated S.W. slow-motion Dial with 2 in. knob, 2/-. Premier All-Wave 2-speed Dial, full vision straight-line, dual ratios 10-1 and 150-1, 6/6, with escutcheon.

Potentiometers by well-known makers. All values up to 1 meg., 2/-; with switch, 2/6. **GRAMOPHONE MOTORS**. Collaro Gramophone Unit consisting of A.C. motor, 100-250 v. high quality pick-up and volume control, 45/-; Collaro motor only, 30/-; Collaro Universal Gramophone Motor, 100-250 v. A.C./D.C., with high quality pick-up and volume control, 67/6; Collaro Universal Motor only, 49/6; Edison Bell double-spring motors, including turntable and all fittings, 15/-; Cosmo-cord Gramo unit, comprising A.C. motor pick-up and volume control (list 55/-), 35/9.

TUBULAR CONDENSER, non-inductive, all values up to 5 mfd., 6d. each.

Wire-end RESISTORS, any value, 1 watt, 6d.; 4 watts, 1/-; 8 watts, 1/6; 15 watts, 2/-; 25 watts, 2/6 each.

Reliable **MORSE KEYS** with Morse Code engraved on bakelite base, 2/- each.

Bakelite case **BUZZERS** 1/3; Walnut case "Loud-tone," 2/6 each.

Super Quality lightweight **HEADPHONES**, 3/3 pair.

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

PREMIER SUPPLY STORES.
 PLEASE See Our Displayed Advertisement on this Page.
 ALL Post Orders Should be Addressed to Jubilee Works, 167, Lower Clapton Rd., London, E.5. Callers as usual to:—
 20-22, High St., Clapham, S.W.4. Open till 9 p.m. Saturdays, Wednesdays 1 p.m. Macaulay 2381.
 165 and 165a, Fleet St., E.C.4 (next door to Anderton's Hotel). Early closing Saturday 1.30 p.m. Central 2833. [0488]

RADIO and ENGINEERING SUPPLIES.

ELIMINATORS, super quality, guaranteed 12 months. Westinghouse rectifier, input 200-260v. A.C., output 150v. 30 m.a., taps at 60, 90 and 150v., 21/6; with 2v. ½ amp. trickle charger, 27/6; it will pay you to send for details before buying your eliminator.

SPEAKERS by World Famous Manufacturer, 8 in. P.M., pentode transformer, high-flux mag., super finish; 13/6.

TUBULAR Condensers by Well Known Manufacturer, 0.002, 0.01, 0.05, 0.02, 3d.; 0.1, 0.25, 5d.

ERIL Resistors, 1-watt, all values, 4d.

SHORTWAVE Plug-in Coils, fit standard valve-holder, 13-26, 22-47, 41-94 metres, 4- or 6-pin, 1/9 each. super quality, 2/6 each; set of three, 7/-.

SHORTWAVE Condensers, 0.0001, 0.00015, 0.002, 0.00025, 1/11; with 10-1 slow motion and 3 in. dial and knob, 2/11.

SHORTWAVE all Brass Slow Motion Condensers, 0.00015, 4/3; 0.0002, 0.00025, 4/9.

SHORTWAVE Low-loss Chokes, 10-100 metres, 7d. each.

SHORTWAVE Straight Vision Drive, 4/9; dual ratio, 8-1 and 100-1, 5/6.

VALVE HOLDERS Clix Chassis mounting, 4- and 5-pin, 3d.; 7-pin, 4d.

AMERICAN Valves, first grade Hytron, three months' guarantee, all types, 5/-; line cords, 2,6 each.

HVAC Valves, complete stock, send for list, liberal discount to the trade.

AIRPLANE Dials, square type, chrome; 4/6.

SHORTWAVE Bargain List, send stamp.

TRADE Enquiries, special service to the trade, send stamp and trade heading for lists.

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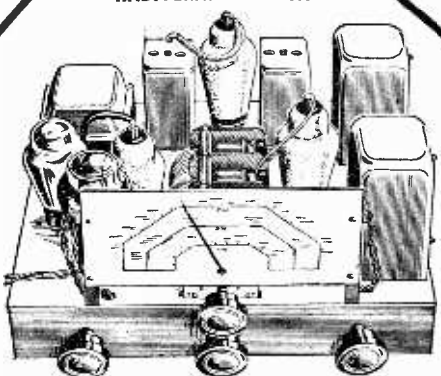
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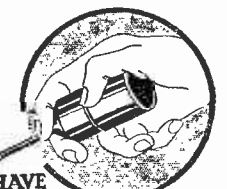
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PATENTS

PATENTS and Designs Acts, 1907 to 1932.

NOTICE is hereby given that Marconi's Wireless Telegraph Co., Ltd., of Electric House, Victoria Embankment, London, W.C.2, seek leave to amend the specification of Letters Patent No. 357,968 granted to Charles Holt Smith and Frederick William Meredith for an invention entitled "Improvements in or relating to electric indicating systems."

PARTICULARS of the Proposed Amendment were set forth in No. 2497 of the Official Journal (Patents), published on November 25th, 1936.

ANY Person, or persons, may give notice of opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton Buildings, London, W.C.2, within one calendar month from the date of publication of the said Journal.

M. F. LINDLEY, Comptroller-General. [3260]

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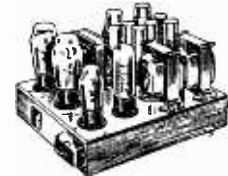
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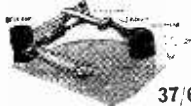
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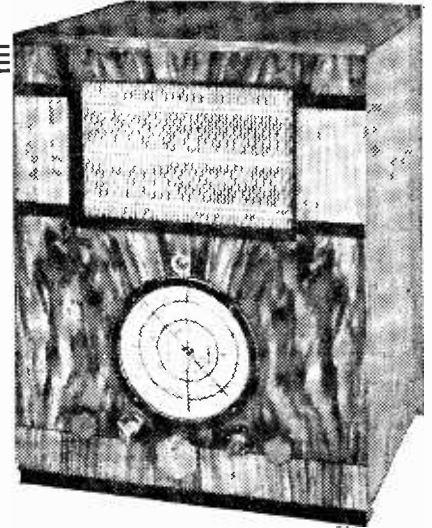
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