The Wireless World AND RADIO REVIEW

VOLUME XXIV

JANUARY 2nd—JUNE 26th, 1929

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BOOK REVIEWS.

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NEW YEAR RESOLUTIONS.

THE making of New Year resolutions is a practice of questionable value, for so often such resolutions are hastily framed and recklessly undertaken only to be broken before many weeks or perhaps even many days of the New Year have passed.

We do not, therefore, propose on this occasion to make New Year resolutions for ourselves, but instead to adopt the very much easier task of suggesting some New Year resolutions for the observance of others for the mutual benefit of ourselves and our readers.

A Resolution for Geneva.

First, let us turn our attention to the broadcasting authorities of Europe, and especially to the Geneva Committee, and for their consideration recommend a New Year resolution that 1929 shall see the elimination of all mutual interference between the broadcasting stations of Europe and the establishment of wavelengths and power on a basis of equity which shall give satisfaction in every country. We would also recommend to Geneva the consideration of station identification signals, a vexed question which yet remains unsettled in spite of the fact that it becomes year by year a factor of greater importance to the listener whose interest in foreign reception steadily increases.

For the B.B.C.

Next, we may turn to our own Broadcasting Corporation and invite them not to halt and look back with pride on the accomplishments of the past but to face the future with that same pioneering spirit of enterprise which has built up the foundations of our broadcasting service so surely, and let them never forget the prime object for which the Corporation exists, however alluring might be the picture of a jam factory as a profitable commercial enterprise.

If it has been decided that the Regional Scheme is to be the basis of our broadcasting distribution, then let that scheme be proceeded with without delay or hesitation. Before we conclude our New Year resolutions for the British Broadcasting Corporation, let us remind them that what others can do, and have already achieved, in the direction of short-wave world broadcasting, that much, at least, we expect of them.

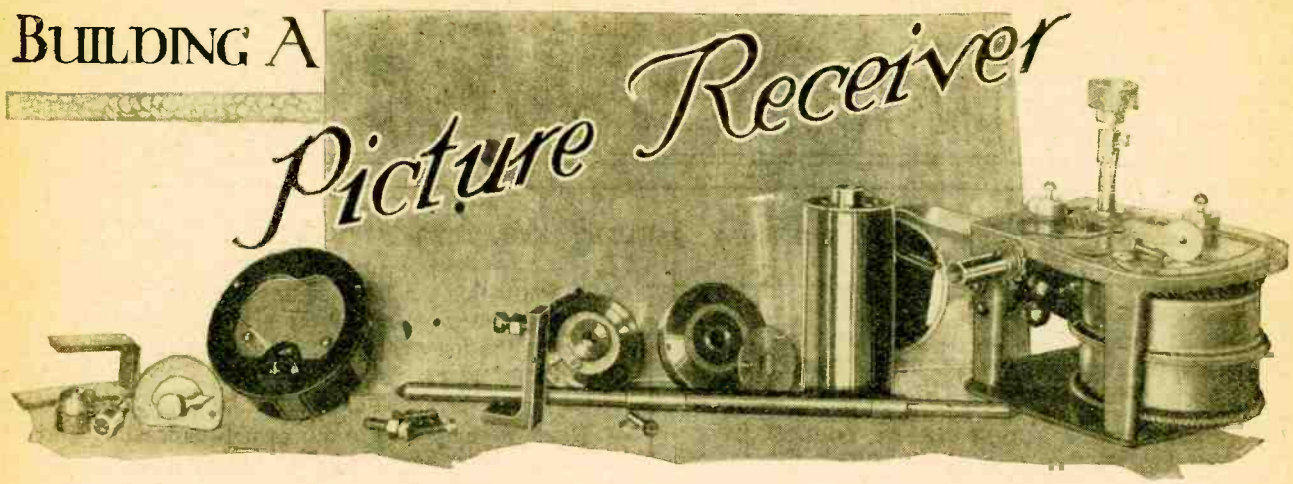
For the Manufacturers.

To the manufacturers on whom we are all dependent for our wireless apparatus, let us commend as a New Year resolution that they should not ignore the hopes of the public that in 1929 the announcement of new products may coincide with the ability to supply to the public by a more successful anticipation of public demand. Next, let us invite the manufacturers to consider the question of standardisation, which is still in many branches of the industry a matter of vexation and disappointment. Let us have standards in sizes of such details as grid batteries, so that different makes may be interchangeable; a standard nomenclature for valves and standardisation in the methods adopted for the distribution of electrode connections in the screened-grid valve.

Standardisation is called for in a host of other instances, and whilst the price of different makes of valves is practically standardised according to type, yet we would remind the valve manufacturers that such standardisation need not be upset by a scale reduction of prices of valves in 1929.

In conclusion, whilst wishing our readers all prosperity and happiness in the New Year, we also take this opportunity to invite them to offer to us their suggestions to guide us in any direction in which they may think the value of our service to them may be enhanced.

BUILDING A Picture Receiver



Making the Components.

By F. H. HAYNES.

SINCE picture transmissions became part of the Daventry programme many enquiries have been made for details of the apparatus needed for the reception of the pictures. It has always been implied that whatever device may be required in radio reception or transmission that it is within the skill and facilities of everyone to construct the necessary apparatus. So with the picture receiver, and it is taken for granted that the making-up of such an instrument falls within the scope of the kitchen table workshop.

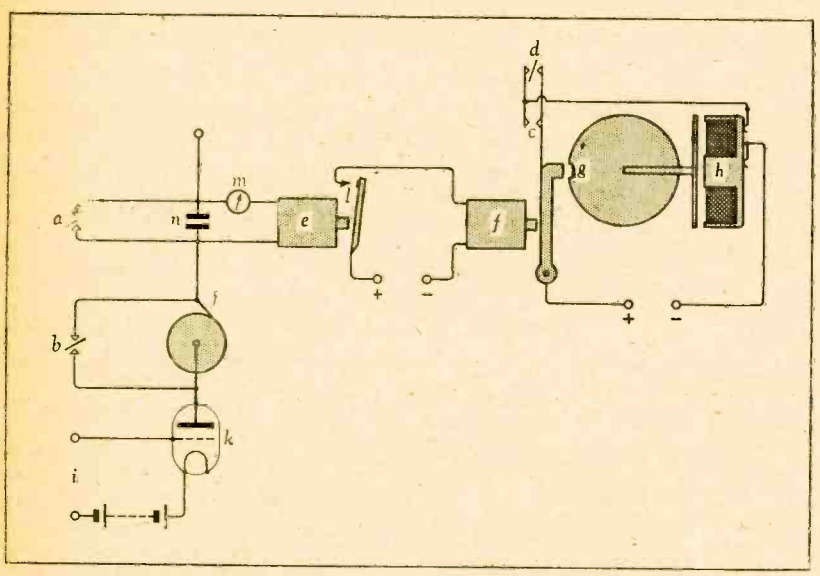
To build a machine from raw materials which will receive the pictures in a reliable manner will prove an attractive undertaking for the model maker who possesses a small lathe and a few bench tools. It is out of the question, however, to attempt a design that can be followed out by a home constructor possessing the modest array of tools required for the construction of radio sets. To meet this new situation, therefore, certain conditions must be fulfilled in contemplating the design. First, the components must be of simple design to suit the home model maker, and, secondly, they must be capable of being easily and cheaply manufactured so that the parts can be readily purchased and assembled with the same ease as the making of a simple wireless set.

Finished Components to be Available.

Regard for these two considerations has governed the details of the designs which have been developed for inclusion in this article. The more elaborate units are dealt with here so that the model maker can proceed with their construction ready for their inclusion in the complete design to be given later, while the manufacturer will be able to supply the made-up component parts almost as soon as the complete design appears.

More than a year ago the writer gave a simple design for a picture receiver, and described its construction and operation.[1] That instrument, although taking the simplest possible form, is capable of receiving the pictures transmitted to-day, providing that the dimensions of the cylinder which carries the paper and the pitch of the thread which causes it to be traversed are brought into line with the standards that have now been set up.

Whether or not it is true, the wireless amateur feels that his home-built



Schematic circuit diagram showing the action of the various components of a Fultograph picture receiver.

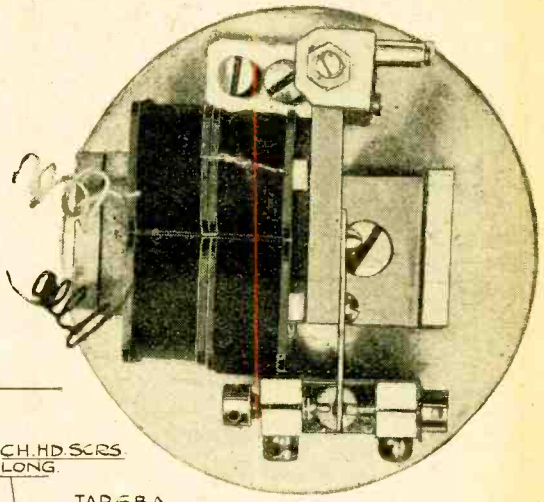
[1] "Practical Picture Receiver," August 24th, 1927.

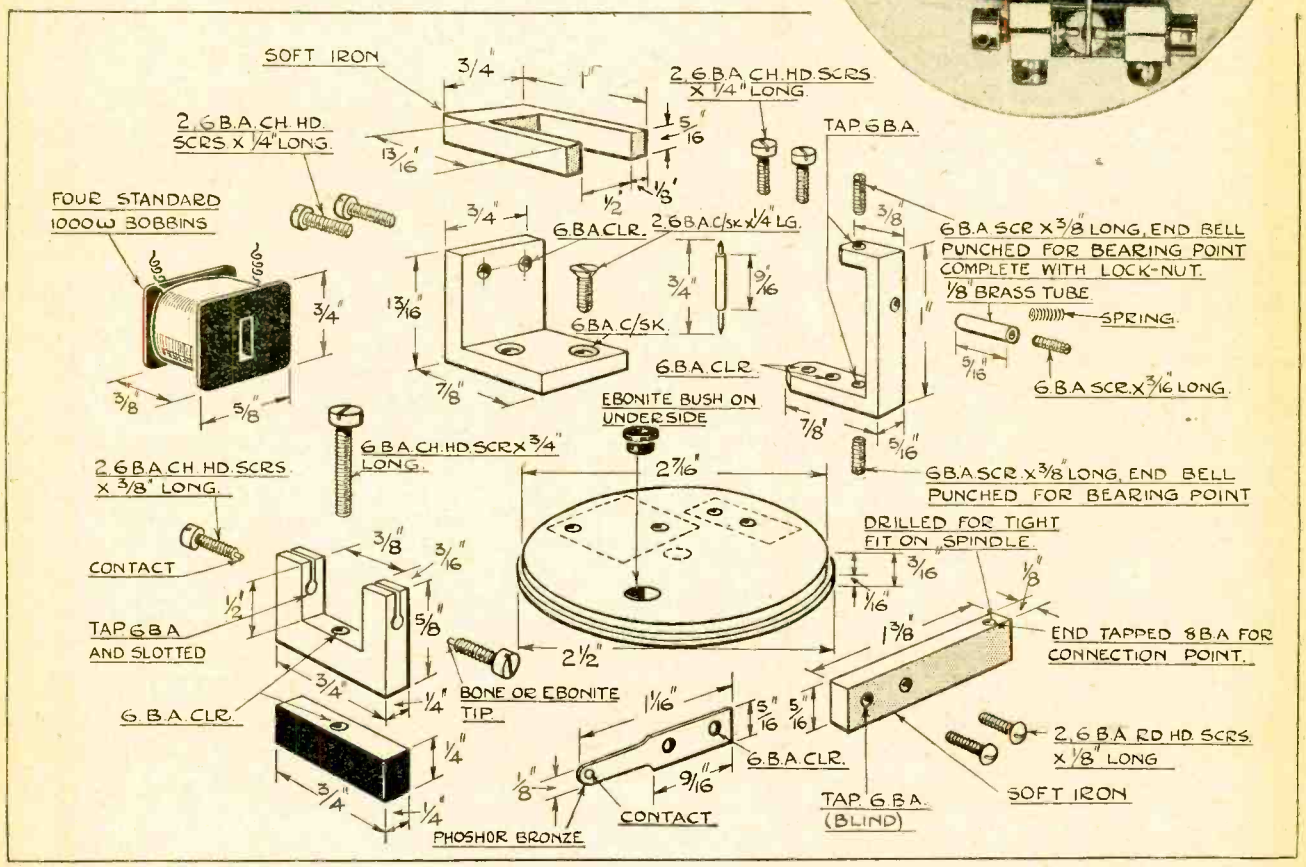
Building a Picture Receiver.—

receiver is better than one he might buy. This point of view deprecates any bid for simplicity which might render the instrument of his labours inferior to the commercial article. Two good reasons necessitate that this design must use as its basis the Fultograph picture receiver. It is to receive from transmissions made with Fultograph apparatus, while a detailed examination of that machine reveals such perfection that any attempt at drastic modification for development on new lines is not likely to lead to the production of a better article.

The Fultograph System.

To avoid reiteration of the details of the Fultograph system the reader is referred to the description and circuits which have already appeared in this journal.[1] Briefly, the action of the various components is as follows: A trigger (*f*) engaging in a slot (*g*) arrests the rotation of spindle and cylinder once each revolution. To avoid imparting a shock to the driving mechanism and to ensure an immediate restoration of rotation at constant speed, the drive is applied through a magnetic clutch (*h*). As the position of stopping is approached a cam (*d*) rotating with the spindle breaks the magnetic clutch circuit, and the trigger falling into a slot locks the action. Concurrent with the breaking of the clutch circuit contacts which normally short-circuit the relay are opened (*a*). A metal cam actuates this contact, and short-circuits the path whereby the incoming signal is taken to the stylus and the cylinder (*b*). It is in this position that a momentary break occurs in the transmission pending the sending out of the synchronising dot. On receipt of the brief synchronising signal the relay is actuated, and, in turn, pulls back the trigger, thus setting the cylinder free.





THE RELAY. This design is given as a basis for constructing a simple relay possessing ample sensitivity. Modifications can obviously be introduced to make use of any small parts one may have to hand. An extension on the magnet bracket shown in photograph affords an alternative support for a release spring.

[1] "The Fultograph." First complete description, October 24th, 1928.

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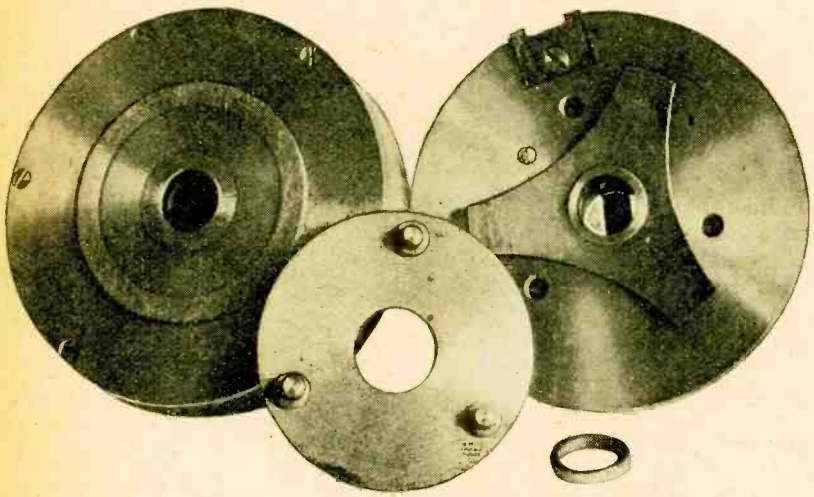
Back contacts (*c*) on the trigger provide for energising the clutch at this moment, but as soon as the cylinder has moved off, this is taken charge of by the cam contacts (*d*). It is important that the synchronising signal shall continue and the trigger be held hard out and its contacts (*c*) closed until the clutch cam (*d*) has moved clear. Further rotation causes a closing of the contacts (*a*) which are across the relay winding, and removes the short circuit (*b*) between stylus and cylinder, so that the incoming signal is now diverted to cause a marking on the paper. Analysing the machine into its component parts, we have the relay, the trigger, cylinder and cams, spindle, magnetic clutch and pinions, the motor and baseplate, the carrier for the knife wheel and stylus, and the radio components, such as milliammeter, input transformer and valve.



THE CLUTCH. The small ring in the centre engages on the pole face while the three pins impart the drive to the catch plate shown on the right.

A Sensitive Relay Required.

Relay.—Sensitiveness of the relay is one of the limiting factors of the range of picture reception. It should be as sensitive as is reasonably possible, and a good standard to specify is that it shall be actuated with a good pressure at its contacts with a current of 1 mA. when its resistance does not exceed 8,000 ohms. After tests with both polarised and non-polarised types it was apparent that a non-polarised relay gave the better results and was easier to adjust. It is essential, however, that the iron used for the magnet shall not retain appreciable magnetism. If it does, increased pressure must necessarily be applied by the tensioning spring in order to restore the armature, and this will render the relay insensitive. The magnet used was actually cut from a piece of soft cast-iron, and was not found to be satisfactory until it had been heated in a bright fire and allowed to cool as the fire extinguished. The armature may need similar treatment.

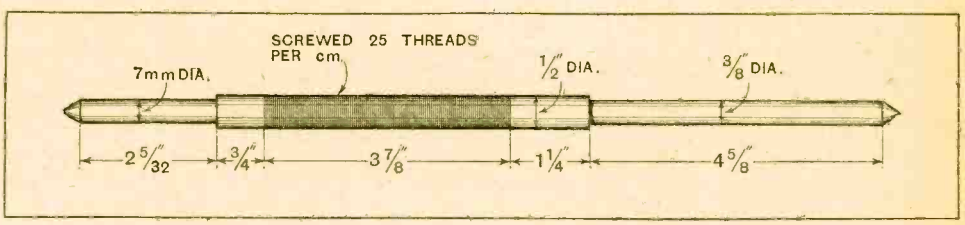
The base plate on which the relay parts are assembled is turned from a brass blank or piece of $\frac{3}{16}$in. hard brass sheet, and the step at the edge allows of the fitting of a cylindrical cover. A clock spindle is made a tight fit in the armature, and is mounted in a bracket between two hollow-ended screws. This bracket is made from a piece of 1in. channelled brass. A small piece of brass tube inserted at its edge before filing down to size encloses a light coiled spring which is adjusted by a screw in the end of the spring. The contact blade is a piece of stiff bronze.

Overall Test for Relay.

Platinum contacts are to be recommended, and all the contacts needed for the machine can be made from $\frac{1}{2}$in. of No. 20 platinum wire. A further $\frac{1}{8}$in. No. 24 platinum wire will be required for the tip of the stylus. The stationary contact and stop are mounted in a bracket cut from $\frac{1}{4}$in. brass sheet. This bracket is actually a telegraph relay fitment and can be readily picked up second hand. A piece of 1in. by $\frac{1}{8}$in. angle brass supports the magnet.

The four bobbins are of standard size and can be purchased ready wound to 1,000 or 2,000 ohms apiece. It is as well to test the polarity of each bobbin before assembling. They are connected in series with N and S ends adjoining each other following around the "U" of the magnet. An error in connecting up is easily made and will render the relay insensitive. An 8,000 ohm relay should pull up on 8 volts and with a 4,000 ohm winding the approximate equivalent test potential with fewer turns and increased current is 6 volts.

Trigger. As angle brass of suitable size is not available for constructing the frame and to avoid the trouble of making a small brass casting a piece of $\frac{1}{8}$in. soft brass sheet (bending brass) was bent up to form a piece on which the parts might be arranged. The armature lever is shaped from a piece of hard brass strip and great care is needed in setting it upon its bearing pin in order that it may be absolutely true and free from side play. It must be realised that there is an appreciable pull on its bearing pin at the moment that the catch engages and stops the rotation. When the catch is just engaging the brass piece is vertical so that the face of the armature actually tilts towards the



Dimensions of spindle with traversing thread arranged to suit a standard magnetic clutch.

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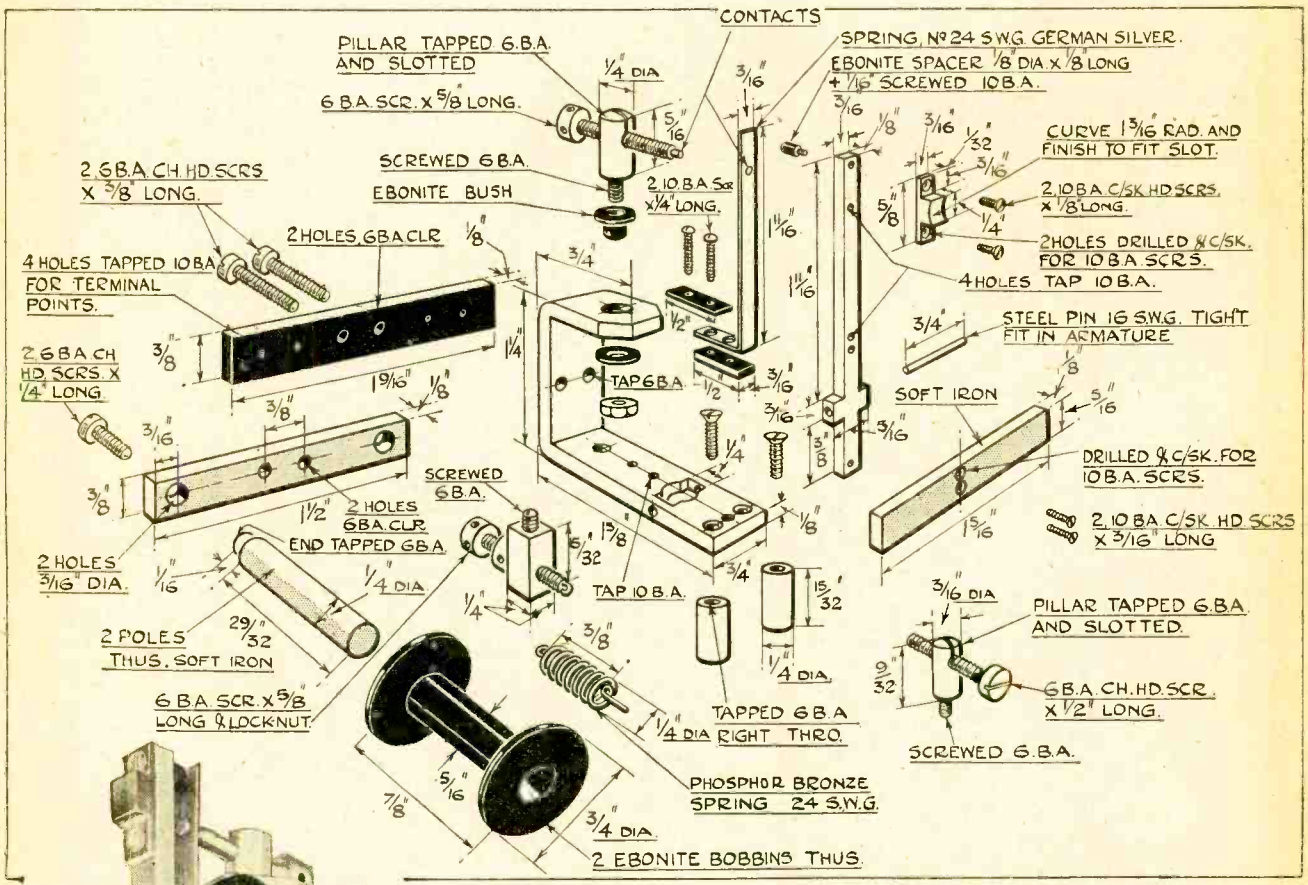
poles when pulled. The gap is, however, exceedingly small and can, if necessary, be finally adjusted by a small brass packing piece inserted at the magnet mounting screws, or, on the other hand, the poles themselves may be adjusted. The tensioning spring is wound from bronze wire and gives a fairly strong pull on the arm. A small brass soldered-on nipple prevents the end of the spring from pulling through the clearance hole at the end of the brass upright.



THE TRIGGER. Here again, obvious modifications may be introduced providing that the tensioning spring, back stop, catch and contact are in the approximate relative positions shown. The arm carrying the armature must be free from side-play and robustly mounted.

It is the top contact that limits the pull of the armature, and complete details of its construction can be gathered from the drawings. Platinum is not essential for this contact and silver, gold-silver or German silver may be used. Suitable contacts can be removed from the blades of old breakjacks. Good insulation of the magnet windings from the frame is essential and turned ebonite bobbins are recommended. For use on a six-volt circuit No. 32 D.S.C. wire is used, giving 800 turns per bobbin and a magnet resistance of 18 ohms. For 4 volts wind with No. 30 D.S.C., and for 2 volts the winding will consist of 450 turns per bobbin of No. 28 D.S.C., giving a resistance of 6 ohms.

Steel is used for making the catch, and after being carefully fitted to size it will need hardening.

A Light Well Balanced Cylinder.

Cylinder and Cams. Lightness is the only aim in making the cylinder, a fact which is, perhaps, not obvious from the drawings. A piece of brass tube of suitable size is readily obtainable, and should be examined for trueness. Circular blanks are soldered in for the end pieces, and metal is removed wherever possible. It is finally trued up when mounted on a spingle, taking care not to reduce the wall thickness to an extent where it becomes springy. The cylinder should be exactly 5 cms. in diameter, for an error in the diameter will result in the length of the received picture being slightly modified. In making the cams, small pieces of brass and bakelised sheet $\frac{1}{8}$in. in thickness are filed to shape and finally reduced to exact size in the lathe after mounting.

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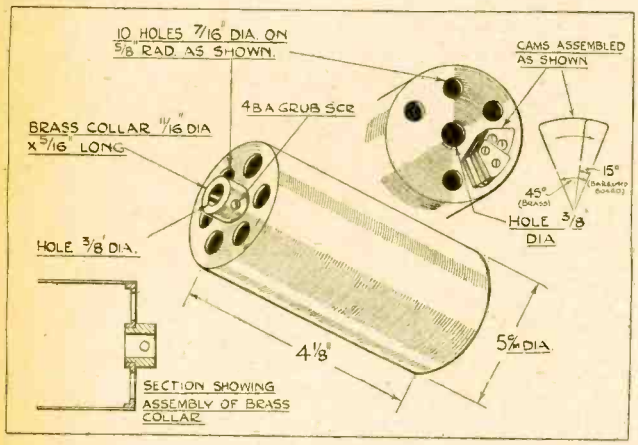
Spindle and Bracket. A skilled worker can make his own spindle, and no constructional comment need be made here, though a good deal of trouble may be saved by purchasing the finished article.

Its mounting brackets are cut from 2in. face rough angle iron, so that the centres may be accurately set



Constructive details of the light brass cylinder and contact cams.

up at ·5 cm. above the base plate. It is absolutely necessary that adjustments of the end screws shall not rotate the centre points. These centre holes are best made by mounting the screws in a piece of brass which has been accurately drilled and tapped in the lathe.

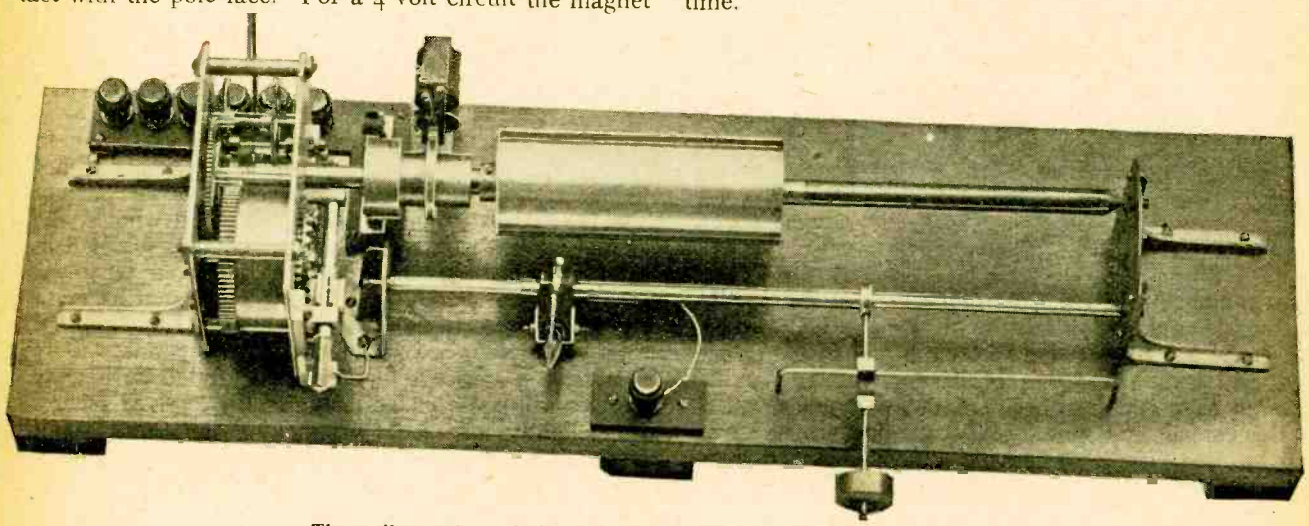
Magnetic Clutch. Reference to an accompanying illustration reveals the general principle of the clutch. It consists of a short recessed iron cylinder and cover plate resembling very much the magnet of a moving coil loud speaker, though being very squat and having a gap of about ¼in. This gap carries a cork inset, and when the magnet is energised a floating ring is pulled down on to its face. On the back of the floating ring are three pins which permanently engage in the catch plate. A light spring keeps the ring in friction contact with the pole face. For a 4-volt circuit the magnet winding has a resistance of 25 ohms, and this winding will give satisfactory performance also on 2 or 6 volt supplies. In this connection it may be pointed out that the 4-volt trigger winding can be used with a 6-volt battery.

Two annular brass rings mounted on bakelised sheet on the reverse side of the clutch serve for picking up contact. The magnet runs free on the spindle while the catch plate is held with a grub screw. This clutch together with fibre to brass worm pinions can be purchased complete. A reduction of about 100 to 55 is provided through the pinions. Fibre frictioning pins are also fitted to the clutch so as to maintain rotation when the clutch cam lifts.

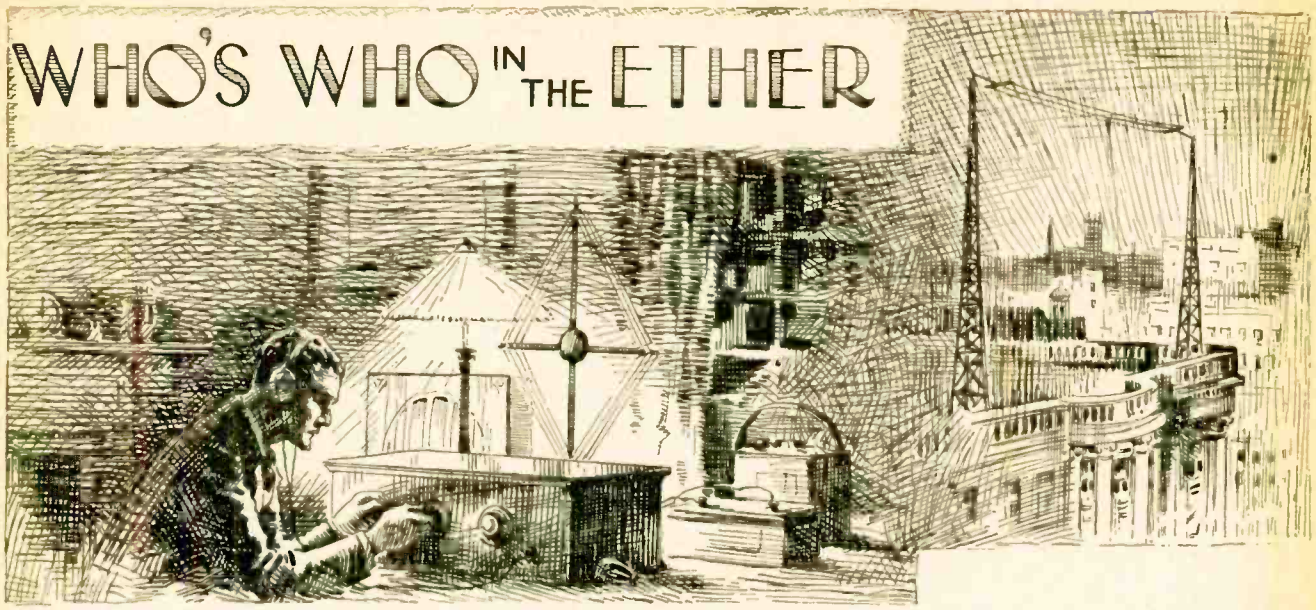
The Motor. A good gramophone motor is selected for this purpose. Its spindle should run perfectly true and should be reasonably free from play in its top bearing. For securing the brass pinion an adaptor is necessary on the gramophone spindle and this should fit down on to the taper.

The Carrier. Much latitude exists in constructing an easy running carrier used to link the knife edge wheel and stylus. It runs on a pair of " V " pulley wheels so as to offer a minimum of resistance. A frame has been assembled, using ⅝in. square brass tube and ¼in. square brass for the arms, though for manufacturing purposes a small brass or aluminium casting could, of course, be adopted. The angle of the knife edge wheel is such that it does not quite bed down into the bottom of the thread on the spindle. Its diameter is equal to that of the spindle, while the two centres used for its bearings are liberally spaced to prevent wobble. Should the knife edge wheel not run perfectly true, it may be left locked between its centres. Firm brass pillars support a length of ¼in. silver steel on which the carrier freely runs. Pieces of bakelite sheet provide a support for the platinum-tipped stylus pin.

In a further article, details of assembly and operation will be given assuming the making or purchasing of components more or less following this specification. Certain of the components are already available, and other sources of supply will no doubt arise in the meantime.



The easily constructed picture receiver previously described in this journal.



A Guide to the Identification of Distant Transmissions.

By J. GODCHAUX ABRAHAMS.

"I AM a mere novice in wireless, but have constructed the . . . . three-valve receiver. Last night, at 9.30 p.m., I heard some music, and later a ticking noise like a clock. I do not know the wavelength, but my condensers pointed to 63 and 75. What station was that?"

To the listener who has handled his wireless set for some little time the question appears a hopeless one, and it is true that it would be exceedingly difficult to give it a satisfactory reply. Yet, at the time, the data furnished comprised all the information the beginner had gathered from the transmission heard. Later, without doubt, important details which had escaped him would thrust themselves upon his notice, and if his observations were logged while still fresh in his memory, it would be an easy matter to solve his problem.

Unless a transmitter is labelled by a clear announcement, such as the name of the city from which the speech or music is broadcast—and this is not necessarily an infallible proof in view of relays—for the purposes of identification, means must be found to estimate as accurately as possible the wavelength on which it is picked up.

Roughly speaking, three important factors are indispensable, namely, some correct idea of wavelength, an indication of the language heard, and some information as to whether we are receiving the transmission from its *original* source or through a *relay* station. We can estimate the position of the transmitter in the wave-band in a rough-and-ready fashion by an easy method, for which but little explanation is required. What we want for so doing is a list of the broadcasting stations, in order of wavelengths, and a sheet of foolscap paper or a small logbook in which to enter the settings of the condensers as each transmission is tuned in. In most valve receivers used for distant reception it may be taken that we have two tuned circuits each of which is tuned by means of coils and variable condensers. If fixed coils are used, covering a large portion of the band, *i.e.*, say from 200-600 metres and from 1,000-2,000 metres, the matter is considerably simplified; the use of interchangeable plug-in coils with their more restricted range means slightly extra trouble, for whereas with the former as we increase the capacity by means of the condensers we should get a regular sequence of higher readings in degrees, plug-in coils would give us irregularly increased readings, owing to the fact that the wavelengths covered by them would overlap. As an example, a station would be tuned in on one coil at a *high* reading, and again, the same station on the next higher coil at a *low* reading of the condenser dial.

Estimating Wavelength.

Bearing in mind that a higher reading on a condenser (equivalent to an added capacity) indicates a longer wavelength, we have in this a simple way of placing the "mystery" station in its approximate position in any table we care to draw up. Although some slight variation may occur in the degrees of the aerial condenser according to the length of aerial used, it will be found that the readings on the condenser controlling the secondary tuned circuit will prove to be a permanent value for any given wavelength.

To estimate the wavelength of transmissions we have three methods at our disposal: (1) a calibrated wavemeter, (2) a chart or graph to show the relationship between dial readings and wavelengths, and (3) a simple table showing the condenser readings against already recorded known wavelengths. The first two methods named will not be dealt with now. It suffices to state that

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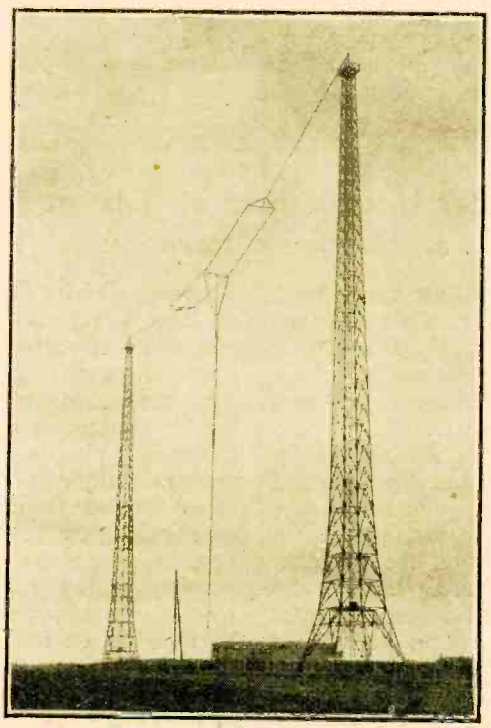
by the use of the meter it is possible to measure the wavelength and thus assist considerably our identification of the transmitter. For the plotting of a graph (method 2) we require a sheet of paper ruled off into a number of large squares, each of which is subdivided into one hundred smaller squares. On the left side of the sheet we mark off a scale from, say, 0 to 100 or 180, according to the condenser dials used on the receiver, and on the bottom of the sheet we record at the edge of each large square numbers comprising the range of the coils used, *i.e.*, say from 250-550 or 600, in steps of fifty, leaving the smaller squares to denote increases in fives. I trust this is clear to you. All that we need now do, providing we have adopted square law condensers which will give us wavelengths, is to plot out on the graph the position of well-known stations which we have already identified. In every instance your local station will be one, and possibly Daventry 5GB another. With the knowledge of, say, the wavelength of 2LO, if you live near London, and the readings of the aerial or secondary tuned circuit condenser—preferably the latter—at which it is brought in, we can plot our first position on the graph. Merely make a dot at the junction of a line taken from the condenser reading on the left of the sheet with that of another line (vertical one) starting from the actual known wavelength of the transmitter marked at the bottom of the chart. Do the same with, say, Daventry 5GB, and any other stations you may pick up and of which the wavelength and condenser readings are *known*. You may now draw a line through the dots plotted on the graph, and if your registration was accurate, it should be a fairly straight one.



The steel lattice towers of the Stuttgart broadcasting station.

Now, to tune in to a transmitter, of which again you know the wavelength but not the condenser readings. Simply look at the graph. Say you want Stuttgart; draw a line upwards from its wavelength at the bottom of the chart, place a dot where it joins the line you have drawn through the logged stations; all you need to do is to follow the horizontal line to the left until you read off the degrees of the condenser inscribed on that edge of the chart. If now you turn the condenser of your receiver to that position, somewhere in that neighbourhood you should pick up the transmitter's carrier wave. The matter is much simpler than it appears in print; a graph can be plotted in a few minutes, and, providing you do not change the coil, and the stations maintain the same wavelengths, you will find the chart of considerable help. As you tune in to and identify other transmitters, a question with which I will deal later, you will gradually increase your records until the graph shows the majority of the stations you have picked up and which you may again capture on a future occasion if you use the same settings.

Clues Revealing Identity.

Personally, although this kind of chart has much to recommend it, for my own work I prefer the simplest kind of log, namely, a mere record of the condenser readings jotted down on a sheet of foolscap in order of wavelengths. Make a list of the principal stations working on the band from 241 metres (Nuremberg) to, say, 580 metres (Laibach). If you wish to do so, you may leave spaces for the smaller relays which no doubt you will pick up at some time or other, and add to the list. Divide the sheet into vertical columns thus: (1) Wavelength; (2) name of station; (3) aerial condenser; (4) secondary circuit condenser, or, in the case of a "superhet.," aerial condenser and oscillator. As you record the stations identified so you will find by looking at your log the approximate readings on which you may *expect* to find the transmission you wish to tune in. It may only be a rough-and-ready guide, but it will give you sufficient data to narrow down the search over, say, ten degrees of the dial, as against wasting time by swinging the condensers backwards and forwards in an aimless and less systematic manner.

Now as to the question of identification. If all stations gave their call regularly before or after each item broadcast, or adopted some simple identification signal as *The Wireless World* has often recommended, the matter would be a simple one. Unfortunately for most of us, although some studios do so at various intervals during the broadcast, others are more negligent, with the result that the listener may "hang on" for quite a long period without receiving any clear clue as to the origin of the broadcast. It is true that the constant reiteration of the name of the city or town from which the transmission is made, although of help to more distant listeners, would prove wearisome to the nearer subscribers for whom the wireless entertainment is primarily destined. In order to avoid this repetition and to advertise their presence on the air, many stations have adopted opening or interval signals, of which there happens to be a considerable variety. Germany, I believe, was the first country to use a metronome between items broadcast, and this system has been copied by a large number of studios. To-day, but for the fact that the "beats" vary greatly per minute, the use of this instrument has somewhat

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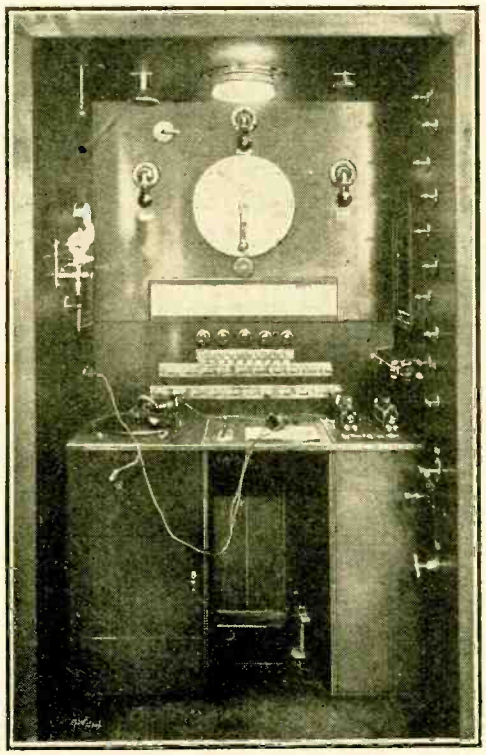
defeated its object. In view of this drawback you will find that other methods have been devised by which some of the transmitters possess highly distinctive signals which can be recognised easily, and once heard cannot be forgotten. Of such we have bells, chimes, gongs, hooters, musical boxes, Morse signs, to mention but a few of them, and these, in some instances coupled with certain characteristics taking into consideration the approximate wavelength on which we judge the transmission to be, according to our graph or log, will greatly assist identification.

Before I take these different characteristics in detail, there is one point to which I should like to draw your attention. Primarily, it concerns those readers who possess receivers working with frame aerials. Their directional properties can be of great assistance in determining the position of the transmitter in respect to the listener. If, for instance, in London, I happen to pick up a transmission on, say, 500 metres or so, and my aerial points east and west, it is not difficult to realise that the broadcast is *not* reaching me from the *west*, but from the Continent of Europe. A little reflection (and examination of any wavelength list, if necessary) will prove that eastwards (within workable limits) there are no stations transmitting on or near that wavelength, and my attention must be drawn to the opposite side of the compass. But until you have checked your frame aerial's directional properties on stations whose positions are known to you, do not forget that local causes may possibly upset the directive effects completely.



The "Norag" equipment used for transmitting identification sounds and signals.

Many of the difficulties in connection with the identification of foreign transmitters arise from the fact that in the call, either the name of the city or town is not given, or, if it is included, the native name is totally different to the one by which we know it in the English language. In the former case we find that some of the German studios, when simultaneously broadcasting a programme from main and relay stations, use an abbreviation which covers them all; thus, when tuned in to, say, Kiel or Hanover, you may pick up the words *Hier Norag,* which cannot possibly convey to the uninitiated foreigners—in this instance, inhabitants of the British Isles—the information that the entertainment is common to Hamburg, Bremen, Hanover, Kiel, and Flensburg. But there it is; we are not given the names of the cities from which the "Norag" or the North German Broadcasting Company transmits the programme. In the same way Stuttgart will call *Achtung! Suedfunk,* and by doing so ropes its relay Freiburg into its net, and the Bavarian transmitters (Munich, Augsburg, Nurnberg, and Kaiserslautern) are collectively referred to as *Die Deutsche Stunde in Bayern.* As an afterthought, perhaps, a conscientious announcer may now and again make it clear that you are in touch with Munich (Meun-shun) and Nurnberg (New-ren-bairg).

Characteristic Signals.

There are other examples I might cite, but these will suffice. Alternately, as stated above, we may be given the name of the station or city, but unless we know its native name, it is difficult to recognise it under the disguise. Tallinn (phonetic: Tar-leen) to us does not sound like Reval, nor Ljubljana (Looblee-arna) like Laibach; it is just as difficult, unless you know, to identify Posnan (Poznarne) as Posen, Coln (Keuln) as Cologne, Moskva as Moscow, Wien (Veen) as Vienna, Praha as Prague, Kaunas (Kownass) as Kovno, and Huizen, as pronounced by the Dutch announcer (Hoy-zen), and many others. However, the difficulties are not insurmountable, as you will find when you have heard the calls on one or two occasions. Your ear will become accustomed to the strange sounds, and the more stations you tune in the more quickly will these foreign names become familiar to you.

As a general rule you may take it that with but few exceptions the German studios preface their call by the word *Achtung* (phonetic: Ar-toong); it signifies attention, or "by your leave." Its parallel in French is *Allo!*

I distinctly referred to German studios, for although the Austrian stations broadcast in this language, they never use this word. Now, since Vienna has been blessed with a high-power transmitter, you will most certainly have heard his clear *Allo! Wien!* Curiously enough, the simple word *Hallo* can be pronounced by the foreigner in many different ways. Take Radio Belgique; listen to the announcer's slow and deep toned *Ah-low,* or as a contrast, Norway, where the Oslo microphone puts over a sharp *Alloou Oslou.* Then again, with the Polish stations, in particular Warsaw and Kattowitz, the word takes on a guttural sound, *Rhar-low,* usually followed by *Polskie Radio,* and the name of the city. The French stations are always recognisable by the fact that one "Hallo" is not deemed sufficient; from them we hear a breezy but somewhat clipped twin *Alloallo!*

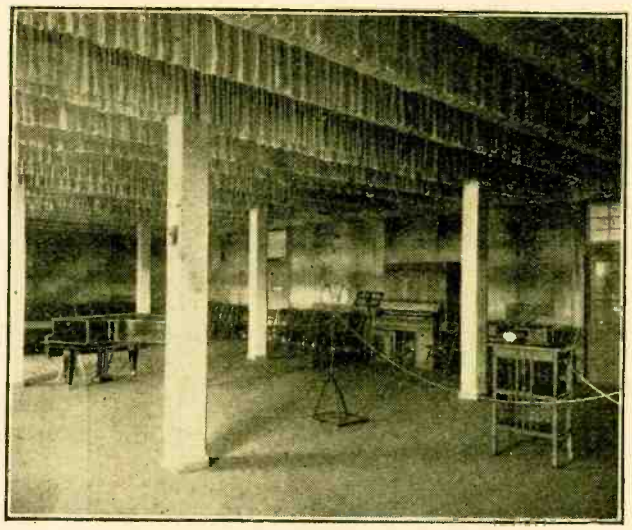
Who's Who in the Ether.—

Now it must also be borne in mind that several Continental studios, for their calls and even announcements, have adopted a subsidiary language. Petit Parisien, Paris, makes the matter easy for British listeners by giving out the programme items in both French and English, but it would be a simple matter to mistake Radio-Sud-Ouest for a station situated in a neighbouring country, for the Bordeaux "speaker" makes a point on every occasion of giving a Spanish translation for the benefit of listeners in the Iberian Peninsula.

Then again, Ljubljana (Laibach), Jugo-Slavia, when going on the air or after any lengthy interval, draws attention to its presence by repeating its original Serbian call in German, French, English, and Italian. Berne, also, in view of its bi-lingual population, uses both German and French.

From the Polish stations on most evenings you will hear a news bulletin in the French language, and in particular from Kattowitz on some nights, thirty minutes or so of what is termed the *Letter Box*, and during which period the station director, an accomplished linguist, verbally replies to his foreign correspondents in French, Polish, German, English, and sundry other tongues.

Finally, on those dates on which specific international programmes are broadcast, or when, as is now customary on the Continent, concerts are common to three or four cities of different countries, announcements are invariably made from the original studio in the languages of the countries to which the broadcasts are destined, or, alternately, fed by land line where this method is used.



The Studio at the Frankfurt Station.

If I have dilated at some length on this question it is merely with the object of warning the listener against taking for granted, when he has tuned in to a foreign station, that its identity may be absolutely confirmed by the language heard. In most cases this will be a helping factor, in conjunction with other characteristics which I will now detail, but in view of the fact that others than the native language may be used, this peculiarity alone would not in itself constitute a definite confirmation.

Use of the Metronome.

I referred previously to the metronome, an instrument widely adopted by stations as an interval signal. I presume that by now almost every wireless listener must be familiar with it, even if in his childhood days he had not heard its monotonous tick-tock, as he reluctantly practised his show piece on the pianoforte. Fortunately, as I have already stated, notwithstanding its use by many transmitters, the beat and sound is variable, and by comparison it is possible to tell to which station you are tuned.

Munich (Bavaria) and Rabat (Radio Maroc), although working on this principle, appear to have adapted the instrument in such a manner as to produce a distinctive note. You cannot fail to recognise the Bavarian stations, as during the intervals you will pick up a sound as if a light hammer were hitting a double slat—something similar to the one used by Harlequin in the old pantomime transformation scene, a double *clop*-clop, *clop*-clop, sixty times per minute. The North African studio differs in this sense, that but *one single* stroke is heard, although it possesses a singularly wooden and hollow sound; the speed is the same.

With the German stations the beats vary little, namely, Frankfurt (192 to the minute), Zeesen and Berlin (210), and Koenigsberg and Breslau (240). Do not forget that when the relays are connected to the main station it is from the latter that the interval signal is heard. Now that Radio Toulouse has forsaken the metronome for the stroke of a bell (one per second) we only get the former instrument from Lyons, PTT (192 per minute), and from Radio Vitus, Paris; in the latter case the signal is not always given, but it is seldom you will have to park on this wavelength for more than a few minutes, as Vitus is a private transmitter owned by a commercial firm, and the call is carefully put out at the end of every item.

If we turn to Vienna we notice immediately that the metronome possesses a very fast beat—in fact, it ticks 264 times to the minute. The Austrian station uses it consistently for every interval lasting more than five minutes.

With the German and Austrian stations on those days on which the relay transmitters give out their own progammes, the signal used is either a single letter or a combination of two or more Morse symbols. As an example, although tuned in to Hamburg, you may be receiving a programme from Kiel or another station of the Norag group. The relays identify themselves by their initials: Bremen (BMN: - . . . - - - .); Hanover (HR: . . . . - .); Kiel (KL: - . - . - . .), and Flensburg, the latest addition to the letter F (. . - .). Hamburg, as a *main* transmitter, is the only German studio retaining a Morse call, namely, HA (. . . . -). A similar method is customary with Graz and Klagenfurt (Austria), but both appear to send out the letter K (. - .).

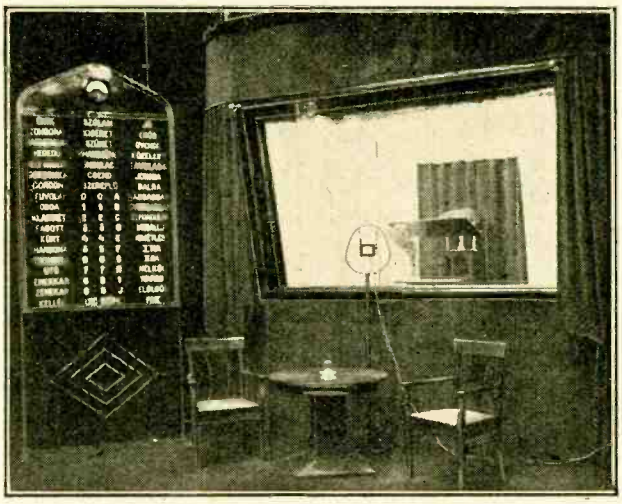
The only other foreign transmitter of importance which has adopted this method, but only as an opening

Who's Who in the Ether.—

signal to its transmissions, is Warsaw (Poland), from which studio prior to the preliminary call by the announcer, you will hear the letter W (. - -) repeated several times.

Until about two years ago, if we heard the voice of a lady announcer we were safe in assuming that it emanated from either an Italian or a Spanish station; to-day, on the Continent, the feminine speaker in many studios has ousted mere man from that honourable calling. From *all* Italian and Polish studios you will hear a female voice, also on most occasions from Moscow, Leningrad, and Berne, and periodically during the evening from Kiel, Hanover, Dresden, Frankfurt, Cassel, Nurnberg, and Bratislava. To the credit of the ladies, however, it must be said that they are more conscientious in putting out the call of the station than their male colleagues, and will not leave you so long in suspense once you have attuned your receiver to the transmitter's wavelength.

Apart from metronomes and Morse signs, we find a variety of gongs, bells, and other signals used to distinguish a station. All studios in turn have given their engineers the task of devising some specific means which will give the station an individuality of its own, and as a result of experiments many methods have been created to obtain characteristic opening or interval signals.



The announcers' sound-proof room at Budapest.

No doubt at some time or other you will have captured a broadcast from Ljubljana—a fairly recent newcomer to the ether—and you will have picked up the call of the cuckoo, a sound so familiar that you could not have mistaken it. In the same way the short nine-chord tune repeatedly played by Budapest as a stand-by signal, would be correctly logged by you as originating from a toy musical box. But, unfortunately, the Ljubljana cuckoo has a competitor on the air; a brother or sister at Wilno; it is in such cases where similar sounds are heard that it is essential you should know to what approximate wavelength you are tuned. In this instance the difference is so great that you could not possibly take one for the other.

Another characteristic signal has also been improvised by Cologne, which prefaces its main transmission by a carillon of bells from the studio, and not, as might well be thought, by the sound, from its famous cathedral. Bear in mind that you will hear these bells through Langenberg or through any other transmitter of the Rhineland circuit.

Gongs and bells have found favour with many stations; Copenhagen (and Kalundborg) open and close the transmission with three resounding "pongs"; on dance nights you may notice that the orchestra fades out at 11 p.m. G.M.T., when you are switched over to the Town Hall (Raadhustornet) for a time signal and chimes from its belfry. If all bells or gongs were struck in the same manner or possessed a similar tone, we should be more perplexed than ever. Fortunately, this is not the case, as it has been possible to play variations on them.

Should you reach out to Bratislava notice the sounds, viz., four bells answering to the notes FACC, or Koenigsberg, two notes forming a perfect fourth (A flat and D flat), or again, Stuttgart, with its flute-like tones C, D, G, repeated until the studio transmits the next part of the programme.

Then again the little Paris station of Radio Vitus, to which I have previously referred, should be identified by its two bells (F sharp and D sharp), struck rapidly between items. Cracow, at intervals, gives you a fair imitation of a troïka (three-horsed sleigh) with its sledge bells, all sounds which, to my mind, once heard and logged definitely label a station.

You are all familiar with the old tuning note, which, until some months ago, characterised the B.B.C. broadcasts; you will find a similar opening signal at Brussels, Cork, Dublin, Rome, Milan, and Naples, although in each individual case the note differs. In a like manner Munich uses a hooter or siren (deep G) to announce its arrival on the air; it is immediately followed by the call (*Hier Deutsche Stunde in Bayern*) previously mentioned. Of late Copenhagen appears to have adopted the same method, which is distinctly helpful for identification.

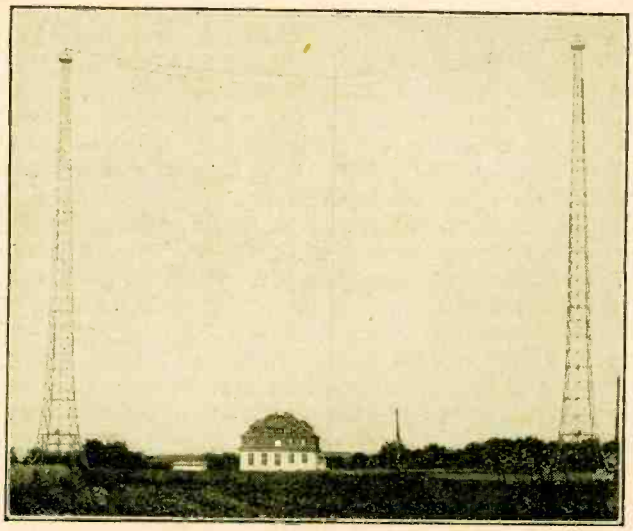
Admittedly there are, I am sorry to say, some stations which neither give a frequent call nor possess any particular peculiarity by which they can be easily recognised, and in such cases identification can only be established by ascertaining the position the transmitter occupies in the waveband, and noting in which linguistic family the words used by the announcer could be placed.

How to Narrow the Search Within Definite Limits.

From experience, based on the solving of many thousands of problems sent up to me, I find that most listeners are capable of stating whether the language heard is of Latin, Teutonic, or Slavonic origin. The point is, that although the enquirer might not distinguish between German, Dutch, or the Scandinavian dialects, such an indication would narrow the search down to a more limited number of transmitters, and with the knowledge that the broadcast was made on an approximate wavelength of, say, 280 to 320 metres,

Who's Who in the Ether.—

by consulting the programmes or a list of stations in sequence it should be possible to identify the transmission without much trouble. In those instances, however, in which definite proof is desired, and where a record of condenser readings has been made, the best plan is to tune in to that particular wavelength at a later date for one special item in the week-end programmes published in *The Wireless World*, and which is to be expected from that station. In such an event choice could be made of an item such as an operatic performance, a language course, or special musical pieces, of which details are given in the station's list of entertainments, any of which would furnish the proof required.



Frankfurt's aerial and station building.

Although many transmitters close their evening programme by playing their National Anthem, there are exceptions to the rule, for some cities, in particular the French, have substituted for the *Marseillaise* a hymn, a folk song, or a patriotic melody associated with the district.

Finally, allow me to lay considerable stress on the adoption of a log, as suggested in the first part of this article; its benefits are cumulative. In the early stages you may spend some little time in setting down records of your captures, but as these grow, so you will find "landmarks" helpfully dotted along the entire waveband covered, thus as time goes on daily narrowing the limits within which the unknown transmitters are to be placed. For the identification of stations all that is needed is a careful record, some patience, a modicum of common sense, and a retentive memory in regard to the peculiarities of the numerous broadcast transmissions heard.

Short-wave Notes.

F 8BP, operated by the "Journal des 8" at Rugles, Eure, France, broadcasts daily on 47 metres between 1330 and 1500 G.M.T., having abandoned its evening transmission.

XC51 a short-wave station of the Mexican War Department, transmits general sports news in English and Spanish daily on 42 metres at 6 a.m. G.M.T.; the news is supplied by the Trens News Service, Mexico City.

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Russian Amateurs.

A correspondent asks if we can give him any information regarding amateur call-signs in Russia. We understand that the old call-signs are now being replaced by others, consisting of a figure to indicate the district followed by two or three letters, but up to the time of writing have not received a revised list of Russian QRAs. We shall welcome any authoritative information on this subject.

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Amateur Call-Signs.

We are often asked by readers where they can obtain complete lists of amateur stations of the world, with their call-signs and addresses, so, risking the charge of "vain repetition," we would inform them of the three best known and, as far as we know, the only publications of this kind.

First, the *R.S.G.B. Annual and Log Book for* 1928. This contains all the known amateur stations in the world, with the exception of those in the United States. From time to time the R.S.G.B.

TRANSMITTERS' NOTES

issues supplements giving additional names ascertained since the publication of the Annual and corrections where necessary. There is no *official* list published of British amateur stations, as the records kept by the G.P.O. are regarded as strictly confidential. The "Annual" may be obtained from the R.S.G.B., 53, Victoria Street, S.W.1, for 4s. post free.

Secondly, the *Citizens' Radio Amateur Call Book*, published semi-annually (in the spring and autumn) by the Citizens' Radio Service Bureau, 508, South Dearborn Street, Chicago, U.S.A. This list includes the U.S.A. stations as well as those in Great Britain and other countries of the world. If we may draw a comparison between the two publications it will probably be found that the R.S.G.B. Annual is more reliable as regards European stations, while the Citizens' Call Book is more up-to-date with those on the other side of the Atlantic, as might reasonably be expected. We understand that next year an amalgamation of these two lists is contemplated, and the joint publication will probably be regarded as the amateur's "Berne List." The price of the *Citizens' Amateur Call Book* is 85 cents.

Finally, there is the official list of *Amateur Radio Stations of the United States*, corrected to June 30th of each year, and obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C., for 25 cents.

The 10-metre Waveband.

A correspondent in Gloucester comments on the scarcity of British signals received on the 10-metre waveband, stating that though he can receive many American stations at good strength, the only British amateurs he has yet been able to hear are G 2OD and G 2KF.

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New Call-signs and Stations Identified.

G 5GR	L. W. Gardner, "Gaydon," 40, Medina Rd., Coventry. (Change of address.)
G 6HL	I. E. Hill, High St., Upton-on-Severn, Worcestershire.
G 6LK	(ex 2BGS), E. J. Laker, 4, Alford Rd., Cranleigh, Surrey.
G 6RR	(ex 2BGT), R. A. Rowden, 15, Pennsylvania Rd., Exeter.
2AJO	Coventry Transmitters' Association, Hon. Sec., L. W. Gardner (G 5GR), 40, Medina Rd., Coventry.
EI 1MG	G. Manni, Pr. Umberto 205, Rome.

We are indebted to Mr. Louis Era (EB 4BC) for the following:—

EB 4EA	Dirickx, 88, rue du Pavillon, Antwerp.
EB 4FE	T. Van Hool, 119, rue Plankenberg, Deurne-Nord, Antwerp.
EB 4GK	Th. Nissen, 97, rue d' Orange, Antwerp.
EB 4HC	S. Van de Wouwer, 228, Ave. Van Haute, Deurne-Antwerp.
EB 4HT	J. Declercq, 31, Avenue A. Goemaere, Antwerp.
EB 4HV	Respeu, 15, Plaine de Malines, Antwerp.
EB 4IA	L. Perlaux, 23, rue d'Orange, Antwerp.
EB 4JJ	J. Joulet, 6, rue des Carmes, Liege.
EB 4JX	J. De Saegher, 5, rue Raikem, Liege.
EB 4LA	F. Le Maire, 8, Vieille rue de Bruxelles, Malines.
EB 4LO	P. Castaing, 42, Grand Place, Courtrai.
ER 5AF	S/Lt. C. Bratescu, 45, rue St. Elefterie, Bucharest, Roumania.
ET 1F	W. Hinentalis, Aukst Karin Kursai, Kaunas, Lithuania.
XEU 87RA	Radio Wagon Murman Station, Leningrad, Russia.
EA KL	W. Blaschek, 29, Balmgasse, Klosterneuburg, Austria.
EA CM	C. Martin, 8, Nussdorferstrasse, Vienna IX, Austria.

CURRENT TOPICS

Events of the Week in Brief Review.

HEARTILY RECIPROCATED!

In this our first issue of 1929 we take the opportunity to thank all those readers of *The Wireless World* who have so kindly sent New Year greetings and cheery wishes for the continued prosperity of "W.W."

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ITALY TO TRY SHORT WAVES.

On October 28th, 1929, the date on which the Italian Government plans to open a new high-power broadcasting station at Rome, using 50 kilowatts, it is hoped that a short-wave station will also be ready to relay the transmissions to America and the Italian colonies.

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AERIAL FATALITY.

The danger of erecting aerials in the vicinity of electric power wires was again illustrated on Wednesday, December 19th, when Oswald Morris, a collier, of Tonteg, Pontypridd, and his wife were both killed when their wireless aerial collapsed. In falling the wire came in contact with an electric light cable, and Morris, in attempting to raise it, received a fatal shock. His wife, who ran to his aid, was also killed instantaneously.

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LANCASHIRE IS ROUSED.

Lancastrians are showing an unwillingness to accept the statement of a P.O. official, made recently at the Bolton Police Court, that there are more unauthorised transmitting stations in South Lancashire than in all the rest of England put together.

When the question was raised last week at the General Post Office, an official said that the statement was based on the number of prosecutions. "We can offer no explanation," he said, "and of course it does not of necessity prove that South Lancashire people are the worst offenders; but most of the offenders who are tracked down are in the Lancashire area."

It is believed that Lancastrians are considering their next move towards clearing the county conscience.

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MEXBOROUGH COUNCIL SAYS "NO."

The Mexborough (Yorks) Urban District Council has decided to discontinue charging the accumulators of wireless listeners at their electricity works, as a result of a complaint by the Electric Light Committee that the practice resulted in members of the public "wandering all over the place." When it was asked whether the Council would provide charging facilities in listeners' homes the electrical engineer said "No."

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BRISTOL LISTENERS' CLUB.

The Bristol Listeners' Club now numbers over 300 members. The object of the club is to give its members special facilities for visiting broadcasting stations and other places of wireless interest. Mutual help in the operation of sets is another of the club's activities.

LET'S CALL IT A DAY.

WEAF, New York, has just announced a new schedule. Broadcasting begins at 6.45 a.m. and continues without intermission till midnight.

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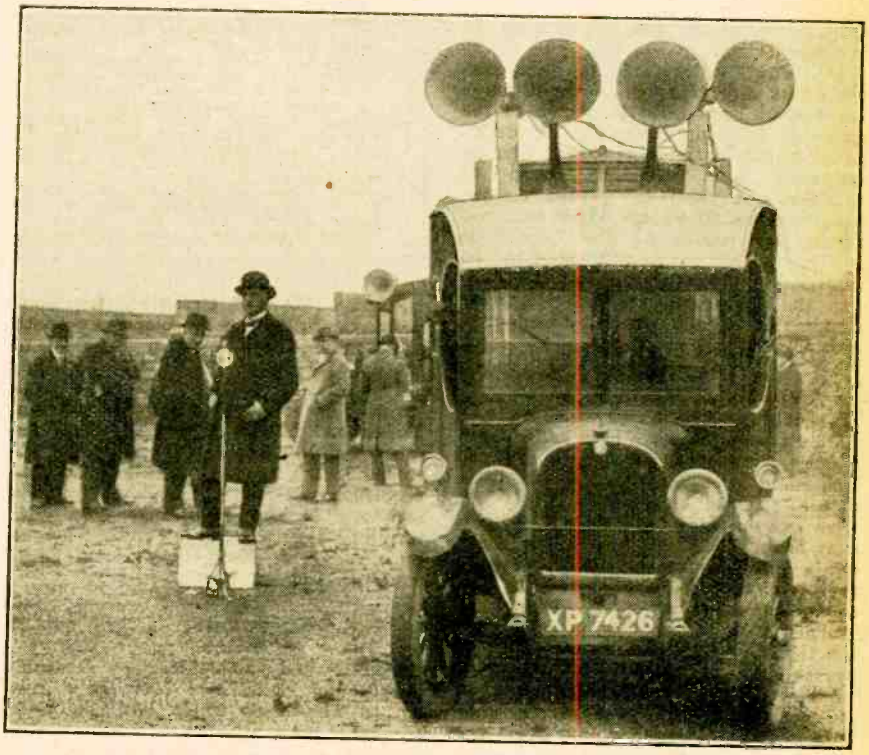
TRANSATLANTIC TELEPHONE DEVELOPMENTS.

In accordance with plans for the development of the Transatlantic telephone service, new equipment will shortly be introduced at the Rugby transmitting station and at the Post Office receiving stations at Cupar (Fife) and Wroughton (Wilts).

Two transmitters and receivers are already engaged in the service and a



M.P.S AND THE MICROPHONE.—Conservative Members of Parliament recently attended a demonstration of Marconiphone loud speakers at Wembley in preparation for the General Election campaign. The photograph shows a member at the microphone testing the capabilities of four loud speakers.

third is expected to be in operation by July. If the present upward tendency in the popularity of the service is continued, a fourth circuit may be added before the end of the present year.

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GERMANY 'PHONES THE ARGENTINE.

The wireless telephone service between Berlin and Buenos Aires, which was opened on December 10th, has now been extended to all German cities. Through a regrettable inadvertence, it was stated in our issue of December 19th that the service employed the Transatlantic telephone system through Rugby. This is, of course, inaccurate; the service is a direct one between Buenos Aires and Nauen, which operates on 14.83 metres. The first experiments were conducted through the British stations.

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OBITUARY.

We regret to learn of the sudden death, which occurred on December 20th, of Mr. Martin Hawke, managing director of the Carborundum Co., Ltd. Although he had been ill for some time, Mr. Hawke appeared to be recovering, and was at business on the day before his death.

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WIRELESS AND THE CHINESE MIND.

A decrease in the characteristic hostility of China to the introduction oi wireless apparatus is referred to in an account of Chinese life and commerce given by Mr. H. H. Fox, commercial Counsellor at the British Legation, Peking, issued by the Department of Overseas Trade.

Mr. Fox writes: "The somewhat mysterious objection which the Chinese Government have hitherto shown to the import of radio apparatus for broadcasting purposes—until quite recently radio equipment was officially classed as munitions of war—is gradually disappearing, and there are signs that the existing restrictions on the import of receiving sets, etc., will shortly be removed."

In the matter of wireless telegraphy considerable progress can already be reported.

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A PUBLIC ADDRESS TRIUMPH.

Probably the largest task which a public address system has ever been called upon to carry out was on the occasion of the Eucharistic Congress in Sydney last autumn. The major part of the work, which was entrusted to Amplion (Australasia), Ltd., consisted of supplying music from a central source to a long procession covering a route through the city a mile and three-quarters in length. It was desirable that the procession, in connection with the carrying of the Host, should engage in choral singing. Synchronisation was necessary, and therefore 60 power loud-speakers were employed in four banks of 15 at vantage points along the route.

The band supplying the accompaniment was situated in the Domain. Here a microphone and Amplion Minor equipment were installed, the output being connected to a Senior Amplifier. The first four outputs of the latter were fed to other Senior amplifiers, multiple wiring being used which allowed of a common feed. In practice is was found that only one-third of the maximum power was necessary to give ample volume to accompany the procession of singers. The batteries supplied 2,000 volts, and the total current consumption was 22 amperes.

The entire installation functioned perfectly and was instrumental in conveying the sounds of the ceremony to a crowd of 150,000.

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EARTHQUAKE REPORTS BY WIRELESS.

At the request of the Meteorological Office, London, an arrangement came into force on January 1st, whereby seismological reports are transmitted regularly from Arlington, New York, with the meteorological message which is sent out at 4h. 0m. G.M.T. The service is supplied by the United States Coast and Geodetic Survey in co-operation with the United States Weather Bureau and the Navy.

The meteorological message from America is re-broadcast from the Eiffel Tower at 6h. 20m. G M.T., and the seismological information will be included in the re-issue. The international or Strasbourg code will be used for this service. Details regarding the code, wavelengths, etc., will be supplied by the Superintendent, Kew Observatory, Richmond, Surrey, on request.

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NO WIRELESS ROYALTIES IN AUSTRALIA.

Doubts and difficulties in Australia over patent rights have been set at rest by an agreement which has now been reached between the Commonwealth Government and Amalgamated Wireless (Australasia), Ltd. It has been agreed that the Company's patent rights shall be made available free of charge to all wireless trade broadcasting companies and listeners for a period of five years dating from November, 1927.

To carry out this arrangement the company has made heavy sacrifices, including an estimated sum of £62,500 on listeners' licences and a similar amount on valve royalties. In consideration for this the company will receive from the Government a payment of 3d. per month, or an average of 3s. per annum, in respect of every receiving licence issued. On a basis of 250,000 licences, the amount received by the company under the amended agreement will be £37,500 or £88,000 less than was originally claimed.

The company states that it has been induced to make these sacrifices by a desire to foster the popularity of wireless.

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NEW MARCONI APPOINTMENT.

Mr. Frederick Sandland Hayburn has been appointed a director and deputy managing director of the Marconi International Marine Communication Co., Ltd. Mr. Hayburn, who has been associated with the company for over 24 years, is vice-president of the Comité International Radiomaritime, which was formed recently to co-ordinate the services of marine wireless companies throughout the world.

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LECTURES ON LOAN.

A short lecture on screen grid valves, illustrated with eighteen lantern slides, has been prepared by the Marconiphone Co., Ltd., 210-212, Tottenham Court Road, London, W.1, for loan to radio societies. We understand that the company is preparing a second lecture on the subject of drawing power from A.C. mains.

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PORTABLE RADIO COMPASS.

A new direct-reading wireless compass for use on small ships has been produced by the Kolster Radio Corporation of New York. The complete instrument is only 3½ft. in heignt and can be accommodated on an ordinary table.

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RADIO WAR IN U.S.

The first battle in the war which has been threatening the American radio industry for some time has been won by "big business," as represented by the General Electric, Radio Corporation, American Telephone and Telegraph, the Western Electric, the Westinghouse Electric, the International Radio Telegraph and the United Fruit and Wireless Specialities Apparatus Company. Their opponents are the Radio Protective Association, representing independent concerns, which claim that the firms mentioned are monopolising the manufacture and sale of radio equipment.

The Federal Trade Commission has dismissed the complaint, deciding that it is without jurisdiction to prosecute. It is reported that the Radio Protective Association will resume the attack by pressing the Department of Justice to bring the "Radio Monopoly" into Court.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 2nd.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (Light Refreshments at 5.30.) Lecture: "The Design of Transmitting Aerials for Broadcasting Stations," by Messrs. P. P. Eckersley, T. L. Eckersley, B.A., B.Sc., and H. L. Kirke.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Business Meeting, followed by an evening with the Society's apparatus.

THURSDAY, JANUARY 3rd.

Slade Radio (Birmingham).—At the Parochial Hall, Broomfield Road, Erdington. Talk on Transmitting, by Mr. C. H. Young.

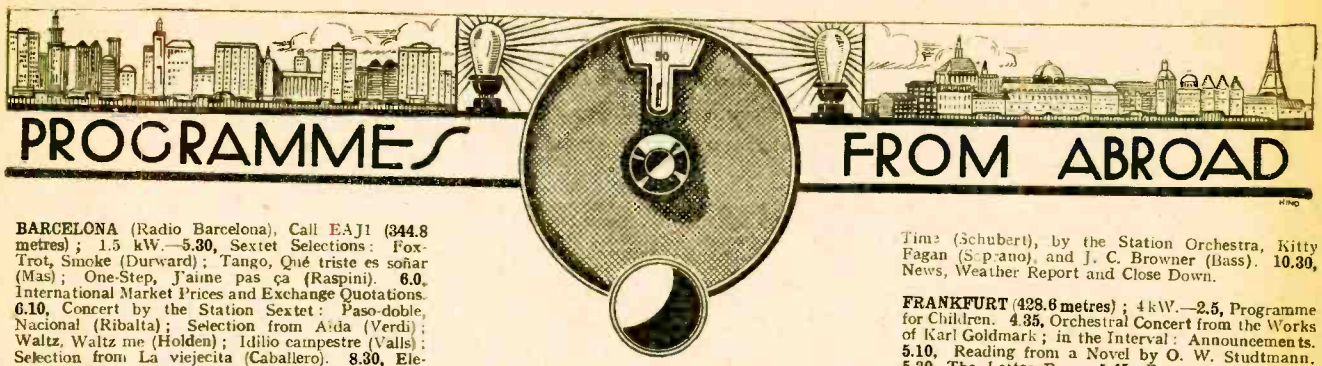
Ilford and District Radio Society.—Informal Meeting.

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. "Chronicle" Receivers, by "Radiodca."

MONDAY, JANUARY 7th.

Newcastle-upon-Tyne Radio Society.—At 7.30 p.m. At 11, Saville Row. Lecture: "Recent Developments in Broadcast Receivers," by Mr. F. Youle, of the Marconiphone Co., Ltd.

Hackney Radio and Physical Society.—At 8 p.m. At the Electricity Showrooms, Lower Clapton Road, E.5. Annual General Meeting and Election of Officers.



SATURDAY, JANUARY 5th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**5.30,** Sextet Selections: Fox-Trot, Smoke (Durward); Tango, Qué triste es soñar (Mas); One-Step, J'aime pas ça (Raspini). **6.0,** International Market Prices and Exchange Quotations. **6.10,** Concert by the Station Sextet: Paso-doble, Nacional (Ribalta); Selection from Aïda (Verdi); Waltz, Waltz me (Holden); Idilio campestre (Valls); Selection from La viejecita (Caballero). **8.30,** Elementary French Lesson by Prof. Martin. **9.0,** Chimes from the Cathedral, followed by Weather Report. **9.5,** Exchange Quotations, News, Announcements and Market Prices. **9.10,** Concert by the Station Orchestra: Military March, La Vosgienne (Jacques-Dalcroze-Mouton); Habanera, La ultima lágrima (Cotó); Selection from La tempestad (Chapí); Fox-Trot, Tell me you're sorry (Davis and Burke-Haring). Erlkönig (Schubert-Salabert); Hungarian Dance No. 7 (Brahms-Becce). **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**5.30,** Programme for Children. **6.0,** Programme for Girls. **7.0,** Orchestral Concert. **7.30,** Saxophone Recital by Erne Reti. **7.50,** Topical Talk. **8.0,** Recitation by Karl Bergmann. **8.30,** Concert by "The Young Men's Association" Orchestra, conducted by Mr. Gehring. **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,649 metres**), 40 kW. —**12.45,** Phototelegraphy Transmission. **1.30,** Programme for Children. **2.0,** Herr Graef, Talk: The Technique of Speech. **2.30,** Weather Report and Exchange Quotations. **2.40,** Dr. Elly Heuss-Knapp: Talk for Women, The Art of Telling Stories. **3.0,** News from the Educational Periodicals. **3.30,** Programme relayed from **Hamburg.** **4.30,** Herr Tejessy, Talk: The Police Force. **5.0,** Dr. F. M. Feldhaus, Talk: Instruments of War in Ancient and Modern Times. **5.30,** Elementary Spanish Lesson. **5.55,** Alf Due, Illustrated Talk: Norwegian Folk-Songs. **7.0,** Country Programme: The Peace and Comfort of the Provincial Town; Musical Selections and Readings by Herr Fried Kieling, followed by Relay from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Programme of Gramophone Records. **10.30 a.m.,** Exchange Quotations. **11.55 a.m.,** Time Signal. **12.30,** Weather Report and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations, Agricultural Report and Time Signal. **2.30,** Chess Talk by Herr E. Nebermann. **3.0,** Dr. Paul Frank, Talk: Medical Hygiene. **3.30,** Recitations by Albert Reinicke. **4.0,** Orchestral Concert: Comedy Overture (Kéler-Béla); Norwegian Bridal Procession (Grieg); Andante appassionato (Ralf); Helvetia (Scassola); Valse joyeuse (Provaznik); Scherzo (Lalo); Selection from The Merry Widow (Lehár); Tango, Komm (Dazar); The Three Bears (Coates); Waltz, Himmelsfunken (Waldteufel); Scarf Dance (Chaminade); Le Cygne (Saint-Saëns); In the Interval, Advertising Notes. **6.0,** Talk by Dr. Busse. **6.25,** Prof. Hans Delbrück, Talk: The Relation of the various forms of Government to War and Peace. **7.0,** "Die Unschuldige": Play in One Act (Heinrich Mann), with Incidental Music; "Prinzessin Tessa und ihre Freier", Play (Bernhardt Reese), followed by Concert from the Hotel Kaiserhof, Weather Report, News, Time Signal and Sports Notes, and Dance Music. **11.30** (approx.), Close Down.

BERN (**411 metres**); 1.5 kW.—**3.30,** Programme for Children. **4.0,** Concert by the Kursaal Orchestra. **6.29,** Time Signal and Weather Report. **6.30,** Medical Talk relayed from **Basle** (1,010 metres). **7.0,** Play in Dialect. **7.40,** Selections by the Kursaal Orchestra. **8.0,** Vocal Selections by Mixed Choir. **8.15,** Selections by the Kursaal Orchestra. **8.30,** Vocal Selections by Mixed Choir. **8.45,** News, Announcements and Weather Report. **9.0,** Concert by the Kursaal Orchestra. **9.35,** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—**3.0,** Review of Books, by Frieda Weiszmann. **3.30,** Concert: Overture to The Mastersingers (Wagner); Fantasia on Schubert's Works (Urbach); Air from Rusalka (Dvorak); Selection from Oberon (Weber); Kamarinskaja—Fantasia on Two Russian Folk-songs (Glinka); Selection from Der Tribut von Zamora (Gounod-Schreiner); Overture to Le Roi d'Ys (Lalo). **5.0,** Film Review. **5.25,** Talk in Esperanto by Hans Plehn. **5.35,** Agricultural Talk by Herr Scheibe. **6.20,** Shorthand Lesson. **6.50,** Herr H. v. Wedderkop, Illustrated Talk: New French Literature. **7.15,** "With the Microphone through Breslau." **7.40,** Request Programme by the Station Orchestra. **9.0,** News. **9.30,** Dance Music by the Station Dance Orchestra. **11.0** (approx.), Close Down.

BRÜNN (**441.2 metres**); 2.5 kW.—**3.30,** Programme for Children. **3.30,** Talk. **3.45,** Selections from the Works of Suk. Barcarolle; Ballade; A bouquet in the band; My Mother. **4.15,** Talk: Education in Slovakia under the Hungarian Rule. **4.30,** Music Talk. **4.45,** German Programme; News and Popular Songs. **5.15,** Weekly Report for Journalists, by Dr. C. Jerabek. **6.0,** Concert of Dance Selections. **6.45,** Prof. Dr. Traub, Talk: The Czecho-Slovakians before the March Revolution in 1848. **7.0,** Popular Programme. **8.0,** Concert: Overture to Nabucco (Verdi); Ballet, The Two Pierrots (Drigo) Semiramis (Rossini); La Gioconda (Ponchielli); Ernani (Verdi); Fantasia on Bellini's Works (Urbach). **9.0,** Programme relayed from **Prague.** **9.25,** Relay of Tzigane Music from **Bratislava** (300 metres).

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0,** Dance Music from the St. Sauveur Palais de Danse. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Pianoforte Selections. **7.0,** Columbia Dance Records. **7.30,** "Radio Chronique." **8.15,** Concert; In the Interval, Topical Talk. **10.15,** News. **10.30** (approx.), Close Down.

BUDAPEST (**556.6 metres**); 20 kW.—**3.0,** Review of Books. **4.10,** Talk. **4.40,** Concert by the Sovánka Zigeuner Orchestra. **6.0,** Reading. **6.30,** "Alexandra"—Operetta in Three Acts (Albert Szirmay). **9.0,** Weather Report, Time Signal, and News, followed by Selections by the Zigeuner Orchestra from the Hotel Hungaria.

CRACOW (**566 metres**); 1.5 kW.—**3.35,** M. V. Francic, Talk: The Habits and Customs of the Slavonic Races of Southern Europe. **4.0,** Divine Service relayed from **Vilna.** **5.0,** Programme relayed from **Warsaw.** **6.0,** Miscellaneous Items. **6.30,** M. J. Regula, Talk: The Foreign Politics of the Previous Week. **6.56,** Time Signal from the Astronomical Observatory. **7.0,** Agricultural Report. **7.5,** News and Announcements. **7.30,** Programme relayed from **Warsaw.** **9.0,** Programme relayed from **Warsaw.** **9.30,** Concert from a Restaurant.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30,** Weather Report and Concert of Gramophone Selections. **7.20,** News. **7.30,** Poetry Recital by May Pitchford. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Concert of Opera Selections by the Station Orchestra, Gwen Price (Soprano), Joseph O'Neill (Tenor). **8.40** (approx.), Orchestral Selection: A Kiss for Cinderella (Bucalossi). **9.0,** Mandoline Solos by Oscar MacRisteard. **9.15,** Light Songs by Louis Spiro. **9.25,** Selections by the Station Celeste Orchestra. **9.40,** Baritone Solos by Norman Apperson. **9.50,** Selections from (a) La Juive (Halévy), (b) Lilac Time (Schubert), by the Station Orchestra, Kitty Fagan (Soprano), and J. C. Browner (Bass). **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**2.5,** Programme for Children. **4.35,** Orchestral Concert from the Works of Karl Goldmark; in the Interval: Announcements. **5.10,** Reading from a Novel by O. W. Studtmann. **5.30,** The Letter Box. **5.45,** Esperanto Lesson by W. Wischhoff. **6.15,** Pfarrer Taesler, Talk: Goethe's "Faust." **6.45,** Henriette Fürth, Talk: Humanity. **7.15,** Programme relayed from **Stuttgart,** followed by Dance Music relayed from **Voxhaus.**

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—**9.15 a.m.,** News. **10.0 a.m.,** Programme of Gramophone Records. **11.10 a.m.,** Weather Report. **11.15 a.m.,** Exchange Quotations. **11.30 a.m.,** Concert relayed from **Hanover** (297 metres); in the Interval at **11.55 a.m.,** Time Signal. **12.10,** News. **1.40,** Exchange Quotations. **2.30,** Review of Books. **3.0,** Illustrated Music Talk by Dr. Wilh. Heinitz. **3.30,** Concert: Suite in Old Style, Op. 84, for Flute and Piano (Kronke); Suite, Op. 1, for Piano (D'Albert); Suite, Op. 16, for Flute and Piano (Lilge); Gavotte for Piano (Philipp); Suite in D Minor, Op. 87, for Piano (Niemann); Gigue for Flute and Piano (Huë). **4.30,** Request Programme. **5.30,** Dr. Frieda Wunderlich, Talk: The Protection of Workers. **6.0,** Talk: The Wanderings of My Farthing—Review of the Hamburg Savings Bank of 1827. **6.55,** Weather Report. **7.0,** Relay of the Programme of the Wireless Ball from the Curiohaus; Fackeltanz (Meyerbeer); Mondnacht auf der Alster (Fetrás); Fantasia on A Midsummer Night's Dream (Mendelssohn); Barcarolle (Offenbach); A Night in Venice, Overture (Strauss); Festival Polonaise (Svendsen); Gramophone Selection; Programme from the Tanagra Theatre; in the Intervals: News, Sports Notes and Programme Announcements. **10.50,** North Sea and Baltic Weather Report. **11.0,** "A Polonaise through Ether!"

HILVERSUM (**1,071 metres**); 5 kW.—**9.40 a.m.,** Time Signal. **9.42 a.m.,** Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Concert of Trio Music. **1.40,** Orchestral Concert under the Direction of Mr. Max Tak, from the Tuschinski Theatre, **Amsterdam.** **3.40,** Italian Lesson by Mr. Giovanni Rizzini. **4.40,** French Lesson by Mr. R. Lafont. **5.40,** Concert of Trio Music. **6.25,** German Lesson by Mr. Edgar Grün. **7.25,** Police Announcements. **7.40,** Programme arranged by the Workers' Radio Society: Concert and Talk. **11.15,** Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits on 1,852 metres from 5.40 p.m.—**12.10,** Concert of Trio Music. **2.40,** Programme for Children. **5.10,** Concert of Gramophone Selections. **6.10,** Talk by Mr. Schyndel. **6.30,** Catholic Bulletin. **6.40,** English Lesson. **7.10,** Lesson in Dressmaking. **7.40,** Talk by M. L. J. M. Fener. **8.0,** "Joseph en Dothan" (Vondel).

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**6.30 a.m.,** Morning Gymnastics. **10.0 a.m.,** Weather Report. **2.30,** Instrumental Concert: March, The Handicap (Rosey); Overture to The Italian Girl in Algiers (Rossini); Waltz from Die geschiedene Frau (Lehár); Dramatic Poem, Ajax (Brusselmans); Selection from Carmen (Bizet); Neapolitan Serenade (Sgambatti); Russian Dance (Tchaikovsky); Selection from the Novel, "Armod" (Oluf Böggild), by Carl Schiönning (Elocutionist); Selection from Martha (Flotow); Waltz from The Dollar Princess (Fall); Cavatina for Violin (Raff); Spanish Dance in C Major, No. 8 (Sarasate); Albumblatt (Wagner); Rigaudon from the Tordenskjold Suite (Halvorsen); The Entry March of the Bojards (Halvorsen). **5.20,** Peter Ostergaard, Talk: The Religious Tendencies of To-day. **5.50,** Weather Report. **6.0,** News, Exchange Quotations and Time Signal. **6.30,** Herr Carl Gad, Talk: Modern Foreign Authors—Hermann Hesse. **7.0,** Chimes from the Town Hall. **7.2,** Twelfth Night Concert: Old German Dances (Michael Praetorius); "The Three Wise Men," Play; Selections (Valentine Hausmann), (a) Pavane, (b), Gagliarda; Suite, Blanchetto musicale (Joh. Hermann Schein); followed by News. **8.15,** Reading from the Novel, "Peter Camenzind" (Hermann Hesse). **8.45,** Concert of Light Music: Overture to Light Cavalry (Suppé); Gavotte tendre (Ganne); Selection from

Programmes from Abroad.

La belle Hélène (Offenbach); Serenade for Strings (Chaminade); Waltz Fantasia (Glinka); Prestissimo Gallop (Waldteufel). **9.45,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

KATTOWITZ (422 metres); 10 kW.—**3.0,** Music Lesson, by Prof. F. Sachse. **3.35,** Children's Letter Box. **4.0,** Divine Service from the Ostra Brama Chapel at **Vilna. 5.0,** Programme for Children. **6.0,** Announcements and News. **6.30,** Talk. **6.55,** Time Signal and Agricultural Report. **7.30,** Programme relayed from **Warsaw. 9.0,** Weather Report and News. **9.30** Dance Music.

KAUNAS (2,000 metres); 7 kW.—**3.0,** Concert of Gramophone Records. **3.15,** Talk: The Influence of Christianity on our Legends. **3.45,** "Radio Patarejas." **4.30,** News. **5.0,** Weather Report. **5.2** (approx.), News and Announcements. **5.15,** Talk for Farmers. **5.45,** Popular Orchestral Concert: Lithuanian Song; Vort-Post (G. Karla); O Frühling, wie bist du so schön—Waltz (Lincke); Indian Romance, Hebomoko (Ernest Reeves); Rêverie (Prisovsky); March, Spirit of Freedom (Rosey).

LAHTI (1,522.8 metres); 35 kW.—**4.0,** Selections by the Station Orchestra; Overture to Tancred (Rossini); Waltz, Tout Paris (Waldteufel); Songs (Bellman). **4.35,** Talk. **5.15,** Selections by the Station Orchestra. Song (Angerkoski); Merellä (Merikanto); Teas soivat no suuret surut (Merikanto); Sinisellä sillalla (Kaski); Kesäyö kirkkomaalla (Kuula); Lastu lainchilla (Sibelius); Aidin silmät (Hannikainen); Ristiretkeilijä (v. Rothen). **5.35, Talk. 6.0,** Selections by the Station Orchestra: Overture to Tartuffe (La Gye); Gipsy Suite (Coleridge Taylor.) **6.30,** Recitation. **6.50,** Saxophone Solos by Harald Mannerström. **7.0,** Songs by Reine Volanen. **7.20,** Selections by the Station Orchestra; Ballet Suite from Les Millions d'Arlequin (Drigo); Musizierende Zigeuner (Eilenberg). **7.45,** News in Finnish and Swedish, and Close Down.

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres), and **Münster** (250 metres).—**12.5,** Orchestral Concert: March, Heil der Zukunft (Frantzen); Intermezzo from Naila (Delibes); Overture to Le Cheval de bronze (Auber); Selections from **Aïda** (Verdi); Violin Solos, (a) Havanaise (Saint-Saëns), (b) Scherzo Tarantella (Wieniawsky); Northern Suite (Torjussen); In Liebesrausch (Clemus); Potpourri, Offenbachiana (Conradi). **1.30,** Hints for the Housewife. **2.0,** Programme for Children. **2.40,** Arthur Wurbs, Talk: The Basis of Wireless Technique. **3.5,** Dr. Hans Lorenz Lenzen, Talk: Young People and Music. **3.30,** Talk for Women: Sociability in the Country. **4.0,** Line Wallerstein, German Artists on their Travels. **4.20,** English Lesson by Prof. F. Hase. **4.45,** Orchestral Concert: Overture in Italian Style in G Major (Mozart); Airs with Orchestral accompaniment (Mozart), (a) Misera, dove son, (b) Non più, tutto ascoltai; Overture in D Major (Schubert); Songs with Orchestral accompaniment (Schubert), (a) Suleika 1, (b) Allmacht. **5.30,** Prof. Boerschmann, Talk: Landscape and Culture in China—Travels in the Holy Mountains. **6.15,** Oskar Pucklitsch: Talk for Workers: Ernst Abbe, a Biography. **6.40,** Prof. Hessen, Talk: What do we know of the Soul? **7.0,** Variety Programme. **9.15,** News and Sports Notes. **9.30,** Gramophone Records. **10.30,** Orchestral Selections and Dance Music. **12.30 a.m.** (Sunday), Close Down.

LEIPZIG (365.8 metres); 4 kW.—**2.0,** Weather Report, and Concert of Gramophone Selections. **3.0,** Chess Notes. **3.30,** Concert by the Station Orchestra: Selections from Lucia di Lammermoor (Donizetti); Marche militaire (Schubert); Suite, Pastorale (Chabrier), Hungarian Dances Nos. 11 to 16 (Brahms); Liebeswalzer (Moszkovsky). **4.45,** Wireless Notes and Talk. **5.20,** Weather Report, Time Signal and Labour Market Report. **5.30,** Programme relayed from **Königswusterhausen. 6.0,** Josef Greff, Talk: Psycho-Analysis. **6.30,** Prof. Georg Witkovsky, Talk: Lessing. **7.0,** Popular Concert by the Station Orchestra, under the direction of Wilhelm Rettich. **9.0,** News, Sunday Programme Announcements and Sports Notes. **9.30,** Dance Music relayed from **Voxhaus.**

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Böden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**4.0,** Concert of Light Music. **5.0,** Programme for Children. **5.30,** Selection of Old Time Dance Music. **6.30,** Talk: The Career of a Shorthand Typist. **6.45,** Pianoforte Recital, Nordisk dityramb (Sjögren); Selections (Lundberg) (a), Marin in E Flat Minor, (b) Marin in E Flat Major, (c) Nocturne. **7.0,** Programme of Gramophone Records. **8.0,** Topical Talk. **8.15,** News and Weather Report. **8.45,** Dance Music. **11.0** (approx.), Close Down.

Saturday, JANUARY 5th.

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OSLO (461.5 metres) 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres) and **Rjukan** (448 metres).—**5.0,** Programme for Children, "The Sleeping Beauty." Play based on Grimms' Fairy Tale. **6.0,** Birthday Greetings. **6.15,** Weather Report. **6.30,** Herr Hugo Caspari, Talk: The Lapp Market in Sweden. **7.0,** Time Signal. **7.2** (approx.), Orchestral and Vocal Concert from the Works of Wagner; Orchestral Selection, Overture to The Mastersingers; Soprano Solo, Elizabeth's Air from Tannhäuser; Baritone Solo, The Dutchman's Air from The Flying Dutchman; Orchestral Selection from Lohengrin; Vocal Duet from the Second Act of The Flying Dutchman; Orchestral Selection, Overture to the Third Act of The Mastersingers; Wotan's Farewell and Fire Magic from The Valkyrie. **8.30,** Weather Report, News and Announcements. **8.45,** Topical Talk. **9.0,** "Luftruten," Sketch (Per LykkeSeest). **9.30,** Dance Music from the Grand Hotel, **Oslo. 11.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(1485.15 metres);** 5 kW.—**5.0,** Pasdeloup Concert. **7.10,** Weather Report. **7.50,** "Le Journal Parlé."

PARIS (Radio-Paris), Call CFR **(1,750 metres);** 6 kW.—**12.30,** Concert of Columbia Gramophone Records: Ma Mere l'oye (Ravel), by Walter Damrosh, New York Symphony Orchestra; Bass Solo from The Magic Flute (Mozart), by M. Fred Bordon; Stenka Rasine (Glazounoff), by the Don Cossack Chorus; Pianoforte Solo, Romance Op. 32 (Schumann), by Francis Planté; Pianoforte Solo, Etude No. 23 (Chopin), by Francis Planté, Si j'étais Demoiselle by Maurice Chevalier; Ukulele Selection, That's my weakness now; Fox-Trot, Hello Montreal, by Ted Lewis and his Orchestra; Fox-Trot, I can't give you anything but love, by The Knickerbockers; Fox-Trot, Too busy, by the Clicquot Club Eskimos; One-step, Constantinople, by Paul Whiteman and his Orchestra; Song, Callecita de mi Barrio by Pilar Arcos, with Orchestral Accompaniment; In the Intervals: News. **2.0,** Market Prices and Religious Information. **3.45,** Dance Music by the Joss Ghisley Symphonians; In the Intervals, News. **6.30,** Agricultural Report. **6.45,** Musical Selections. **7.30,** Pianoforte Lesson by M. Pierre Lucas. **8.0,** Talk arranged by the Union des Grandes Associations Françaises, followed by Market Prices, News and Announcements. **8.15,** Concert of Chamber Music, Songs and Dance Music by the Joss Ghisley Symphonians. In the Intervals, News.

POSEN (344.8 metres); 1.5 kW.—**3.25,** Talk. **3.45,** Violin Recital, by Mr. Mieczyslaw Paszkiet. **4.15,** Talk on Boy Scouts. **4.30,** Talk. **5.0,** Programme relayed from **Warsaw. 6.0,** Talk for Women by Mme Sabina Swidzinska. **6.20,** Musical Interlude. **6.40,** English Lesson by Dr. Arend. **7.5,** Miscellaneous Items. **7.30,** Programme relayed from **Warsaw;** in the Intervals: Theatre and Cinema Announcements. **9.0,** Time Signal and Weather Report. **9.30,** Cabaret Programme. **11.0,** Orchestral Concert, arranged by the Maison Philips. **1.0 a.m.** (approx.), (Sunday), Close Down.

PRAGUE (348.9 metres); 5 kW.—**3.30,** Concert: Gli Orazi e curiazi (Cimarosa); Selections (Couperin), (a) L'Artiste, (b) Les Bergeries, (c) Les Moulins à vent; Scottish Melodies (Beethoven); Trois pieces montées (Satie); Waltz (Poulenc); Allegro ironico (Bartok); Serenade (Haas); The Snow Man (Korngold). **4.30,** Talk. **4.40,** Talk for Workers. **4.50,** Agricultural Talk. **5.0,** German Programme: News and Recitations. **6.0,** Relay of "Die Herzogin von Chicago," Operetta (Kalman), from the Urania Theatre. **9.0,** Time Signal, News and Theatre Notes. **9.20,** Relay of Tzigane Music from **Bratislava** (300 metres).

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres);** 30 kW.—**11.58,** Weather Report. **12.0 Midnight,** Phil Spitalny's Music from **New York. 12.30 a.m.** (Sunday), Musical Programme from **Rochester. 1.30 a.m.,** Concert from the Studio. **2.0 a.m.,** Lew White, Organ Recital, from **New York. 2.30 a.m.,** Programme by Mildred Hunt, with the Marimba Orchestra, from **New York. 3.0 a.m.,** Lucky Strike Programme, from **New York. 4.0 a.m.,** Time Signal. **4.2 a.m.,** Dance Music. **5.0 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**3.30,** Concert **4.30,** Market Prices. **5.15,** Concert of Turkish Music. **7.30,** Weather Report and Time Signal. **7.40,** Vocal and Orchestral Concert: Orchestral Selections, (a) Overture to Tannhäuser (Wagner), (b) Adagio sostenuto (Beethoven), (c) Vier Ernste Stunden (Beethoven); Songs; Orchestral Selections, (a) Légende (Wieniawsky); (b) Slavonic March (Tchaikovsky). **9.0,** News.

STUTTGART (379.7 metres); 4 kW.—**10.0 a.m.,** News and Weather Report. **11.15 a.m.,** Concert to Gramophone Selections. **12.45,** News. **1.0,** Programme for Children. **2.0,** Concert: Overture to Indra (Flotow); Song without Words (Mendelssohn); Rhapsodie (Reindl); Der Spielmann (Hildach); Ich wollt' meine Liebe ergösse sich (Mendelssohn); Ballet from Faust (Gounod); Spielmanns Wanderlied (Horstein); Gruss (Mendelssohn); Frühlingssuite (Nevin); Herbstlied (Mendelssohn); Prelude to Die Lorelei (Bruch). **3.35,** Concert, relayed from **Frankfurt. 5.0,** Time Signal and Weather Report. **5.15,** Talk by Dr. Hoffmann, relayed from **Freiburg** (577 metres). **5.45,** Otto Schwarz reads from his own Works. **6.15,** Franz Carl Endres, Talk: Magic of the Present Day. **6.45,** Time Signal, Sports Notes and Report on Snow Conditions. **7.15** "Eine Ballnacht," Operetta in Three Acts (Leopold Jacobson and Rob. Bodansky), Music by Oscar Straus.

TOULOUSE (Radiophonie du Midi) **(389.6 metres);** 8 kW.—**12.45,** Concert by the Radio Club of Bigourdan: Military March from the Algerian Suite (Saint-Saëns); Overture to The Thieving Magpie (Rossini); Second Waltz (Benjamin Godard). **1.0,** Time Signal. **1.5,** Concert (continued): Nine Selections from Lohengrin (Wagner). **1.45,** News. **8.0,** Market Quotations and News. **8.30,** Concert: The Fifth Symphony, Op. 64 (Tchaikovsky); Selections from Coppélia (Delibes), (a) Introduction and Waltz, (b) Various Slavonic Themes, (c) Mazurka, (d) Ballad, (e) Scene and Waltz from La Poupée; Arabian March (Ganne); Waltz, Santiago (Corbin); One-Step, Constantinople (Carlton). **9.0,** Time Signal. **9.2,** Concert by "La Dépêche," under the direction of M. Canteuys; in the Interval: Musical Selections, Le Septuor (Saint-Saëns), (a) Préambule, (b) Menuet, (c) Intermède, (d) Gavotte et Finale. **11.0,** North African News, **11.10** (approx.), Close Down.

VIENNA (517.2 metres); 15 kW.—**2.15,** Phototelegraphy Transmission. **3.0,** Concert: Die Irrfahrt um's Glück—Overture (Suppé); Waltz, Was tut man nicht alles aus Liebe (Ascher); Tirol in Lied und Tanz (Fetrás); Serenade from Der Goldschmied von Toledo (Offenbach); 'Cello Solos (Squire), (a) Consolation), (b) Romance, Wachtparade der Hutzelmännchen (Ecklebe); Potpourri, Liebe Lust und Leben (Ischpold); Overture (Wichtl); Trio Selection, Du liebe gold'ne Meisterin (Eysler); Der lustige Posaunist (Lake); Potpourri, Perlen vom Donaustrand (Kaiser); March, Aus eigener Kraft (Ruprecht). **4.45,** August Angenetter, Talk: An Old German 12th Night Custom. **5.15,** "The Three Wise Men" (Felix Timmermann); Gertrude Lasch (Elocutionist), Adelheid Bergmann (Songs to the Lute). **5.30,** Josef Friedrich Perkonig reads from his own Works, with Introductory Talk by Dr. Erich Korningen. **6.30,** Pianoforte Recital by Ignaz Friedmann: Sonata in E Minor, Op. 90 (Beethoven); Selections (Chopin), (a) Nocturne in B Major Op. 62, (b) Fantasia in F Minor, (c) Mazurka in B Minor, (d) Polonaise in A Flat Major. **7.30,** Time Signal, Weather Report and News. **7.35,** "The Three Merry Kings"—Play (Heinz Steguweit), followed by Dance Music from the Grill Room of the Hotel Bristol and Phototelegraphy Transmission.

VILNA (435 metres); 1.5 kW.—**2.10,** Gramophone Selections. **3.10,** News in Lithuanian. **3.25,** Programme relayed from **Warsaw. 4.0,** Service from the Ostra Brama Chapel. **5.0,** News. **5.20,** Poem Recitations by Mr. Wyszomirski. **5.35,** Clarionet Recital by Mr. Sylvestre Czosnowski. **6.5,** Selection by Mr. Léon Wollejko. **6.30,** Programme relayed from **Warsaw. 7.0,** Talk. **7.30,** Programme relayed from **Warsaw. 10.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**3.0,** Talk. **3.25,** Announcements. **3.35,** Talk by Prof. H. Moscicki. **4.0,** Programme relayed from **Vilna. 5.0,** Programme for Children. **6.0,** Miscellaneous Items. **6.30,** "Radio-Chronique," by Dr. M. Stepowski. **6.56,** Time Signal. **7.30,** Concert; in the Interval, Theatre Notes. **9.0,** Aviation Notes and Weather Report. **9.5,** News. **9.20,** Police Announcements and Sports Notes. **9.30,** Dance Music by the Oaza Dance Band, directed by W. Roszkowski. **11.30** (approx.), Close Down.

ZÜRICH (588 metres); 1 kW.—**6.0,** Chimes from the Zürich Churches. **6.15,** Time Signal and Weather Report. **6.17,** Orchestral Concert. **7.35,** Concert by the Fidelio Jodel Double Quartet, the "Echo v. Bürgenstock" Orchestra and Emmy Brauen (Soloist). **9.0,** Weather Report and News. **9.10,** Gramophone Selections of Dance Music.

Programmes from Abroad.—

BARCELONA (Radio-Barcelona), Call EAJ1 (344.8 metres); 1.5 kW.—**11.0 a.m.**, Cathedral Chimes Relay. **11.5 a.m.**, Weather Report and Forecast for Spain and Europe, followed by Aviation Route Conditions. **1.30**, Musical Selections by the Iberia Trio; Gramophone Records in the intervals. **2.45 to 5.30**, No Transmission. **5.30**, Opening Signal, followed by Opera Relay from the Gran Teatro del Liceo; Stock Exchange Quotations and Market Prices in the Interval. **8.0 to 8.20**, Programme arranged by the Catalonian Institute of Agriculture at San Isidro. **8.20**, Concert of Instrumental Music by the Station Orchestra; Song and Wedding March by J. Pahissa. **8.40**, Sports News. **9.0** (approx.), Close Down.

BERGEN (370.4 metres); 1.5 kW.—**9.30 a.m.**, Relay of Divine Service. **11.30 a.m.**, Meteorological Report and News and Announcements. **7.0**, Concert of Orchestral Music. **7.50**, Talk, "Topics of the Day." **8.0**, Lecture by Mr. M. Aalin, "Holland." **8.30**, Concert of Vocal Music. **9.0**, Meteorological Report and Weather Forecast, Late News and Announcements and Time Signal. **9.15**, Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) **(1,649 metres)**; 40 kW.—**7.55 a.m.**, Chimes, relayed from the Garrison Church at Potsdam. **8.0 a.m.**, Musical Festival with Sermon, relayed from **Voxhaus**, followed by Chimes from the Berlin Cathedral. **10.30 a.m.**, Morning Concert, relayed from **Voxhaus**. **12.45**, Experimental Picture Transmission. **1.30 to 2.25**, Three Talks for Farmers from **Voxhaus**. **2.30**, Reading of Fairy Tales, from **Voxhaus**. **3.0**, Talk. **3.30**, Concert Programme. **5.0**, Talk. **6.0**, Talk. **7.0**, Musical Programme, followed by News and Announcements. **9.30**, Programme of Dance Music. **11.30** (approx.), Close Down.

BERLIN (Voxhaus) **(484 metres)**; 4 kW.—**7.55 a.m.**, Garrison Church Chimes, relayed from Potsdam. **8.0 a.m.**, Morning Recital of Sacred Music with Vocal and Instrumental Items and Address, followed by Chimes Relay from the Berlin Cathedral. **10.30 a.m.** (approx.), Orchestral Concert with Solo Items, relayed from the Grosse Schauspielhaus. **1.0**, Elementary Morse Lesson by Hans W. Priwin. **1.30 to 2.25**, Programme of Agricultural Talks. **1.30**, Practical Hints for the Agriculturist. **1.45**, A Weekly Review of Market Prices and Weather Conditions. **1.55**, Lecture on an Agricultural Topic. **2.30**, Reading of Fairy Stories for Children. **3.0**, Talk. **3.30**, Musical Programme. **6.0**, Talk. **6.30**, Talk. **7.0** (approx.) Concert or Play, followed by Weather Report and Forecast, Late News Bulletin and Sports Results. **9.30**, Dance Music. **11.30** (approx.), Close Down.

BERN (411 metres); 1.5 kW.—**9.30 a.m. to 10.30 a.m.**, Morning Concert. **12.0 Noon**, Time Signal and Meteorological Report. **12.5**, Concert of Orchestral Music. **2.30**, Concert by the Kursaal Orchestra. **6.29**, Time Signal and Meteorological Report. **6.30**, Reading or Talk. **7.0**, Musical Programme. **8.45**, Sports Results, Late News and Announcements and Meteorological Report. **9.0**, Musical Programme. **9.40** (approx.), Close Down.

BÉZIERS (158 metres); 0.6 kW.—**8.30**, News, Announcements and Sports Notes. **8.45**, Concert arranged by the Maison Rein-Minoles at Béziers: Selections from the Pathé-Art Gramophone Records. **10.30** (approx.), Close Down.

BORDEAUX (Radio Sud-Ouest) **(238 metres)**; 1 kW.—**12.30**, Selections from New Gramophone Records. **1.45**, Close Down.

BRESLAU (322.6 metres); 4 kW.—Programme relayed by **Gleiwitz** (329.7 metres).—**8.15 a.m.**, Chimes relayed from Christ Church. **1.0**, Notes for the Amateur Gardener. **1.10**, Talk. **1.35**, Wireless Chess Talk by Adolf Kramer. **2.0**, Programme for Children. **2.30**, Talk for Agriculturists. **2.55**, Musical Programme. **3.45** (approx.), Talk. **4.10**, Concert of Light Music. **8.0**, Cabaret Concert by the Berty Jazz and Salon Orchestra relayed from the Hotel "Haus Monopol." **9.0**, Late News and Announcements. **9.30**, Programme of Dance Music. **11.0** (approx.), Close Down.

BRUSSELS (508.5 metres); 1.5 kW.—**5.0**, Musical Programme by the Orchestra of the Armenonville Tea Room, Brussels. **6.0**, Children's Entertainment arranged by the Brussels Children's Theatre under the Management of M. Léon Leroy. **6.30**, Selections by the Station Trio. **7.30**, Le Journal Parlé de Radio Belgique. **8.15**, Concert: Dumka, Suite based on Ukrainian Airs by Akimenko. **10.15**, Late News and Announcements and Press Review. **11.0** (approx.), Close Down.

BUDAPEST (556.6 metres); 20 kW.—**8.0 a.m.**, General News and Announcements and Programme for Women. **9.0 a.m.**, Relay of Divine Service with Address. **3.15**, Wireless "Lyceum" Programme, Hungarian Song Recital by Vilma Medgyasszay.

SUNDAY, JANUARY 6th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

COLOGNE (283 metres); 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres) and **Münster** (250 metres).—**6.45 a.m.**, Lesson in Self Defence by Dr. Ludwig Bach. **7.20 a.m.**, Review of the Programmes of the Week in Esperanto by Alfred Dormanns. **7.30 a.m.**, Esperanto Lesson by Alfred Dormanns. **8.0 a.m.**, Church Chimes. **8.5 a.m.**, Catholic Festival of Sacred Music, Choral and Orchestral Items, with Address in the interval. **10.0 a.m.**, Philological Talk on the German Language by Fritz Worm. **12.0 Noon**, Concert of Orchestral Music. **1.30**, Talk. **3.30**, Concert. **6.40**, Sports News. **8.0** "The Three Kings," Play based on the Christmas Legend by Felix Timmermanns and adapted for dramatic performance by Eduard Vetermann and Felix Timmermanns, followed by Late News Bulletin, Sports Notes and Musical Programme. **11.0** (approx.), Close down.

CORK, Call 6CK **(400 metres)**; 1.5 kW.—**8.30**, Vocal and Instrumental Concert: Choral Selections by the Cork National Schools Past Pupils' Choir, conducted by Donnchadh O Braoin. **11.0**, National Anthem and Meteorological Report. **11.15** (approx.), Close Down.

CRACOW (566 metres); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Divine Service from Posen Cathedral. **10.56 a.m.**, Relay of Fanfare from the Church of Notre Dame, followed by Time Signal and Meteorological Report. **11.10 a.m.**, Relay of Orchestral Concert by the Philharmonic Society from **Warsaw**. **1.0 and 1.20**, Talks for Farmers. **1.40**, La Chronique Agricole by Dr. St. Wasniewski. **2.0**, Meteorological Report. **2.15**, Orchestral Concert relayed from the Philharmonic Hall at **Warsaw**. **4.55**, Talk: "The Unity and Systematisation of Advertising Campaigns." **6.56**, Time Signal from the Observatory. **7.0**, Relay of Fanfare from the Church of Notre Dame, followed by Sports News. **7.30**, Concert of Vocal and Instrumental Music. **9.0**, Late News Bulletin from **Warsaw**. **9.30**, Musical Programme relayed from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN **(319.1 metres)**; 1.5 kW.—**8.30** Programme relayed from **Cork**. Organ Recital by Herr A. Fleischmann, relayed from St. Mary's Cathedral, Cork. **11.0**, National Anthem and Weather Report and Forecast. **11.15** (approx.), Close Down.

HAMBURG, Call KA (in Morse) **(394.7 metres)**; 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres), and **Kiel** (254.2 metres).—**7.25 a.m.**, Time Signal. **7.30 a.m.**, Meteorological Report, followed by News and Announcements. **7.50 a.m.** (approx.), Talk on Economics and Industry. **8.0 a.m.** Weekly Legal Review. **8.15 a.m.**, Morning Festival. **10.0 a.m.**, Talk. **11.55 a.m.**, International Time Signal, relayed from **Nauen**. **12.05** (for **Hamburg** and **Kiel**), Concert Programme. **12.05** (for **Bremen**), Musical Selections by the Station Orchestra. **2.05** (for **Hanover**), Gramophone Selections. **1.0**, Programme for Children. **6.25**, Relay from the Municipal Opera House of "Boccaccio": Operetta in Three Acts by Franz von Suppé, conducted by R. Krauss and produced by H. Winckelmann, Meteorological Report, Late News and Announcements. **10.50** (for **Hamburg**, **Bremen** and **Kiel**), Meteorological and Weather Forecast for the North Sea and Baltic. **11.0** (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—**2.10**, Concert relayed from the "Concertgebouw," **Amsterdam** conducted by Pierre Monteux. Pianoforte Solos by Yves Nat. **7.40**, Time Signal. **7.42**, General News and Communications, Meteorological Report and Notes. **7.55**, Musical Programme. **10.40** (approx.), Close Down.

HUIZEN (340.9 metres); 4 kW.—Transmits from 5.40 on 1,852 metres.—**8.10 a.m.**, Divine Service. **9.30 a.m.**, Divine Service Relay. **12.10**, Musical Selections by the Station Trio. **2.10**, Orchestral Selections. **5.15**, Relay of Divine Service, relayed from the Juliana-Kerk at **Veenendaal** (on 1,852 metres). Address on the 37th Verse of the 21st Chapter of St. Matthew's Gospel. **7.10**, Talk. **7.40** (approx.), Orchestral Concert Programme. **10.25**, Epilogue by the Choir, conducted by Mr. Jos. H. Pickkers. **10.40** (approx.), Close Down.

KALUNDBORG (1,153 metres); 7 kW.—Programme also for **Copenhagen** (337 metres).—**9.0 a.m.**, Relay of Morning Service with Sermon from **Copenhagen**. **10.30 a.m. to 10.40 a.m.** (**Kalundborg** only), Weather Report and Forecast from the Copenhagen Meteorological Institute. **5.30** (approx.), Entertainment for Children. **5.50** (**Kalundborg** only), Weather Report and Forecast from the Copenhagen Meteorological Institute. **6.0**, Press News and Announcements. **6.15**, Time Signal. **6.30**, Talk. **7.0**, Carillon relayed from the Copenhagen Town Hall. **7.5**, Concert. **8.15**, Pianoforte Recital by Folmar Jensen: Pianoforte Sonata in F Minor, Op. 7 (Edvard Grieg), (a) Allegro moderato, (b) Andante molto, (c) Alla minuetto (d) Finale, molto allegro. **9.45**, Dance Music Programme by the Palace Hotel Orchestra conducted by Teddy Petersen. In the Interval at **11.0**, Carillon Relay from the Copenhagen Town Hall. **11.30** (approx.), Close Down.

KATTOWITZ (422 metres); 10 kW.—**9.15 a.m.**, Divine Service Relay. **10.53 a.m.**, Time Signal. **11.0 a.m.**, Meteorological Report. **11.15 a.m.**, Concert of Light Music by the Kattowitz Station Quartet. **1.0**, Talk. **1.20 and 1.40**, Two Agricultural Talks. **2.0**, Meteorological Report. **2.15**, Relay of Symphony Concert by the **Warsaw** Philharmonic Society: Overture to "Der Freischütz"—Opera (K. M. v. Weber). **5.0**, Concert. **6.0**, Miscellaneous Announcements. **6.20**, "Half an Hour of Jollity," by Professor St. Ligon. **6.56**, Time Signal. **7.30**, Popular Concert relayed from **Warsaw**. **9.0**, Meteorological Report, Press News and Announcements and Sports Notes. **9.30**, Programme of Dance Music. **10.30** (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—**2.30**, Entertainment for Children. **3.0**, Programme for Young People. **3.30**, Talk on Health and Medicine by Dr. Jurgelionis. **4.0**, Talk by J. Ardickas: Economics and the Life of the People. **4.55**, Meteorological Report and Press News and Announcements. **5.0**, Polish and Lithuanian News and Information. **5.40**, Programme arranged by Union for Defence. **9.0** (approx.), Close Down.

KÖNIGSBERG (303 metres); 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**8.0 a.m.** (**Königsberg** only): Recital of Sacred Music with Choral and Instrumental Items, Solos and Address. **10.0 a.m.** (**Königsberg** only): Meteorological Report. **10.15 a.m.**, Morning Festival. **11.55 a.m.**, International Time Signal from **Nauen**, followed by Meteorological Report. **3.15**, Orchestral Concert. **7.0**, Cabaret Programme, Artistes: Max Kuttner (Berlin), Karl Napp and the Station Orchestra conducted by Walter Kelch. **9.15**, News and Announcements, Sports Notes and Results. **9.30**, Programme of Light and Dance Music. **11.30** (approx.), Close Down.

LAHTI (1,522.8 metres); 35 kW.—Programme also for **Helsingfors** (375 metres).—**8.0 a.m.**, Relay of Church Service. **9.50 a.m.**, News from the Press. **10.5 a.m.**, Musical Selections. **10.50 a.m.**, Weather Report and Forecast and Time Signal. **11.0 a.m.**, Relay of Church Service (in Swedish). **3.0**, Concert by the Lahti Station Orchestra conducted by Erkki Linko. **3.50**, Talk. **4.10**, Musical Programme. **4.30**, Talk. **4.57**, Time Signal and Weather Report and Forecast. **5.10**, Concert by the Wireless Orchestra. **5.30**, Lecture. **6.0**, Musical Programme. **6.20**, Pianoforte Recital by Gorda Veneskoski. **7.45**, General News Bulletin given in Finnish. **8.0**, News Bulletin in Swedish. **8.30** (approx.), Close Down.

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**6.45 a.m.**, Lesson in Boxing by Dr. Ludwig Bach. **7.20 a.m.**, Review in Esperanto of the Week's Programmes by Alfred Dormanns. **7.30 a.m. to 7.55 a.m.**, Esperanto Instruction by Alfred Dormanns. **8.0 a.m.**, Church Chimes. **8.5 a.m.**, Catholic Morning Recital of Choral and Instrumental Music with Address in the interval. **10.0 a.m.**, Philological Talk by Fritz Worm on the German Language. **12.0 Noon**, Orchestral Concert. **1.30**, Talk. **3.30**, Concert. **5.25**, Talk by Hulda Pankok: "Contemporary Phenomena under the Microscope." **6.5**, Sports News. **8.0**, Play, Late News Bulletin. **11.0** (approx.), Close Down.

LEIPZIG (365.8 metres); 4 kW.—Programme relayed by **Dresden**. (275.2 metres).—**7.30 a.m.**, Recital of Organ Music. **8.0 a.m.**, Morning Concert of Instrumental Music. **10.0 a.m.**, Talk by Doctor Koebner: "Constitutional History of the British Empire." **10.30 a.m.**, Talk by Doctor Conrad Weygand: "The Chemistry of Daily Life." **11.0 a.m.**, Musical Programme. **12.0 Noon**, Talk for Farmers. **12.30**, Talk. **1.0**, Readings from the Foreign Press. **2.0** (approx.), Gramophone Selections. **5.30** Talk. **6.0**, Talk. **8.0**, Wireless Cabaret, Artistes: Agnes Delsarto and Andreas Irion (Vocal Selections), Käte Schindler (Humorous Prose and Verse Recitations), Reinhold Balqué (Humorous Selections). **9.15** (approx.), Sports Notes and Press News and Announcements, followed by Dance Music relayed from **Berlin**. **11.30** (approx.), Close Down.

LYONS (Radio Lyon) **(291 metres)**; 1.5 kW.—**7.30**, The Radio-Lyon "Journal Parlé" with News and Announcements, Press and Theatre Review. **8.0** Instrumental Concert, Soloists: Madame Ducharn

Programmes from Abroad.—

(Pianist), M. Camand (Violinist) and M. Testanière ('Cellist); "Wine, Women and Song." Waltz (J. Strauss). **10.0** (approx.), Close Down.

MADRID (Union Radio) Call EAJ 7 (**434.8 metres**); 1.5 kW.—Programme relayed by **Salamanca** (EAJ 22) (405 metres).—**2.0**, Relay of Chimes and Time Signal. **2.5**, Concert of Orchestral Music with Interlude: Jeux d'enfants, Orchestral Suite (Bizet), (a) March, Trumpet and Drum, (b) Berceuse, The Doll, (c) Impromptu, The Top, (d) Duet, Little Husband and Wife; Interlude by Luis Medina. **3.30 to 7.0**, No Transmission. **7.0**, Chimes. **7.5**, Musical Programme by the Union Radio Sextet and Interlude by Luis Medina. **8.0**, Dance Music Programme by the Palermo Orchestra at the Alkazar. **8.30 to 10.0**, No Transmission. **10.0**, Chimes and Time Signal. **10.5**, Musical Programme. **12.0 Midnight**, Relay of Chimes, followed by Dance Music Programme by the Palermo Orchestra relayed from the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, MI (**549 metres**); 7 kW.—**9.0 a.m.**, Opening Signal and English Language Lesson. **9.30 a.m. to 10.30 a.m.** (approx.), Recital of Vocal and Instrumental Sacred Music. **11.30 a.m.**, Time Signal. **11.35 a.m.**, Musical Selections by the Milan Station Quartet. **12.30 to 3.0**, No Transmission. **3.0**, Opening Signal. **3.5**, Variety Concert Programme. **4.15** (approx.), Programme by the Tzigane Orchestra at the Fiaschetteria Toscana. **5.0 to 6.55**, No transmission. **6.55**, Opening Signal. **7.0**, Press News. **7.15**, Talk. **7.25**, Sports News. **7.30**, Time Signal. **7.35**, Relay of Operetta—Trio: "Il Tabarro," "Suor Angelica" and "Gianni Schicchi," by G. Puccini; In the interval: Sports Results and News from the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (**1,380 metres**); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.6 metres).—**10.0 a.m.**, Relay of Divine Service from a Church in **Stockholm**. **1.0**, Concert Programme. **3.0**, Musical Programme. **4.0**, Programme for Children. **4.55**, Chimes relayed from the Town Hall at **Stockholm**. **5.0**, Relay of Divine Service. **6.15**, Literary or Dramatic Programme. **8.0**, Incidental Music to "Peer Gynt" (Grieg). **10.30** (approx.), Close Down.

MUNICH (**535.7 metres**); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (277.8 metres) and **Nuremburg** (241.9 metres).—**10.0 a.m.**, Relay of Chimes from the Munich Town Hall. **10.10 a.m.**, The Bavarian Wireless Weather Chart. **10.25 a.m.**, Time Signal followed by Weather Report and Forecast. **11.35 a.m.**, Time Signal and Weather Report and Forecast followed by Announcements of Forthcoming Porgrammes. **2.0**, Programme of Music or Literary Reading. **7.0**, Musical Programme. **9.0** (approx.), Late News Bulletin followed by Relay of Concert. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333.3 metres**); 1.5 kW.—**8.30 a.m.** Elementary French Lesson by Prof. Etienne Verdier. **9.0 a.m.**, Recital of Sacred Music. **3.45**, Programme for Children. **4.0**, Musical Variety Programme. **4.30**, Time Signal. **7.30**, News and Announcements. **7.50**, Report of the Neapolitan Harbour Authorities. **8.0**. Time Signal. **8.2**, Concert of Vocal and Instrumental Music: Duetto from Act II of Manon Lescaut (Puccini), for Soprano and Baritone, rendered by E. Blandi and R. Aulicino. **9.0**, Sports News. **9.50**, Calendar and Review of Forthcoming Programmes. **10.0** (approx.), Close Down.

OSLO (**461.5 metres**); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**9.50 a.m.**, Carillon. **10.0 a.m.**, Morning Service Relay from St. Saviour's Church. **4.50**, Carillon. **5.0**, Relay of Evensong from St. Saviour's Church. **6.15**, Meteorological Report and Weather Forecast, followed by Press News and Announcements. **6.30**, Talk. **7.0**, Time Signal. **7.50**, Orchestral Concert. **8.30**, Meteorological Report and Press News and Announcements. **8.45**, Talk by a Journalist on a Topical Subject. **9.0**, Musical or Literary Programme. **9.30**, Dance Music Programme. **11.30** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (**458 metres**); 0.5 kW.—Programme relayed at Intervals by the following Stations: **Bordeaux**, PTT (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres), Lille (264 metres), **Limoges** (285 metres), **Lyons**, PTT (480 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse**, PTT (260 metres).—**8.0 a.m.**, News and Announcements and Time Signal. **9.25 a.m.**, International Time Signal and Meteorological Report. **12.0 Noon**, Concert. **1.0**, "Le Journal de France Economique." **1.30**, Musical Programme, organised by the General Association of French Wireless Listeners. **2.30**, Symphony Concert relayed from the Concert Hall of the Paris Paper, "Le Journal."

Wireless World

Sunday, JANUARY 6th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

4.0, Pasdeloup Symphony Concert Relay from the Théâtre des Champs Elysées, conducted by M. Rhené-Bâton. **6.30**, "Le Radio Journal de France." **8.0**, Sports Notes and News. **8.15**, Talk, under the auspices of the Union of French Associations. **8.30**, Orchestral Programme, arranged by the General Association of French Wireless Listeners. **10.30** (approx.), Dance Music Programme from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**1,485.15 metres**); 5 kW.—**7.56 a.m.**, Time Signal on 32.5 metres.—**9.26 a.m.**, Time Signal on 1,485.15 metres. **5.0**, Pasdeloup Concert Relay. **7.10 to 7.20**, Meteorological Report. **7.50**, (approx.), "Le Journal Parlépar T.S.F.," with Talks by its Regular Contributors: Health Talk, Police Memoirs, Sports Notes and Racing Results. **7.56**, Time Signal on 32.5 metres. **8.0 to 9.0**, Orchestral Concert with Vocal and Instrumental Solos. Second Hungarian (Liszt) rendered by Diane Modigliani. **10.26**, Time Signal on 2,650 metres. **11.15** (approx.), Close Down.

PARIS (Petit Parisien) (**340.9 metres**); 0.5 kW.—**8.45**, Popular Gramophone Records. **8.50**, Talk. **8.55**, Press News and Announcements. **9.0**, Orchestral Concert with Vocal and Instrumental Soloists. **9.25**, News and Announcements. **9.30**, The Half Hour of Symphony Music under the direction of Prof. Estyle, of the Paris Conservatoire. **10.0**, Late News and Announcements. **10.15**, Orchestral Selections. **11.0** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (**1,750 metres**); 6 kW.—**8.0 a.m.**, General News and Announcements and Press Review. **8.30 a.m.**, Physical Culture Lesson by Dr. Diffre. **12.0 Noon**, Religious Address, followed by Recital of Sacred Music. **12.30**, News and Announcements. **12.45**, Concert by the Albert Locatelli Orchestra with Interlude by Bilboquet. **4.30**, Concert of Gramophone Records, arranged by "L'Industrie Musicale"; in the Interval: News and Announcements. **6.30**, Agricultural Notes. **6.45**, Gramophone Selections. **7.30**, News and Announcements. **7.45**, Guignol Radio Paris. **8.15**, Concert of Vocal and Instrumental Music; in the Intervals: News Bulletin from the Evening Press and Late News and Announcements. **10.30** (approx.), Close Down.

POSEN (**344.8 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Sacred Service. **11.0 a.m.**, Time Signal. **11.5 a.m.** and **11.30 a.m.**, Two Talks for Agriculturists. **2.15**, Symphony Concert, relayed from **Warsaw**. **4.20**, Talk. **4.45**, Talk. **5.30**, Programme for Children. **6.0**, Programme arranged by the League of Polish Youth. **6.20**, Talk, relayed from **Warsaw**. **7.5**, Variety Programme. **7.30**, Concert of Vocal Selections, rendered by M. Mieczyslaw Perkowicz (Operatic Tenor): Song from "The Jewels of the Madonna," Opera by Wolff-Ferrari. **9.0**, Time Signal. **9.5**, General News Bulletin. **9.20**, Dancing Lesson by Mr. Starski. **9.40**, Dance Music Programme. **11.0** (approx.), Close Down.

ROME, Call 1RO (**447.8 metres**); 3 kW.—**8.30 a.m.**, Opening Signal, followed by Instruction in the German Language. **9.0 a.m.**, Vocal and Instrumental Recital of Sacred Music. **9.45 a.m., to 12.0 Noon**, No Transmission. **12.0 Noon**, Opening Signal. **12.5 to 1.0**, Trio Selections. **1.0 to 4.0**, No Transmission. **4.0**, Opening Signal. **4.5 to 5.30**, Musical Variety Programme. **6.50**, Opening Signal, followed by Press News and Announcements. **7.10**, Talk for Agriculturists. **7.15**, Sports Notes and News Bulletin. **7.29**, Time Signal. **7.31**, Topical Talk. **7.45**, "Il natale del redentore," Oratorio for Soloists, Choir and Orchestra, by Lorenzo Perosi, rendered by the Station Choir and Orchestra; Reading in the Interval. **9.50**, Late News Bulletin. **10.0** (approx.), Close Down.

STAMBOUL (**1,200 metres**); 5 kW.—**3.30**, Musical Programme. **4.30**, Stock Exchange Quotations and Grain Market Prices. **5.15**, Concert of Turkish Music. **7.30**, Meteorological Report and Time Signal. **7.40**, Lecture on the History of Music. **8.0**, Concert of Classical Music. The Works of Franz Liszt. Pianoforte Solos. **9.0**, Late News and Announcements. **9.30** (approx.), Close Down.

STUTTGART (**379.7 metres**); 4 kW.—Programme relayed by **Freiburg** (577 metres). **10.0 a.m.**, Morning Musical Recital. **11.0 a.m.**, Programme of Light Orchestral Music, followed by Gramophone Selections. **2.0**, Talk or Reading. **2.30** (approx.), Concert. **5.0**, Time Signal and Sports Notes. **7.0** (approx.), Concert followed by Late News and Announcements and Sports Notes. **10.30** (approx.), Close Down.

TALLINN (**408 metres**); 2.2 kW.—**8.0 a.m.**, Divine Service Relay. **12.30**, Programme of Instrumental Music. **4.45**, Press News and Announcements. **5.0**, Musical Programme. **5.30**, Talk. **6.0**, Concert with Instrumental and Vocal Items. **9.0** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi), (**389.6 metres**); 8 kW.—**12.20**, Weather Report and Forecast, News and Announcements. **12.45**, Concert of Instrumental Music. **1.0**, Time Signal. **1.5**, Concert (continued). **1.45**, Press News and Communications. **8.0**, Stock Exchange Quotations and Grain Prices from Paris. **8.15**, News of the Day, supplied by the Parisian Press. **8.30**, Orchestral Concert. **8.55**, Concert arranged by "L'Association des Commerçants Radio-Electriciens du Midi": Overture to "Les Saltimbanques"—Opéra-comique (Ganne); In the interval at **9.0**, Time Signal. **10.15**, News from North Africa and Late News Bulletin. **10.30** (approx.), Close Down.

VIENNA (**517.2 metres**); 15 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres).—**9.20 a.m.**, Choral Selections by the Vienna Boys, Choir, conducted by Professor Hans Muller. **10.0 a.m.**, Classical Concert by the Vienna Symphony Orchestra and Soloists. **2.30** (approx.), Experimental Transmission of Pictures. **3.0**, Orchestral Concert with Soloists. **7.0**, Time Signal, Meteorological Report and Weather Forecast, followed by News and Announcements. **7.5**, "The Birdfancier"—Operetta by Zeller, followed by Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

VILNA (**435 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Divine Service relayed from a Cathedral. **10.55 a.m. to 4.20**, Programme relayed from **Warsaw**. **10.56 a.m.**, Time Signal, followed by Fanfare from the Church of Notre Dame at **Cracow**. **11.5 a.m.**, Aviation Notes and Weather. **11.10 a.m.**, Concert of Symphony Music by the Warsaw Philharmonic Society. **1.0 to 2.0**, Three Talks for Agriculturists. **2.15**, Concert of Orchestral Music. **4.20**, News and Announcements. **4.40** (approx.), Talk in Lithuanian. **5.0**, Gramophone Selections. **5.20**, Items for Children. **5.45**, A Quarter of an Hour of Zither Music by Professor Witold Jodko. **6.0** (approx.), One of a Series of Humorous Talks. **6.30**, Programme of Zither Music by Professor Witold Jodko. **6.56**, Time Signal. **7.0 to 10.30**, Programme relayed from **Warsaw**. **7.0**, Talk. **7.30**, Orchestral Concert: "Norma"—Overture (Bellini). **9.0**, Aviation Route Report and Meteorological Report. **9.5**, News and Announcements from the Polish Telegraph Agency. **9.20**, Sports News and Police Report. **9.30**, Programme of Dance Music relayed from the "Oaza" Restuarant, **Warsaw**. **10.30** (approx.), Close Down.

WARSAW (**1,111 metres**); 10 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Divine Service from a Cathedral. **10.56 a.m.**, Time Signal. **11.0 a.m.**, Fanfare Relay from the Church of Notre Dame at **Cracow**. **11.5 a.m.**, Aviation Route Report and Meteorological Report. **11.10 a.m.**, Philharmonic Symphony Concert arranged by the Department for Education and Culture of the Magistracy of **Warsaw**. **1.0 to 2.0**, Three Talks on Agriculture. **2.0**, Meteorological Report. **2.15**, Relay of Symphony Concert by the Warsaw Philharmonic Society. **4.30** (approx.), Talk. **4.55**, Talk on Aviation. **5.20**, Orchestral Concert: Fantasia on themes from "The Haunted Castle"—Opera by Moniuszko, arranged by Konopasek. **6.0**, Variety Items. **6.20**, Talk. **6.45**, News and Announcements. **6.56**, Time Signal. **7.0**, C. Jablonowski, Talk: Intellectural Amusements. **7.30**, Concert by the Polskie Radio Orchestra. **9.0**, Aviation Notes and Meteorological Report. **9.5**, News supplied by the Polish Telegraph Agency. **9.20**, Police Information and Sports Notes. **9.30**, Programme of Dance Music from the "Oaza" Restaurant. **10.30** (approx.) Close Down.

ZAGREB (**309.2 metres**); 0.7 kW.—**10.30 a.m.**, Morning Musical Programme. **4.0**, Programme of Dance Music relayed from the Club-Cabaret. **6.45**, Talk for Amateurs of Wireless. **7.0**, Opera Relay from the National Theatre, Zagreb. In the intervals: General News and Communications and Meteorological Report. **10.0** (approx.), Close Down.

ZÜRICH (**588 metres**); 1 kW.—**10.0 a.m.**, Musical Programme. **11.29 a.m.**, Meteorological Report. **11.30 a.m.**, Musical Selections by the Station Orchestra. **3.0**, Programme by the Castellano Orchestra, relayed from the Carlton Elite Hotel. **6.30**, Time Signal. **6.33**, Religious Address. **8.0**, Relay of Musical Recital from the Grossmünster, Zürich: The Station Orchestra, Conductor: Hermann Hofmann. Soloists, Hermann Achenbach (Baritone) and Viktor Schlatter (Organist). **9.0**, Meteorological Report, Late News and Announcements and Press Service from the Neue Züricher Zeitung. **9.30** (approx.), Close Down.

VALVES we have TESTED

Two New Marconi and Osram Valves.

THE H.L. 610 is a new valve, having a satisfactory mutual conductance, and appearing in the lists of both Osram and Marconi valves; the particular specimen that we have tested was a Marconi. As the initial letters of its name implies, it is intended for general work and is suitable, provided the circuits with which it is to be used are correctly designed, for high- or low-frequency amplification or for detection.

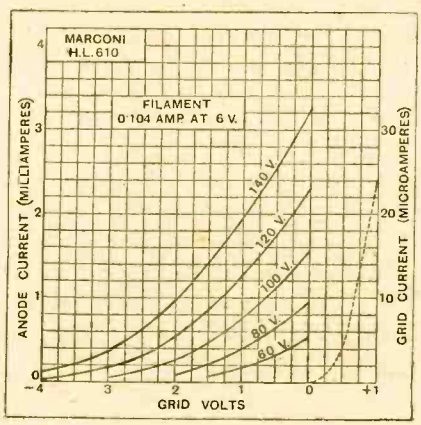
In the past the series of valves with "610" filaments has been incomplete in that the D.E.H. 610 has a very much higher impedance and amplification factor than the next valve in the series, the D.E.L. 610. This gap has been accentuated by the revision and improvement of the characteristics of the series as a whole, so that the H.L. 610, which is intended to fill this gap, should be welcomed by very many valve-users.

The valve falls roughly into the same class as the well-known D.E. 5b, but consumes far less filament current and offers better characteristics than its predecessor.

In appearance the new valve is indistinguishable from the other members of the series; the only difference presumably consists in the closeness of the grid-mesh, and this cannot be seen on account of the "getter" which covers the whole of the upper portion of the bulb. The characteristics of an average valve, as issued by the makers in their catalogues, are as follows:

H.L. 610.	
A.C. Resistance	30,000 ohms.
Amplification Factor	30
Mutual Conductance	1.0 milliamp. per volt.
Maximum H.T.	150 volts.

Two specimens of this valve were tested; there was so little difference between the two that the figures for one only are given. It was found that the figures given by the maker as typical of the average valve were very closely adhered to by the samples examined if we make allowance for the fact that the impedance as quoted by the makers is measured with zero grid voltage. For receiver design it is necessary to take into consideration the fact that the impedance of a valve, especially one in which the impedance is fairly high, is dependent to quite a surprising extent upon the working voltages adopted in practical use.



Characteristic curves of the Marconi H.L. 610 valve.

With this fact in mind, the first examination made was directed to finding the grid-voltage at which grid-current started; it was found that, provided the anode voltage was not less than 60 volts, the grid-current was less than one-fifth of a microamp. at grid-voltages up to 0.2 volts positive. This indicated that it will be possible to keep the impedance of the valves down to quite a low value by using much less grid-voltage than the makers suggest, provided always that the signal-voltage to be dealt with is but small, as will be the case, for example, in a high-frequency amplifier.

The following table gives the amplification factor and impedance of the valve under the various operating conditions suggested; the curves reproduced herewith will supply further data if such are required.

Valve Amplifying at:	Anode Volts.	Grid Volts.	Amplification Factor.	Impedance.	Plate Current (mA.)
High Frequency.	150	−0.5	28.5	21,000	3.0
	120	−0.5	29	28,000	1.7
Low Frequency	150	−1.5	29	28,000	1.8
	120	−1.5	30	33,000	1.3

It will be noticed that the mutual conductance with maximum anode voltage and minimum grid-bias rises to the very high value of 1.35 milliamps. per volt. Used with a standard high-frequency transformer of *Wireless World* pattern, with an extra turn or two on the primary, these figures lead one to expect an amplification of about sixty times in one stage; for this purpose the valve is eminently suited.

For detection and low-frequency

Valves We Have Tested.

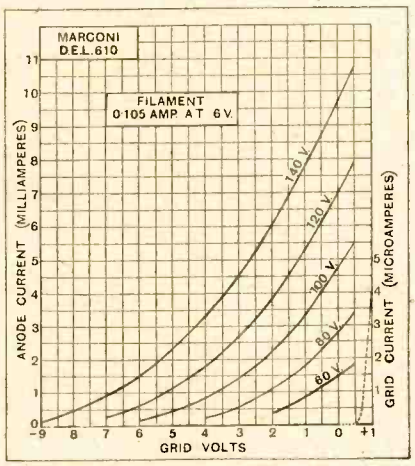
amplification in receivers using resistance-capacity coupling this valve offers a very acceptable compromise between the warring claims of high amplification per stage on the one hand, and proper reproduction of high notes on the other. An anode resistance of some 150,000 ohms when the valve is an amplifier, or 250,000 ohms when it is an anode detector, will be found very satisfactory. Some care should be used in following this valve, used either as amplifier or grid detector, by a transformer, as its impedance, though not perhaps prohibitively high, is definitely on the high side for such use.

It is satisfactory to note that the valve entirely refused to give any indication of softness, either in the form of reverse grid-current, or of "creeping" of plate current when a high anode voltage was used in conjunction with zero grid bias, even though the makers' maximum anode-voltage rating was considerably exceeded in this test.

The D.E L. 610.

This is not an entirely new valve, but an old one redesigned, to the great improvement of its characteristics; the amplification factor has been raised a little, and the impedance has been lowered a good deal since the earlier model was produced. Further, it is now rated to withstand 150 volts H.T., instead of the original maximum of 120.

In appearance it is indistinguishable from the H.L. 610 just described, the electrodes as before being protected from inspection by the "getter." Again it was found that the valve was quite hard, there being no reverse grid-current, and it was possible to make the grid positive, to the extent, this time, of about half a volt, before any measurable grid-current flowed.



Characteristic curves of the Marconi D.E.L. 610.

The manufacturer's data for the valve are as follows:—

D.E.L. 610.	
A.C. Resistance	7,500 ohms.
Amplification Factor	15
Mutual Conductance	2.0 milliamps. per volt.
Maximum H.T.	150 volts.

As before, the makers measure amplification factor and impedance at anode volts 100, grid volts zero, so that the actual working values cannot be expected to be quite so good; in addition, the valve tested did not come up to specification, having an impedance of 9,500 ohms and an amplification factor of 14.3 under the conditions specified.

The following table gives recommended working conditions for three different plate voltages, together with the impedance and amplification factors found under those conditions; it will be seen that these latter figures depend, as usual, upon the working voltages used.

Anode Volts.	Grid Bias.	Anode Current. (mA.).	Amplification Factor.	Impedance (ohms).
150	−4.5	4.5	12.5	10,000
120	−2.5	3.3	13.0	11,500
100	−1.5	2.7	13.6	12,700

Further information is given on the curves, from which the above figures have been deduced.

This valve is not the best one to choose for high-frequency amplification, as the maximum amplification that can be expected from it, even with a high-frequency transformer designed to suit it, is very decidedly less than that which can be attained from the next valve in the series, the H.L. 610. As a grid detector preceding a transformer, or as a transformer-coupled L.F. amplifier, it is very suitable indeed, and in such positions will give of its very best. Where a low-magnification L.F. stage is wanted, as is often the case, after an anode rectifier, this valve, in conjunction with a plate resistance of some 50,000 ohms is suitable. It is particularly fitted to precede a pentode in these specific circumstances, as its low impedance ensures that, even with the high input capacity of that valve, the high-note loss will not rise to appreciable dimensions.

NEWS FROM THE CLUBS.

Push-Pull Amplification.

The possibilities of transformer amplification were fully demonstrated by Mr. R. Garside, of Messrs. Ferranti, Ltd., at the last meeting of the North Middlesex Radio Society. The demonstration receiver consisted of a screened grid H.F. stage followed by an anode bend detector, and the novel method of adjusting this gave almost perfect rectification. The output from the detector was passed via a transformer to the first L.F. stage of push-pull amplification, and thence to a further similar stage employing four 1,700-ohm valves, consuming 20 watts, which fed a moving coil loud speaker. The difference between valves in parallel and in push-pull was emphasised. The fact that the current in the two halves of the push-pull transformer cancels out, thus retaining the maximum inductance, was pointed out as one of the advantages of this method of amplification.

In the near future the Society will carry out a comparative demonstration of several of the latest types of loud speaker.

Hon. Secretary: Mr. E. H. Laister, "Endcliffe," 7a, Station Rd., Winchmore Hill, N.21.

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Pick-ups Compared.

Some interesting comparative experiments with gramophone pick-ups now on the market were carried out at the meeting of the Swindon and District Radio Society on December 11th. Two-valve amplification was used in conjunction with a moving coil loud speaker. By means of a multiple switch three tone arms, carrying different makes of pick-up could be tried on the same type of record with a minimum of delay between each. The demonstration was followed by a debate on the best type of tone arm and subsequently by a demonstration in which one of the best known types of gramophone failed to satisfy when tried beside a moving coil loud speaker.

A receiver consisting of separate units is shortly to be placed at the disposal of members for experiment.

Hon. Secretary: Mr. M. Hill, Windyridge, Okus, Swindon.

Impedance in Moving Coil Loud Speakers.

The question of impedance in a moving coil loud speaker was discussed at a recent meeting of the Croydon Wireless and Physical Society on the occasion of a demonstration of Baker's moving coil instrument, demonstrated by Mr. C. H. P. Nutter. In the discussion, the effect of unmatched impedance was mentioned, with an idea of arriving at some decision as to how to ascertain whether the moving coil impedance was too high or too low by the quality of reproduction.

Visitors are warmly welcomed to any of the Society's meetings. Particulars may be obtained from the Hon. Secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

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New Marconi Set Demonstrated.

At a recent meeting of the Ilford and District Radio Society, Mr. Youle, of the Marconiphone Co., Ltd., lectured on screened valves, and gave a demonstration of the Marconi 61 receiver in conjunction with a Marconi moving coil loud speaker.

Although the Society's membership has increased of late, there are still vacancies for enthusiasts, who should write for full particulars to the Hon. Secretary, Mr. C. E. Largen, 16, Clements Rd., Ilford.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

The Brussels Scheme.—British Wavelength Changes.—Bristol and 5WA.—More About the Regional Scheme.—Wanted: A Name.—P.O. and the "Pirate" Problem.

A Memorable 13th.

We are about to bid adieu to an old friend—the *Plan de Geneve*. With an engaging disregard of popular superstition, the Union Internationale de Radiophonie introduces the *Plan de Bruxelles* on January 13th—a Sunday—on which date the wavelength pack is to be reshuffled once more. In the majority of cases the changes will not be revolutionary, for the committee, which has been meeting at Brussels under the chairmanship of the indefatigable M. Braillard, thoroughly endorses the Tennysonian sentiment: "The little more, how much it is; the little less, and oh! what world's away."

Talking in kilocycles, it is the little more or the little less which makes all the difference between an unadulterated signal and a nightmarish heterodyne.

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The Case of Aberdeen.

The biggest changes among the British stations are those affecting Aberdeen and Newcastle. Aberdeen will occupy what is virtually Newcastle's present wavelength, a drop from 500 to 311.2 metres, but Aberdonians who might be inclined to resent such a giddy fall can take heart of grace from the thought that their new wavelength is to be an exclusive one, thereby saving them (let us hope) from interference from any source whatsoever.

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An Honour for Newcastle?

Newcastle will have the honour of possessing the lowest wavelength ever used by a B.B.C. station, viz., 243.9 metres.

The only station to retain its present wavelength will be Daventry 5XX; among the other main stations the tendency will be a slight drop in wavelength, so small in most cases that it may pass unnoticed in the general run of unselective sets.

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The Relays Combined.

The same day will see the concentration of all the relays, together with Bournemouth, on the national common wavelength of 288.5 metres. No doubt there will be many listeners to these who have never "heard tell" of a national common wavelength, and a few sets will probably be wrecked before their bewildered owners discover that this time the set is blameless.

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"P.P." Optimistic.

Captain Eckersley is highly optimistic concerning the new arrangement, going so far as to say that, "humanly speaking, the scheme seems bound to work."

We can only hope he is right. At all events, the change can hardly be for the worse, for among British stations the only two which have not filed a complaint at headquarters in regard to heterodyning during the past month are Belfast and London.

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Rehearsals Forbidden.

I understand that there are to be no preliminary tests with new wavelengths. When the Geneva plan was in the air, there was a terrible hubbub in the European ether for weeks before the plan actually came into force. In fact, some stations were so zealous in the matter that they adopted their newly allotted wavelengths for regular broadcasting some considerable time before the date fixed.

This time rehearsals are forbidden, even in the wee sma' hours.

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The New Wavelengths.

Below is the list of wavelengths which will come into force on Sunday, January 13th:—

Metres.	Station.	Kilocycles.
1,562.5	Daventry 5XX	192
482.3	Daventry 5GB	622
401.1	Glasgow	748
378.3	Manchester	793
358	London	838
323.2	Cardiff	928
311.2	Aberdeen	964
302.7	Belfast	991
288.5	Relays and Bournemouth	1,041
243.9	Newcastle	1,230

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The Plight of Bristol.

It has always been a sore point with Bristolians that their city is denied a broadcasting studio of its own. The B.B.C. has decreed that they shall listen to Cardiff, and from time to time has supplied an inducement in the shape of special programmes from 5WA employing Bristol artists. But nature has stepped in as a common enemy which even the British Broadcasting Corporation seems unable to vanquish.

For some unexplained reason, nature objects to the passage of ether waves from South Wales to Somerset, a fact which is specially tantalising to Bristol listeners when they know that Cardiff is staging a programme for their particular benefit.

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Why Bristol Prefers Daventry.

Nature's contrariness in this matter came into unusual prominence during the recent Bristol Radio Week, when Cardiff placed all its resources at the call of its opposite neighbours, with disappointing results.

Many Bristol listeners have given up 5WA in disgust, preferring the more reliable though frequently heterodyned

FUTURE FEATURES.

London and Daventry.

JANUARY 6TH.—National Sunday League Concert, relayed from the London Palladium.
JANUARY 9TH.—A Talk on International Affairs.
JANUARY 10TH.—Illustrated Talk on "How to Play Syncopated Music."
JANUARY 12TH.—Six Strange Saturdays.—I.

Daventry Exp. (5GB).

JANUARY 8TH.—"Carnival," a play.
JANUARY 9TH.—Spain in Music of the 20th Century.
JANUARY 10TH.—Orchestral Concert of Music by Rameau and Gluck.

Cardiff.

JANUARY 6TH.—New Year Programme.

Manchester.

JANUARY 10TH.—Hallé Concert, relayed from the Free Trade Hall.
JANUARY 11TH.—Scottish Programme.

Newcastle.

JANUARY 8TH.—Musical Comedy Old and New.

Glasgow.

JANUARY 9TH.—Concert of French Music.

Aberdeen.

JANUARY 7TH.—Scottish Programme.

Belfast.

JANUARY 7TH.—Programme of Elizabethan Music.
JANUARY 12TH.—An Irish Programme.

transmissions of 5XX. Meanwhile they are casting pious hopes towards the Regional Scheme, trusting that 5WA's high power successor will make the Severn look silly.

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Regional Station for Wales.

The Western Regional Station is still an airy nothing. I hear that one member of the B.B.C. Governing Board has suggested that it should occupy a site in the Rhondda Valley, with the object of ensuring good reception for the miners, most of whom use crystal sets. That the station will be in South Wales is a practical certainty, but no move to pin it down to any definite locality has yet been decided upon.

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Lucky Ulster.

The regional stations are to be proceeded with one by one; that is to say, the London station will be operating before the Northern Regional is even begun. The Scottish Regional will probably be the next, and the Western will follow fourth. There is a sufficiently good reason for making the Ulster Regional Station the last on the list. Northern Ireland is nearer to the Listeners' Paradise than any other region to-day. Not only is it sheltered from European interference, but it enjoys in 2BE one of the most reliable and effective stations now operating in the United Kingdom.

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Wanted : A Better Name.

There are confident hopes at Savoy Hill that the whole of the Regional Scheme will be in operation by December, 1930, before the completion of "Broadcasting House."

Talking of "Broadcasting House" reminds me that we may not be talking of it as such for very much longer. The name is being used at present merely for want of something better. The B.B.C. feel that a more national and precise designation is only waiting to be discovered, though nobody has lighted upon it yet.

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A Propitious Atmosphere.

I have not heard that any reward is being offered, but no doubt anyone who has an acceptable brain wave will be very kindly treated at headquarters, and may even find himself in that mecca of the blessed—the Savoy Hill canteen. And, once there, he may be vouchsafed an even better idea.

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A Pertinent Question.

Since December 25 there must be thousands of folk who are saddled for the first time with the awful responsibility of operating their own wireless set, like a frail bark upon an ocean of ether. Quitting poetry, how many of these chappies have licences?

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Licences as Presents?

It would probably be safe to wager that not 25 per cent. of the "affec. uncles," loving grandmas," etc., who bestowed wireless this Christmas ever thought of including a licence in the stocking. People don't generally give licences at Christmas, even for dogs, or guns, or menservants. The inference is that the army of pirates has been augmented, unless all the Bobby's and Jimmy's made a stand for righteousness. One can conjure up a fine picture of a noble youth declining to tune in 2LO because he has no licence, but the picture would need a good deal of "touching up" to make it convincing.

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A Way They Have in "S.A."

Despite the almost daily prosecutions, the Post Office is only nibbling at the pirate problem, which grows bigger every month, and will continue to do so as portable and frame aerial sets increase in popularity.

In South Africa the unlicensed listener has been almost non-existent since the regulations required that the wireless licence must be produced whenever a set, accessory, or component is purchased.

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Time Signals Disputed.

The B.B.C. has encountered its first horological critic. This gentleman, writing from the Midlands, complains that the time signals are inaccurate, he having checked them by his own watch. It appears that the discrepancies sometimes amount to as much as $\frac{1}{10}$th of a second, and the new critic charges the B.B.C. with permitting the intrusion of the "human element."

He feels so strongly on the matter that he proposes to take out a wireless licence to receive foreign stations if he is given an undertaking that not a penny of the money goes to the B.B.C.

o o o o

Shakespeare in Music.

The songs in Shakespeare's plays have been set to music by composers all over the world; this music is to form a programme entitled "The Food of Love," which 2LO will broadcast on January 7. Humperdinck, Tedesco, Mendelssohn, Balakirev, Sullivan, German, Quilter, and Vaughan Williams are to be represented.

o o o o

No Place Like Home—Except 5GB.

Listeners who have never yet tuned in to Daventry 5GB when one of the "Old Folks" programmes is being relayed from the Birmingham studio, thinking, perhaps, that it will be nothing more than a stereotyped kind of song recital, should hear the programme of January 11, presented by the Birmingham studio chorus and orchestra. It should be an eye-opener in programme presentation.

The informality of home life is the keynote of these programmes, and the human element is introduced to such an extent that the most amusing mistakes occur. Sometimes trouble crops up when the song required cannot be found, and at other times there is a rousing discussion as to "what number it might be in the red book." The only difference between these informal concerts and the genuine home product lies in the quality of the output!

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A "Great Play" of France.

Rostand's "The Fantasticks" is the fifth in the broadcast series of World's Great Plays. It is to be heard by listeners to 2LO, 5XX, and other stations on January 15, and to 5GB on January 16.

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Enter a Mongoose.

A new and unexpected patron of broadcasting made a public appearance during the transmission of a Mozart Symphony from the Wellington Hall, Belfast, a few days ago. Half-way through the piece a large and well-fed mongoose ambled on to the platform, and, after stropping his whiskers in perfunctory fashion, stepped down and disappeared beneath the seats in the auditorium. Fortunately, the audience were so engrossed in the music that the unusual visitor remained unnoticed, otherwise the microphone might have passed on some queer interpollations not included in the Mozartian Score.

The mongoose was one of a number which are kept at the Wellington Hall to wage war on rats.

o o o o

A Microphone Record.

I hear that fourteen microphones—the largest number ever employed in an outside broadcast—are to be used at the ceremony of the enthronement of the new Archbishop of York, Dr. Temple, formerly Bishop of Manchester, to take place at York Minster on January 10th. The enthronement, which is to be relayed to Daventry and all stations of the Northern grouping, will incorporate the procedure which has been associated with this historic ceremony for many hundreds of years. The actual installation and enthronement will be performed in the choir, after which the Archbishop will speak to the clergy and give them his blessing from the throne. He will afterwards speak, from the choir screen, to the congregation in nave and transept.

o o o o

The Hallé Orchestra.

Sir Hamilton Harty and the Hallé Orchestra will broadcast on January 10th from Manchester their programme, which is to be relayed to 2LO and 5XX, including Mendelssohn's "Italian Symphony" and Brahms' Violin Concerto in D, with Arthur Catterall as soloist. In the same programme will be given Eric Fogg's "June Twilight," which was heard by listeners to the Promenades last summer. Mr. Fogg will conduct this work in person.

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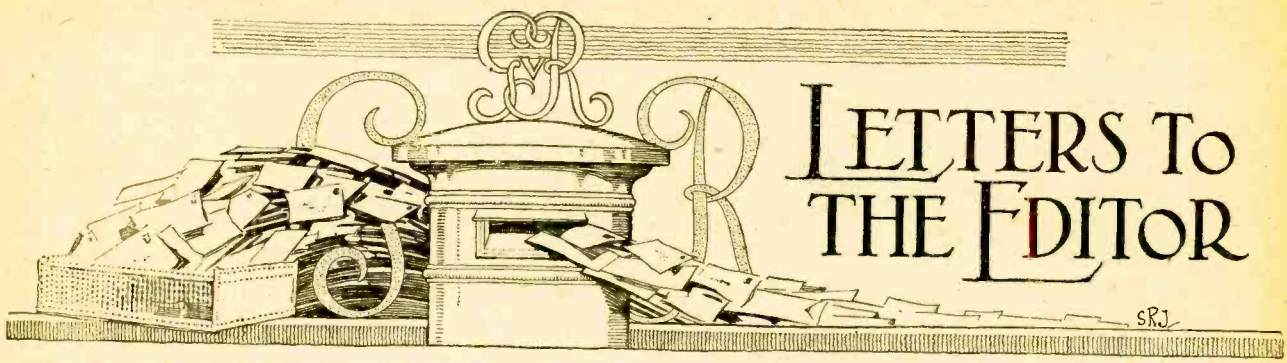
B.B.C. and the Variety Stage.

The B.B.C. begins the New Year with a promise of more amicable relations with the theatrical and variety interests.

On Saturday, January 12th, Jack Morrison, in impressions, will supply the variety turn to be relayed from the stage of the London Palladium to 2LO, 5XX, and other stations. Further Palladium broadcasts are being arranged.

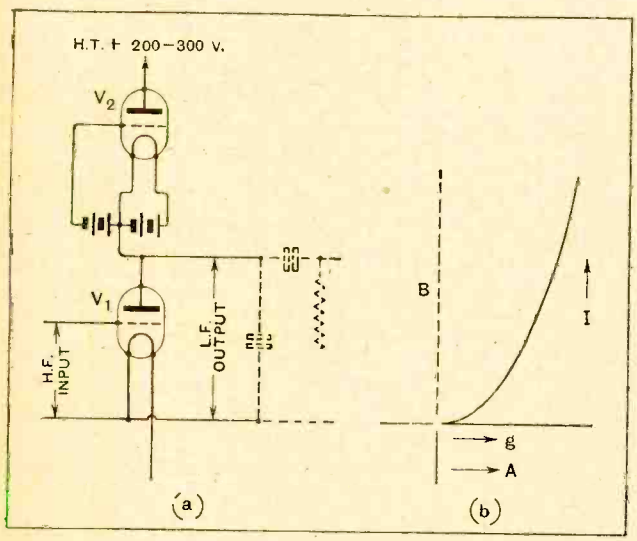


The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

DIODE RECTIFIER.

Sir,—In view of the recent discussion in your pages regarding the merits of the diode rectifier, and previously regarding rectifiers of other sorts, I beg to submit the following idea for the benefit of your readers.



Suppose that both valves in Fig. (*a*) have identical characteristics and that they are both biased to the origin of the anode current curve, *i.e.*, B in Fig. (*b*). Considering this figure as a grid volt/anode current curve, we may say that g is the grid voltage reckoned from the bias point as zero, and considering the same diagram as an anode volts/anode current curve, taken at the appropriate grid voltage, we may say that A is the anode voltage reckoned from B as zero.

We may consider that the anode current I is related to the grid and anode voltages by some expression of the form :

$$I = f(A + \mu g)$$

where μ is the amplification factor and f represents some function unknown.

It is self-evident that the anode current is at all times the same for both valves, and that the sum of the two anode voltages, *i.e.*, the H.T. volts across the two valves in series, is constant.

Now, when a valve having a resistance in its anode circuit has its grid voltage increased, its anode voltage must fall by some amount which we may call D, so that when a positive voltage g is applied to the grid of V_1 its anode current, I_1, is represented by

$$I_1 = f(A - D + \mu g)$$

and for V_2 where g is fixed at 0 (= B, of course), and where anode voltage becomes A+D,

$$I_2 = f(A + D).$$

But $I_1 = I_2$, and $f(A - D + \mu g) = f(A + D)$, and so, whatever f may mean,

$$A - D + \mu g = A + D$$

$$\therefore D = \frac{\mu g}{2}.$$

In other words, we have a perfectly linear relation between the grid voltage and the rectified anode voltage. This is independent of the shape of the characteristic curve, and only requires that μ should remain constant around the lower bend, which is practically true, even though the resistance varies considerably.

It is surely a negligible drawback that an extra valve and independent filament and grid bias batteries are required, and the fact that these components carry low frequency potentials should present no more difficulty than is met with in the various condensers, chokes, etc., in existing arrangements, and the indirectly heated kathode valve provides a solution of the difficulties with the filament circuit.

The advantages claimed are : (1) Linear rectification for A.C. inputs between zero and a peak voltage equal to the grid bias. (2) Sensitivity comparable with that of an anode bend rectifier having an anode resistance equal to that of the valve under rectifying conditions, *i.e.*, several times the normal valve resistance. This is considerably higher sensitivity than can be claimed for the diode. (3) Unlike the diode, it applies no damping to the preceding tuned circuit.

Stratford-on-Avon. P. G. DAVIDSON.

BROADCASTING IN ITALY.

Sir,—It might interest you to know of the regulations recently made by the Italian Government in connection with the improvement of radio transmissions.

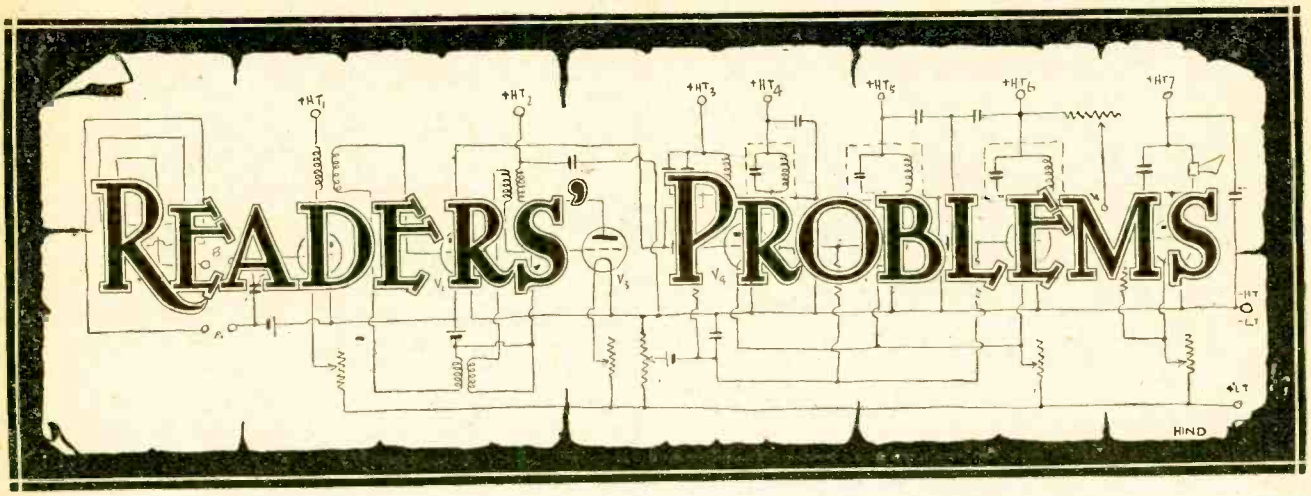
Last June a law was drafted, subsequent to a proposal made by the special State Committee for the Supervision of Radio Transmissions, according to which the "E.I.A.R." (the Italian B.B.C.) are allowed to transmit, on paying compensation, all performances given in the Italian theatres, etc.

Further, in order to make transmissions more perfect, from an artistic point of view, steps are being taken to eliminate, as far as possible, all disturbances from telegraphic stations. All spark stations will be provided with valve transmitters; measures will be taken to keep the wavelength of such stations as constant as possible and to avoid harmonics produced by them disturbing wireless listeners on the 200-500 waveband. In addition, it is proposed to study the possibility of closing down, save in urgent cases, telegraphic wireless transmitters from the hours 2000 to 2330, thus permitting a purer audition of programmes. The elimination of disturbances produced by tramways also comes under study.

It is intended to form a staff of inspectors to help listeners to get the best results for the audition of programmes.

A new station of 50 kW. will be built in Rome, to be opened on October 28th, 1929. It is also proposed to erect a short-wave Marconi beam station for transmitting national programmes to the Colonies and to America, for the benefit of Italian residents over there.

Milan. PAUL CHALLANDES.



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Using the Abacs.

My D.C. mains receiver is fitted with 6-volt valves consuming 0.25 amp.; filaments are connected in series. I now wish to substitute for one of them a valve taking 0.1 amp., and understand that it is necessary to shunt its filament with a fixed resistance. How can the value of this resistance be ascertained? It seems to me that the resistance "abacs" which recently appeared should be useful for solving problems of this kind, but I cannot see exactly how to set to work. J. G.

Your problem is to choose a resistance of such a value that the resultant resistance of filament and shunt will be equal to that of any other valve in the series circuit. This can easily be done with the help of Abac No. 11 (October 3rd).

The procedure is first to find out the resistance (in ohms) of the valve filaments by dividing voltage by current (in amps.). If the new valve is rated at 6 volts, 0.1 amp., its resistance will be 60 ohms. The 0.25 amp. valves already in use will have a resistance of 24 ohms.

Referring to the abac, we will imagine that the figures shown in it are multiplied by 10, thus bringing it up to the resistance range required. Now set a straight-edge to register at 60 on the left-hand line and at 24 on the centre line; the point of intersection on the right-hand line will give the correct resistance of the shunt, which is 40 ohms.

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The "Europa III."

If possible, I should like to use 2-volt valves throughout in the "Europa III" receiver. Is there any objection? If not, will it be necessary to make any modifications? C. W.

Subject to the author's remarks in his opening paragraph, you can certainly use these valves. The only modification necessary is in the grid circuit of the H.F. amplifier; "free" grid bias will no longer be possible, so it will be necessary to alter the connections to conform to those given in Fig. 1.

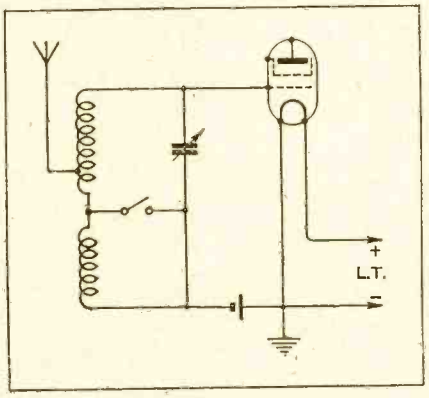

Fig. 1.—Modified grid circuit of "Europa III" receiver.

RULES.

(1.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(2.) Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(3.) Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Short Aerials.

In spite of my efforts to increase the selectivity of my receiver I still find that the waveband occupied by the local station is excessively wide. Do you advise me to put up a shorter aerial? T. B.

It is often recommended that in the vicinity of a transmitting station a comparatively short aerial should be used, but we are not at all sure that this is the best cure for interference troubles. It seems better to retain the receptive powers of your present large aerial (which will always be a help in receiving distant stations), but on wavelengths where interference is bad you can make provision for coupling it very loosely to the grid circuit of the first valve. Provided this coupling is sufficiently loose, there is no real reason why the large aerial should introduce more interference from the local station than would a short aerial tightly coupled.

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Working in the Dark.

Can you help me to trace the cause of a considerable falling off in signal strength? My set is a 1-v-1 combination, which normally gives good loudspeaker reproduction on the three nearest stations. All connections have been examined and tested as far as possible, and everything appears to be in order. The batteries are a few weeks old only, so I do not think they can be responsible. D. V. L.

From your concluding remark we assume that you have not measured the voltage of your batteries, and, in spite of what you say, we are inclined to think that they must be responsible for your trouble, although it is quite impossible to make a definite statement. However, you would be well advised to measure the various voltages, and if the fault is found to lie elsewhere, we think you can fairly suspect that one or more of the valves has partially lost its emission.

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CONTENTS OF THIS ISSUE.

DIODE DETECTION.

IT will be interesting to see if the modernised version of the two-electrode rectifier—forerunner of all present-day valves—will find a permanent place in broadcast reception. An article in this week's issue shows that this method of detection can be applied to the more ambitious type of receiver with great possibilities, not only as regards volume, but also as to sensitivity, and that results approaching perfection are attained only at the expense of considerable care and some complication.

Is it likely to appeal widely to those with less ambitious requirements? To answer this, we must realise that in order to obtain distortionless rectification, it may be necessary to apply a grid polarising voltage sufficiently high seriously to reduce the life of the smaller type of valve; this seems to be one of the gravest disadvantages of the system.

If it is decided to reduce this polarising voltage to a value something less than that required for perfect results, there still remains the very real advantage of freedom from interaction with its consequent distortion, which is often more distressing than that due to defects in detection. Against this we have the drawback of insensitivity, or, perhaps more accurately, the fact that the diode, while efficient enough in performing its function as a rectifier pure and simple, does not amplify, as do either of the principal competing devices; to make good its shortcomings in this direction, it may be regarded as essential to add another valve, over and above the number we generally consider necessary to achieve a given object.

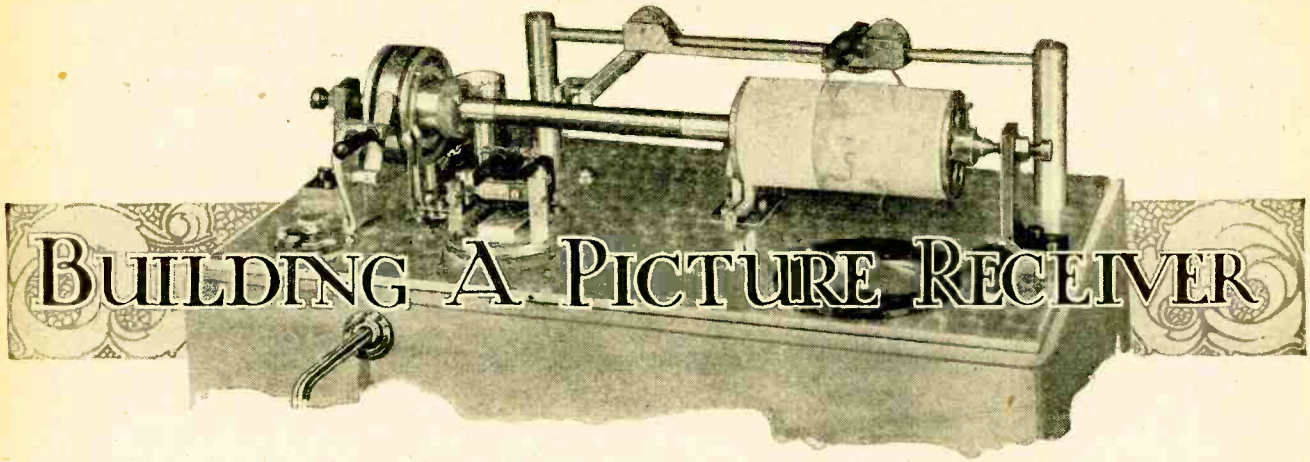
The Demand for Simplicity.

In attempting to reach a conclusion as to whether the two-electrode rectifier is sufficiently attractive to survive, we cannot ignore the fact that it draws a considerable amount of energy from the tuned circuit which feeds it, and consequently introduces a damping effect serious enough to reduce selectivity, in spite of the observance of precautions which have been described. In view of the ever-growing need for this quality, it is not unlikely that this defect will unfavourably prejudice that considerable body of wireless users whose situation is such that nothing tending to aggravate the interference problem can be tolerated. Obviously, reduction of selectivity can be overcome by adding further tuned circuits, generally in the form of couplings between high-frequency amplifying valves, but this is an expedient likely to appeal to the few rather than to the average amateur, who is always reluctant to add to the number of his controls.

As readers are fully aware, it is not our policy to decry any innovation that contributes something to the ultimate end of perfect broadcast reproduction, even though it may be accompanied by its own particular problems and difficulties. Accordingly, we welcome the diode because, properly handled, it will clear one stage of our receivers from risk of distortion.

The amateur must retain a sense of proportion, and should realise that, for example, a correctly-operated anode-bend rectifier only begins to manifest its shortcomings when the depth of modulation at the transmitting station reaches a figure rather higher than the present-day average, and under existing conditions its slight imperfections are hardly likely to become obvious to the ear until loud speakers are still further improved.

In view of this, it would hardly appear to be strictly necessary to include diode detection except in cases where no expense or trouble is spared to avoid distortion at each and every stage of the receiver.



BUILDING A PICTURE RECEIVER

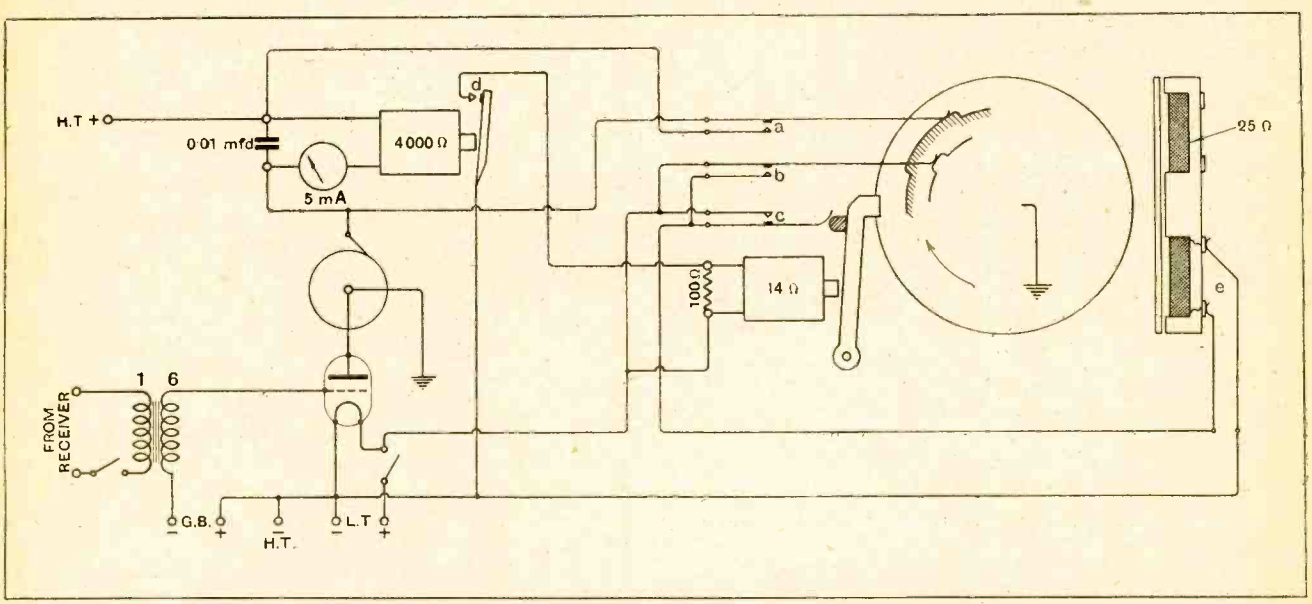
Complete Details for the Home Constructor.

By F. H. HAYNES.

LITERALLY to attempt the building of a picture receiver with the aid only of a screwdriver and the usual wiring requisites might appear unduly optimistic. Nevertheless, this condition has been made the stipulation in the drafting of the following constructional details. To this end, therefore, it was necessary to create certain new components, of which particulars appeared in last week's issue.[1] This has been followed by an enthusiastic response by manufacturers to render available each component part so that the home constructor is merely called upon to assemble, wire and adjust an instrument in which nothing has been spared to render it robust, reliable and capable of the best results. Dimensional drawings of the principal components having been given, it is now necessary to present the leading and essential data of assembly.

[1] "Building a Picture Receiver," page 2, January 2nd, 1929.

As stiffness of the panel is an important factor, hard-rolled aluminium sheet of greater thickness than is commonly used for radio purposes is necessary. Being $\frac{7}{32}$in. in thickness, it is more difficult to work than the usual $\frac{1}{8}$in. aluminium panel. A complete finished panel can, therefore, be obtained, of which precise details are given in an accompanying drawing. Screw heads are avoided on the upper face by tapping blind holes on the underside, a permissible proceeding in view of the liberal panel thickness. Aluminium is not an easy metal in which to tap blind holes, and really the home constructor making his own panel might be well advised to use round-headed nickel-plated screws and nuts, taking the holes right through the panel. No attempt should be made to clean up the face of the panel, and a good finish may be readily given by producing small scratched circles at $\frac{1}{2}$in. intervals with the aid of a piece of fine blue emery paper rotated under the thumb. To protect



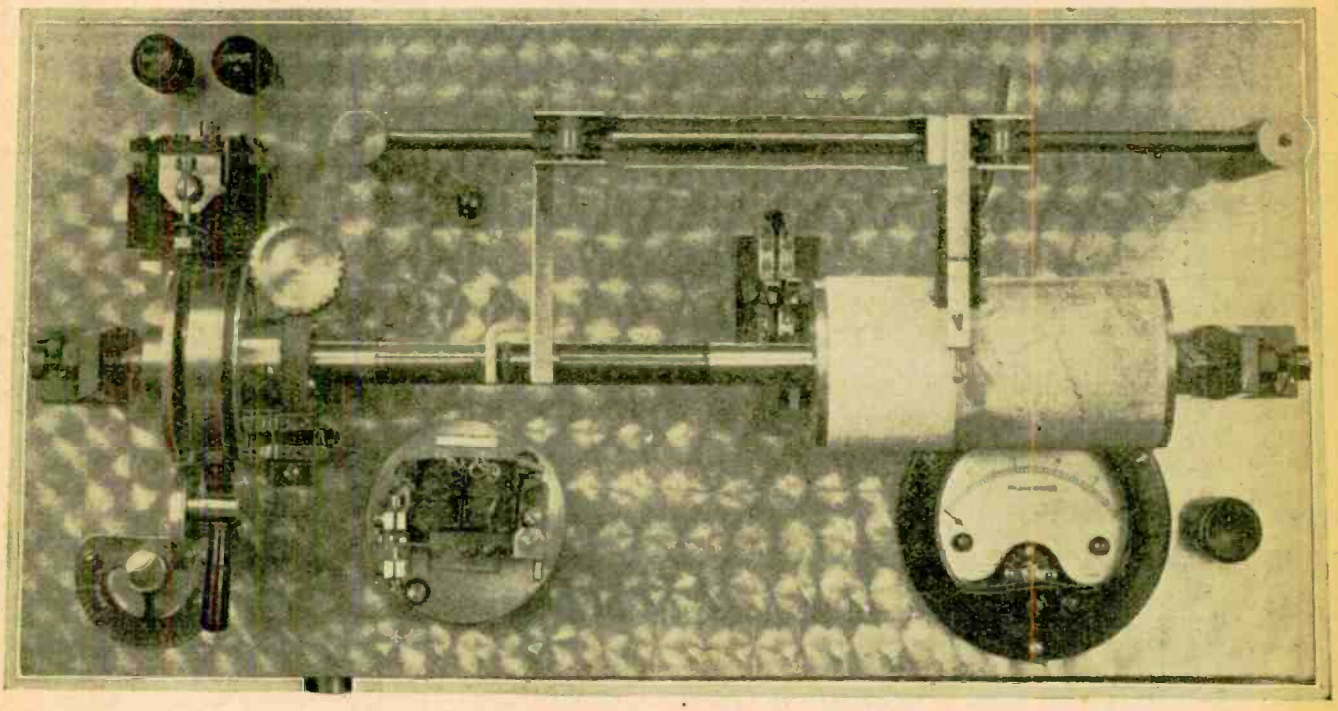
Circuit of the Fultograph picture receiver. Contacts (a) and (b) open together during the passing of the join in the paper under the stylus. The cam operating (a) has a duration of 45 degrees and the cam for (b) 15 degrees.

A 20

Building a Picture Receiver.—

the surface from dulling, treatment on both sides with transparent lacquer is desirable.

The first step in assembly is that of setting up the spindle between the two recessed screws carried in the iron angle brackets, particulars of which have already been given. Oil-retaining holes are taken into these screws beyond the conical part to serve as containers for lubricant. The spindle should run true in its centres without undue friction, while the bracket holding-down bolts are screwed up as tightly as possible. A " blued " finish was given to the brackets and screws of the receiver illustrated here by immersion in hot sand after filing bright and removing all scratch marks, though as a commercial product these brackets, as well as all iron and brass parts, other than the spindle and armatures, will no doubt be preferred nickelled. An important dimension is the spindle height of 5 cms. centres above the panel.



This plan view shows many of the constructional details very clearly. It must not be overlooked that the base of the relay is insulated from the panel.

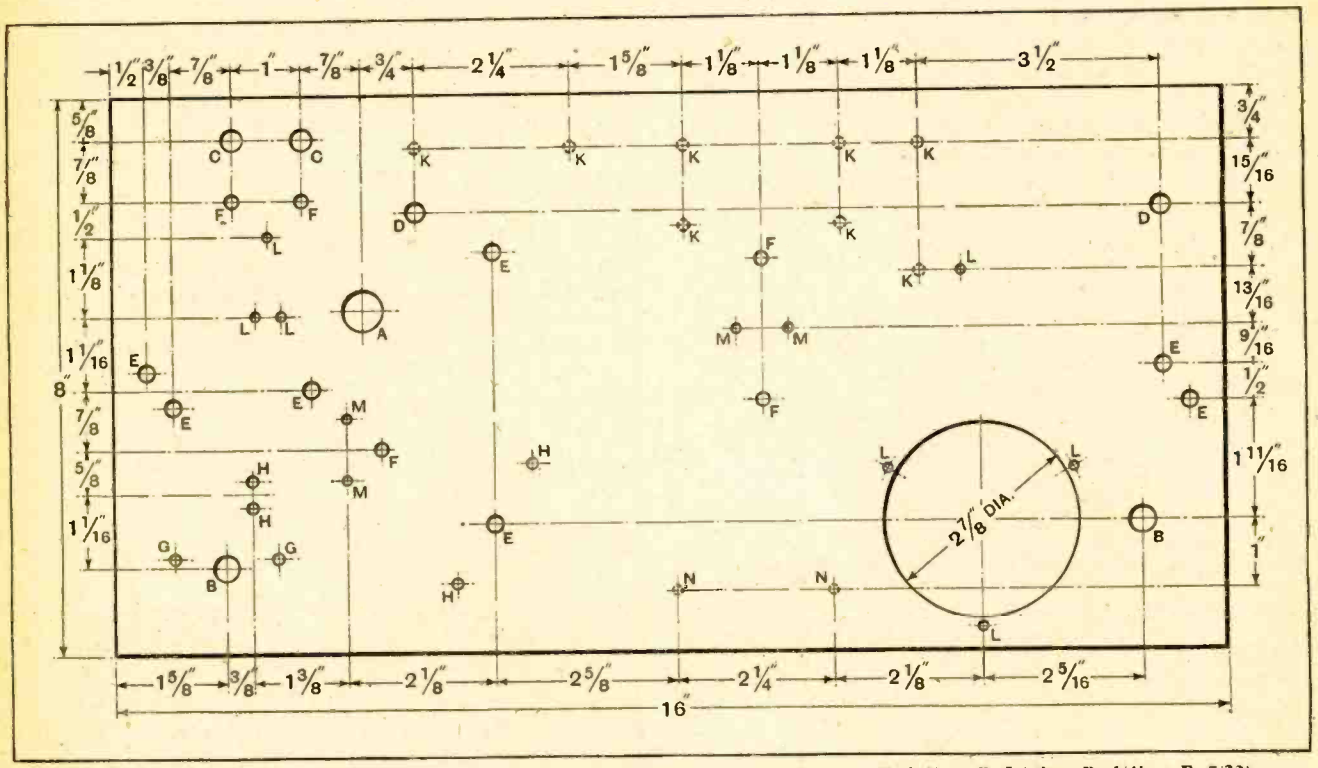
With the clutch components slipped on to the spindle, the trigger which is used to arrest rotation once each revolution may be critically secured in position. Its armature should stand vertical when the curved face of the hardened steel catch frictions against the edge of the catch plate. It is advisable not to drive home the grub screw on the catch plate too securely at this stage of assembly in order to avoid marking the spindle. Sharp rotation of the spindle between the fingers will reveal whether the catch is suitably set-up, as it should never fail to engage, and when once caught there should be an almost imperceptible amount of play. Should the trigger jump the catch as the one is swept quickly past the other, the tensioning spring may be tightened up to exert an appreciable pull, and as a further measure the top of the catch may be slightly ground away so that when resting against the plate its lower end already protrudes into the niche.

In order to finally assemble the clutch it is necessary to secure the cylinder to the spindle with its cams in the correct relative position with regard to the catch. There are two cams, one of brass giving a lift over 45 degrees of rotation, and the other of paxolin giving a lift over 15 degrees. Both cams have their front edges coinciding, so that the pair of light contacts lift together. V-shaped ends on these springs are at the same height above the panel as the spindle centres. Correct relationship between cams and catch is obtained when one spring reaches the centre of the short cam at the same time as the catch engages.

In finally assembling the clutch, treat the parts with light machine oil and see that the three-pin disc has free movement into the holes on the catch plate. First of all press the clutch up as tightly as possible, and then very slightly, to the extent of a few thousandths of an inch only, ease back the catch plate and tighten its grub screw. Adjust the two fibre frictioning plugs so that the clutch is just capable of driving the spindle.

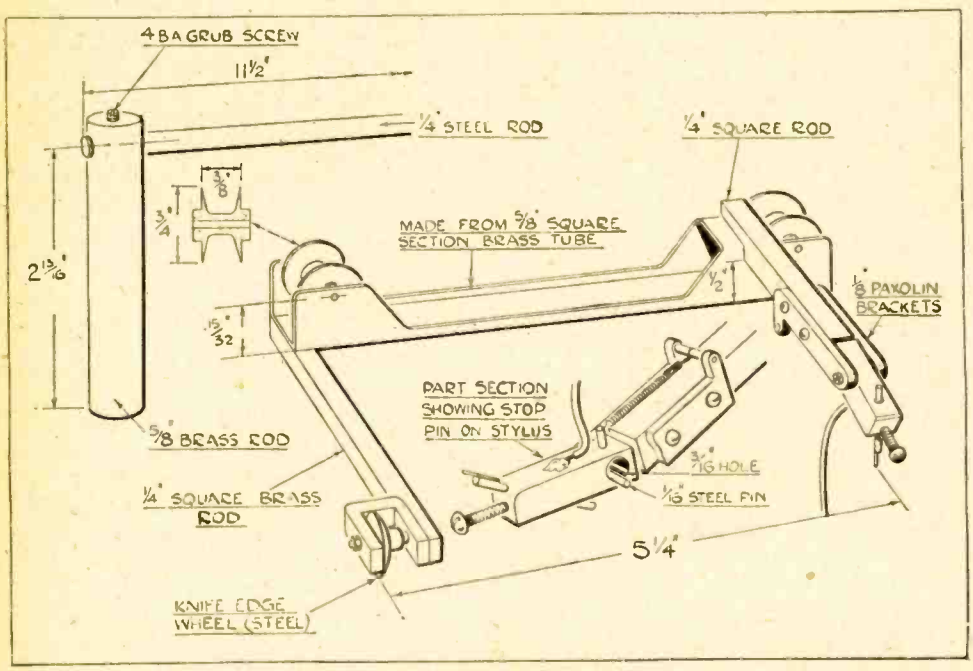
Pieces of $\frac{1}{8}$in. paxolin carry the cam contacts as well as those for energising the clutch. Pairs of 8BA round-headed screws secure the spring contacts and contact brackets, the ends of the screws being filed off flush with the underside of the insulating material. Pieces of mica slipped under the insulating pieces before assembly prevent contact between the screws and panel.

In order to retain the cam-operated contacts in a position for making preliminary adjustments of signal



Drilling details of the panel, which is of hard aluminium 7/32in. in thickness. A, 9/16in.; B, 3/8in.; C, 5/16in.; D, 1/4in.; E, 7/32in.; F, 3/16in.; G, 5/32in. H, drilled and tapped 4BA. K, drilled and tapped 4BA as blind holes on the underside. L, 1/8in. M, drilled and tapped 6BA. N, drilled and tapped 6BA as blind holes on the underside. Holding-down holes are needed at the corners.

strength a brake must be provided to hold the spindle. This consists of the stop supplied with the motor mounted on a ⅛in. brass bracket and engaging on the face of the clutch. Its fibre shoe is shaped to fit the contour of the clutch so as to produce maximum friction, while the lever is arranged so as to release with a good snap action.



Constructional details of the carrier. A short piece of No. 24 platinum wire is used for the tip of the stylus.

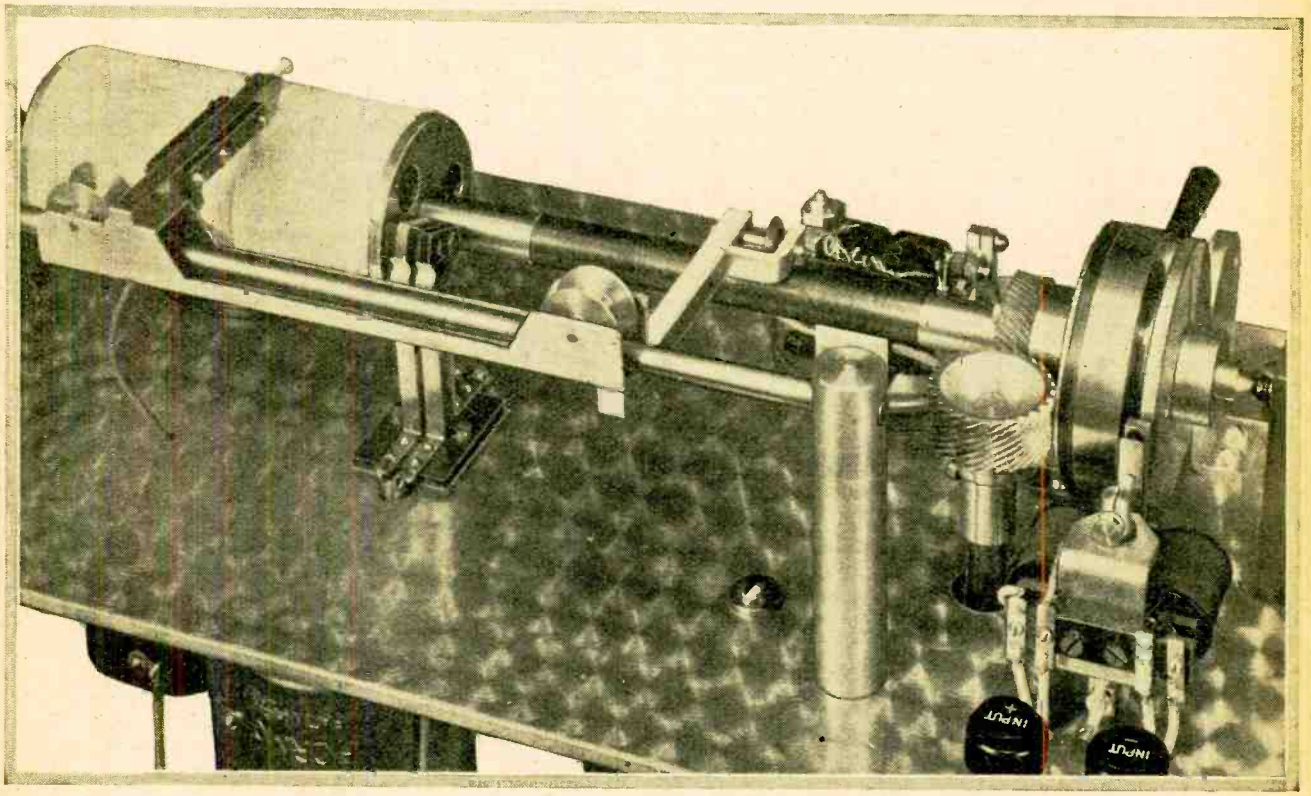
Removal of the spindle permits of fixing the motor by its three screws. It is to be noted that the motor is spaced away from the panel by three ¼in. brass washers, as the rubber spacers normally supplied with gramophone motors are obviously unsuitable here. It is an easy matter to bend round the speed-regulating arm so as to engage on the pin which is operated from the top of the panel. Avoid acute bends, however, in this arm, as it is desirable that it shall not be excessively springy. A brass adaptor fits on to the tapering vertical spindle, and the centre of the pinion secured to this shaft must be 5 cms. from the upper surface of the panel. Before restoring the spindle, run the motor and see that this vertical shaft runs without wobble.

Building a Picture Receiver.—

Tightly mesh the pinions by the play provided in the mounting screws of the motor, taking care to avoid any tendency to bind. A smooth, silent drive should be obtained. Washers are, of course, inserted under the heads of the screws used for mounting the motor, and in order to obviate the slightest shift caused by leverage when winding it is essential that these screws should be right tight.

The relay is conveniently mounted on the front edge of the panel, being supported on a ¼in. paxolin base and using a pair of screws passing through bushed holes.

Many possible designs present themselves in the making of the carrier which traverses the cylinder. In this instance a simple design was adopted incorporating a pair of pulley wheels fitted into the channel provided by a piece of ⅝in. square brass tube. Both arms are horizontal. It is therefore advisable to proceed by adjusting the height of the vertical pillars so that the wheel arm is horizontal and then fitting the stylus arm into a slot of suitable depth. These several parts are soldered together, cleaned bright and treated with cold transparent lacquer. Paxolin side strips insulate the stylus block, while a pin limits its movement. A light spring, which need not be adjustable, keeps the stylus in gentle pressure against the surface of the cylinder. It is most important that there should be no possibility of the stylus arm causing the knife-edged wheel to lift out of the thread. This guide wheel must, of course, run perfectly true, as any tendency to rock from side to side will spoil the quality of a picture. If not absolutely true, it is better to lock the wheel so that it does not rotate and merely frictions in the screw thread. It should be noted, also, that the sharp edge of the wheel does not touch the bottom of the thread.



View showing the finished carrier as well as the setting up of the cams and contacts.

Wiring and Adjusting.

Wiring-up can be proceeded with according to the arrangement adopted in the practical wiring diagram. Insulation of the input terminals from the panel is provided by a piece of paxolin on the underside. A terminating strip is also needed, carrying the three connections to the H.T. and L.T. batteries. A three-wire lead terminating in a pair of tags and an H.T. plug serves to connect to the batteries common to the wireless receiver. Wiring is carried out with No. 20 tinned copper wire and 2 mm. sleeving. A non-inductive wire spool of 100 ohms resistance shunts the trigger winding, and consists of 6 yards of No. 45 Eureka wire wound on double. A 15-volt grid bias battery reposes on the bottom of the box and is adjusted prior to finally inserting the panel. The box is of ½in oak or mahogany, and measures internally 8in. × 16in. × 5¼in., and the panel is mounted on strong supports of 1in. square wood standing in the corners so that its top edge is just proud above the box

Adjustments are as follows: Time the cylinder to run free at about 52 to 53 revolutions to the minute. Set the cam contacts so that a good break is provided, noting also that the brass cam makes good contact with the spring and picks up connection with cylinder and

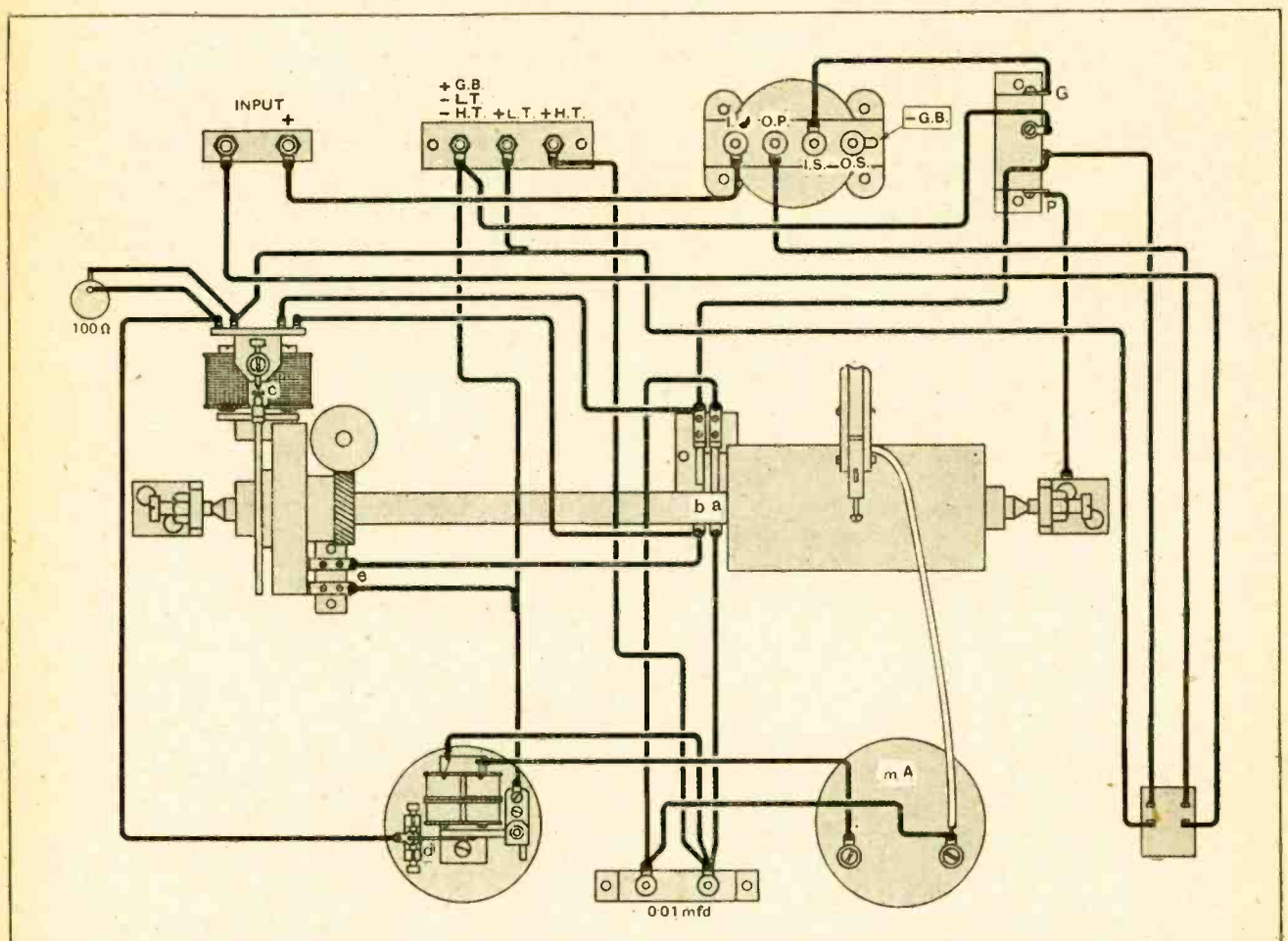
LIST OF PARTS.

Baseplate, finished and drilled as shown (Collinson's Precision Screw Co., Ltd., Provost Works, Macdonald Road, Walthamstow, E.17).
Spindle with end brackets and screws (Collinson's Precision Screw Co., Ltd., Provost Works, Macdonald Road, Walthamstow, E.17).
Magnetic clutch and pinions complete (Wireless Pictures (1928), Ltd., 14/16, Regent Street, London, S.W.1).
Relay as detailed (Goodmans, 27, Farringdon Street, London, E.C.).
Trigger complete (A. Baker, 89, Selhurst Road, South Norwood, London, S.E.25, or Collinson's Precision Screw Co., Ltd.).
Gramophone motor, type 10a, complete with stop and speed regulator. Fitted with extension sleeve on spindle, three brass spacers and preferably a modified speed control arm, and winding handle (The Garrard Engineering and Manufacturing Co., Ltd., 17, Grafton Street, London, W.1.).
Cylinder with cams (Collinson's P.S. Co., Ltd.; Williams & Moffat, Ltd., Ladypool Road, Sparkbrook, Birmingham; Wilkins & Wright, Ltd., Utility Works, Holyhead Road, Birmingham).
Clutch and cam contacts mounted on paxolin bases (Wilkins & Wright, Ltd.).
On and off switch (Wilkins & Wright Type, W.171).
Milliammeter, 5 mA. scale (Ferranti).
Carrier with pulleys, knife wheel and stylus (Williams & Moffat, Ltd.).
Carrier support (Williams & Moffat, Ltd.).
Platinum wire, No. 24 S.W.G., if required separately for stylus, ½in. (Baird & Tatlock, Cross Street, Hatton Garden, London, E.C.).
Valve holder (Aermonic horizontal type, Jas. Christie & Sons, Ltd., 246, West Street, Sheffield).
2 Terminals, "input" (Belling Lee).
Condenser, 0.01 mfd. (T.C.C.).
Intervalve transformer, 6 : 1 ratio. (Formo in plain metal case. The Formo Company, 22, Cricklewood Lane, London, N.W.2).
3 Wander plugs, two red, one green. Also two spade connectors, one red, one green (The Lisenin Wireless Co., 1a, Edgware Road, London, W.2).
Resistance spool.
4 ozs. No. 20 tinned copper wire and 6 yards of 2 mm. sleeving.
Cabinet, internal dimensions, 8in. × 16in. × 5½in. in ½in. oak or mahogany (S. A. Smith, 159, New Kent Road, London, S.E.).
Starch iodide solution (Wireless Pictures (1928), Ltd.).

Approximate total cost, £14.

Until manufacturing arrangements are further progressed only a limited supply of component parts is available and delay in meeting the requirements of readers will be inevitable. Notification of other sources of supply have been received yet reference to them here is omitted owing to uncertainty as to the ability to give reasonably early delivery.

spindle. Adjust the forward stop of the trigger so that catch does not engage unnecessarily deep in the plate. See that its back contact closes just before the limit of movement is reached and does not remain closed, when the catch drops forward against the brass edge of the catch plate. Allow the relay armature to have as small a movement as possible, and see that it has no tendency to stick, adjusting by altering the tension of the armature spring and increasing the gap in front of the poles. For rectification use a valve such as the H.L.610, P.M.6DX, or corresponding valves in other series. With a potential of some 150 volts grid bias is adjusted to

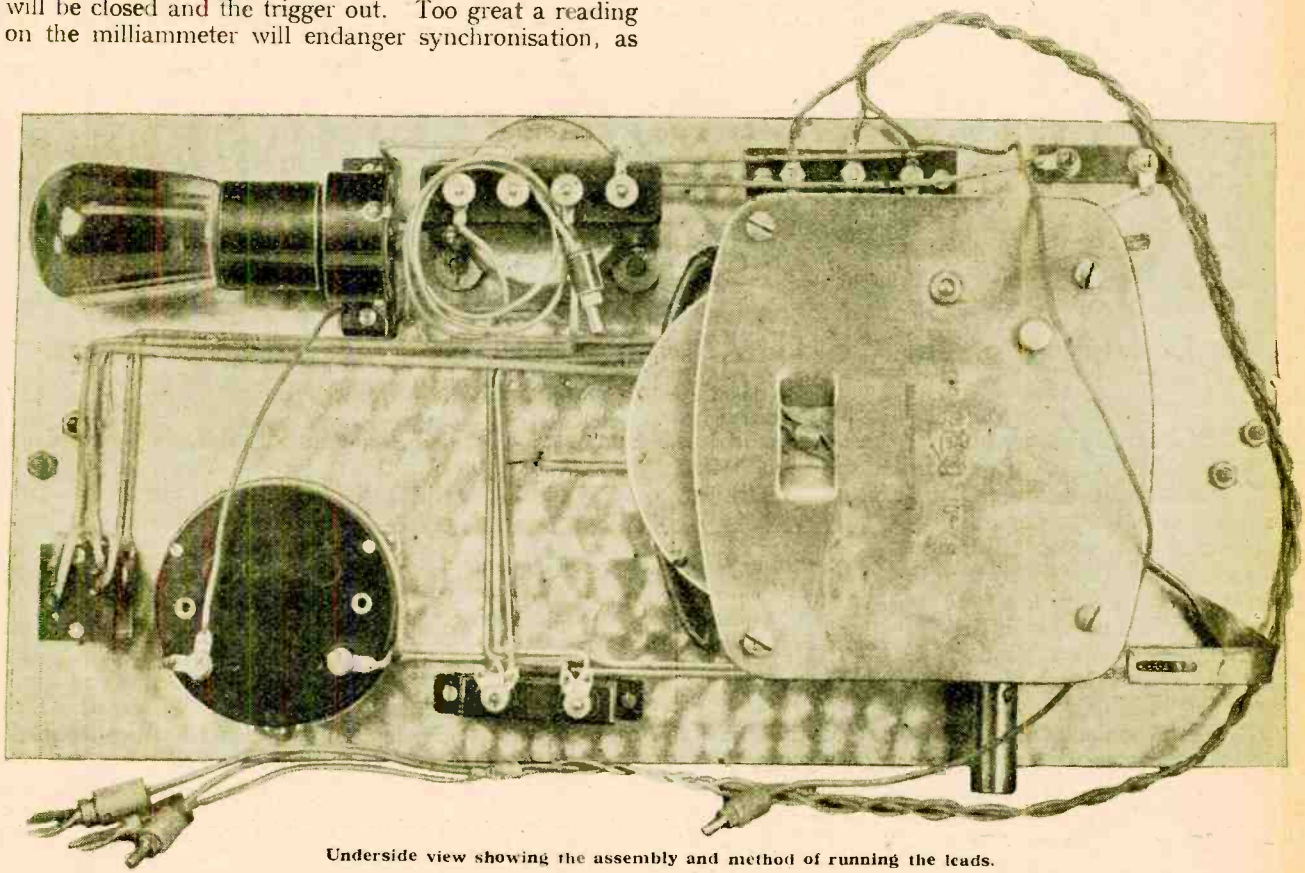


The reference letters on the contacts correspond with those given in the theoretical diagram.

Building a Picture Receiver.—

bring the milliammeter practically back to zero. Preceding the picture transmission is a tuning signal which, by means of volume control, should give a reading of not more than 3 milliamps on the meter. During this adjustment the break must be on the motor, as the relay will be closed and the trigger out. Too great a reading on the milliammeter will endanger synchronisation, as the relay may be operated by mush. Having adjusted the receiver to give the correct meter reading, raise the switch to "off" and let go the break. On the commencement of the preliminary picture signals press down the switch and the machine will then start and run in synchrony.

Much care is necessary in the selection of the paper and in the making up of the starch iodide solution. An absorbent paper is required with a surface that will not fray, while the lines of the image once recorded must not spread. A good grade of paper is known as "Perfection," 18½lb. grade (Venerables, Tyler & Co., Ltd.). Spreading of the fine lines of the image is as much a property of the solution as the paper, and one cannot do better than procure solution ready prepared. As an alternative to the fitting of a clip to the cylinder to hold down the paper a trace of Seccotine will secure the starting edge as well as the flap at the overlap, while by this method folds in the paper are easily avoided.



Underside view showing the assembly and method of running the leads.

A schedule of picture broadcasts will be found on another page. It is believed that an early extension of these transmissions is contemplated.

(This picture receiver is available for inspection by readers at the Editorial Offices, 116-117, Fleet Street, London, E.C.4.)

A Call from Hong-Kong.

Mr. J. W. Brown (VS6AB), of Kowloon, Hong-Kong, begins a series of short-wave tests on Saturday next, January 12th, with the special object of being heard by amateurs in Great Britain. The tests will continue until Friday, January 25th. The wavelength will be 41.8 metres, and the following schedule (G.M.T.) will be observed :—

"ZZZ de VS6AB Test."

Transmission.	Listening Period.
2000 to 2015	2016 to 2029
2030 to 2045	2046 to 2059
2100 to 2115	2116 to 2129
2130 to 2145	2146 to 2200

Reports will be greatly appreciated from transmitting and receiving stations. QSL's will be sent to any British stations during the tests.

TRANSMITTERS' NOTES.

o o o.o

Nationality Prefixes.

With reference to our note on page 702 of our issue for November 21st, we learn that Swedish amateur transmitters will retain their present call-signs, but with the addition of a figure after the SM to denote the geographical position. For this purpose Sweden will be divided into seven horizontal zones, the most northerly, between latitudes 60° and 67° N., being distinguished by the figure 1, and the most southerly (55° to 57° N.) by the figure 7. Italy, we understand, will retain its present call-signs, EAR1, etc.

Kenya Colony.

Mr. Charles F. Fox (FK 1LM) asks us to state that his correct address is Box 635, Nairobi, Kenya. Owing to a misprint the box number appeared as "653" in the R.S.G.B. Annual, and correspondence is often delayed by getting into the wrong box.

The DIODE RECTIFIER

A Description of the "Kirkifier," with Special Reference to Large Inputs.

By H. L. KIRKE, M.I.R.E.

This article, by the originator of the "space charge neutralised" diode detector, explains the precautions that must be taken in order to obtain perfectly distortionless rectification. An interesting new B.B.C. long-range, high-quality receiver is also described.

BEING largely responsible for the development and introduction of the distortionless diode (which, incidentally, has been christened the "Kirkifier" for want of a better name), I feel that a few notes on the subject, giving some of my own experiences with this type of rectifier, will be of considerable use to readers, particularly in conjunction with the recent article in this journal on "The Distortionless Diode," by H. F. Smith.

It may be interesting to describe how this specialised rectifier first came into being.

I had always been interested in the possibility of a linear rectifier of the thermionic variety, as, with such a rectifier, it would be possible to have a permanent and stable arrangement by which certain definite results could be obtained, provided that certain definite conditions were fulfilled.

I was looking up some characteristic curves on valves in which the anode current was plotted against anode voltage for various values of grid voltage. I was actually interested in certain conditions obtaining in a transmitting circuit when, at the instant of time when the voltage at the anode was low and the voltage at the grid was positive. Reference to a set of curves such as these will show that the anode current rises quickly for the first few volts applied to the anode when the grid is positive, and after the anode voltage has reached a certain value the curve flattens off. That is to say, for small anode voltages the impedance of the valve is low, and for higher anode voltages the impedance becomes high or normal. For instance, a valve whose normal anode impedance is of the order of 20,000 ohms may under certain conditions, when the anode voltage is less than the grid voltage (both being positive, of course), have an impedance of the order of 1,000 to 1,500 ohms.

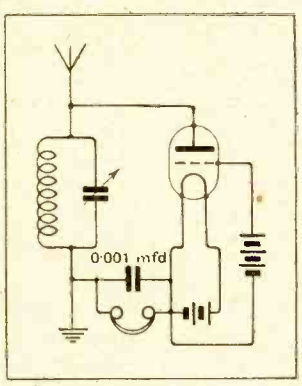


Fig. 1.—Circuit arrangement of a receiver with a single valve connected to function as a diode rectifier.

I noticed, further, that most of the curves are fairly straight over quite a fair sweep of anode voltage.

Having got the idea of the neutralised space charge diode, I immediately rigged up the circuit (Fig. 1) which, it will be seen, is the same as Fig. 3 in the article already mentioned, with the exception that I did not tap down the tuning inductance. The quality was excellent, and the sensitivity good compared with a crystal, although poor compared with other types of valve rectification.

Distortionless Rectification with Deep Modulation.

An investigation into the properties of this type of rectifier was then commenced, and it was found that with a positive potential of 24 volts applied to the grid, the rectifier was linear up to about 2 mA. rectified current with 10,000 ohms in the anode. This was using an LS5B as a rectifier. Under this condition it will be seen that we can work at a normal rectified current of 1 mA, and get distortionless rectification, even if the modulation is as high as 100 per cent. maximum; and at 100 per cent. modulation the peak voltage output from the detector will be 10 volts. Actually, however, the peak modulation seldom exceeds 70 per cent. to 80 per cent.

It was also found that if the value of positive potential applied to the grid was reduced, then the maximum rectified current with linearity was also reduced. The reason for this is that, for linearity, the positive potential on the grid must always exceed the maximum positive potential actually applied to the anode. Persons using this type of rectifier should be extremely careful of the

The Diode Rectifier.—

conditions under which it is worked for this reason. The rectifier was then incorporated in the newest types of monitoring and checking apparatus, as for these purposes it is preferable that every piece of apparatus is as perfect as possible, in order that imperfections in the apparatus under observation may be clearly distinguished.

We wished in this case to have a convenient value of rectified current, so 1 mA. was chosen as being a value which was easily readable on a 0-2 milliammeter, which in turn was a convenient sort of meter to use, the more sensitive types of meter being more expensive, less robust, and, in general, less fit for a maintenance service.

Applications of the Linear Rectifier.

It was necessary to have some readable rectified current, as a modulation meter was worked off the receiver, and was calibrated in modulation voltage for a certain value of rectified current, i.e., 1 mA.

None of the above tests as to linearity was done at high frequencies; and while the actual tests showed that the rectifier was linear, it was quite possible that, under working conditions, the rectifier might not be linear.

A further use for the rectifier was found later in testing the linearity of transmitting apparatus—in particular during the experimental work at 5GB. Here we required to find out whether the envelope of the high-frequency wave form was strictly proportional under all conditions to the low-frequency modulation applied to the transmitter. There are various ways of making this test, some of them including the use of a cathode ray oscillograph.

A method normally employed is to apply the modulated high-frequency E.M.F. to one pair of plates of the oscillograph, and to apply the modulation frequency to the other pair of plates. A truncated triangle results, the straightness of the sides being a measure of the linearity of the apparatus.

The cathode ray oscillograph, under these conditions, was not always entirely satisfactory, and other means

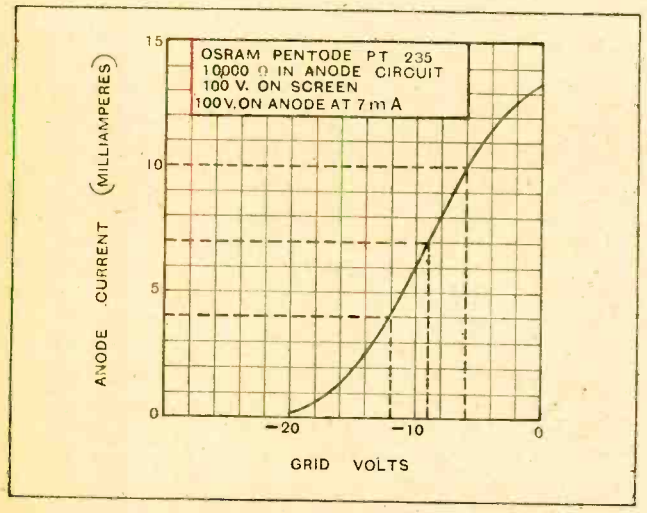


Fig. 2.—Curve showing the performance of a pentode when delivering an input to a diode rectifier under conditions shown at the top of the diagram.

were sought. A method more suitable to the use of a cathode ray oscillograph would be one in which the story, as it were, was written on the oscillograph screen in the form of a single line, which might be a straight line, circle, or a sine wave, according to the type of observation being carried out. This necessitated the

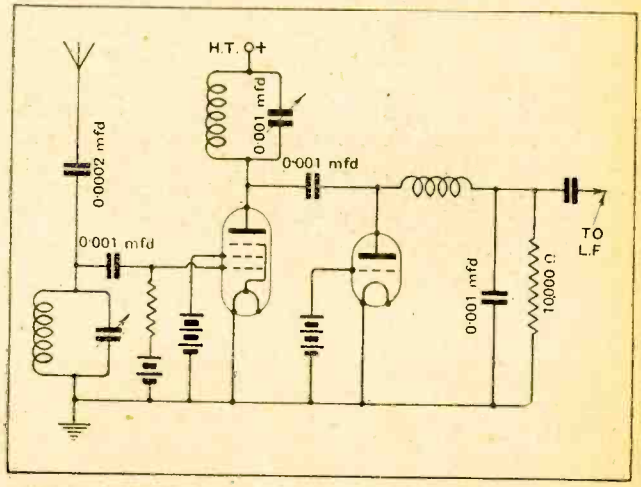


Fig. 3.—A circuit incorporating a pentode before the "Kirkifier."

use of some form of known linear rectifier. It was then necessary to carry out experiments on the Kirkifier to find out how linear it was, and what were the conditions necessary to obtain complete linearity. Further, for convenient observation of the cathode ray oscillograph, a voltage sweep of the order of several tens of volts was necessary.

A number of experiments were carried out with the Kirkifier, and it was found that the most linear result could be obtained by using quite a large positive potential applied to the grid of the order of 50 to 100 volts, when the output from the Kirkifier could be increased considerably.

The Question of Harmonics.

A further effect was observed—that it was preferable for this purpose to arrange the coupling between the high-frequency circuits and the rectifier so that, looking back from the rectifier, the condenser was always connected across the circuit. Therefore, tapping down an inductance coil was not quite as satisfactory as using a low L/C value of tuned circuit, or a tapped-down condenser.

It is well known that any form of diode rectifier produces harmonics of considerable intensity; and it would therefore appear from these results to be desirable to provide a low impedance path for the harmonic currents.

This low L/C ratio is rather inconvenient. The writer has at the moment no suggestions for overcoming the difficulty. Any suggestions from readers will be very welcome.

As has been pointed out, the Kirkifier is a device requiring power to operate it, and power of rather an inconvenient form; apart from all questions of selectivity, the power has to be supplied from the preceding valve, which must not itself distort in supplying the power to the rectifier.

The writer has found that in order to produce 1 mA.

The Diode Rectifier.—of rectified current it is necessary to use a valve of the L.S.5 type, or, at any rate, having the eqpivalent characteristics at a high-tension voltage of the order of 180 to be completely safe.

The Pentode as High-frequency Amplifier.

A further difficulty in connection with the use of the Kirkifier is that a certain amount of distortion is liable to occur if any reaction is permitted between the anode and grid circuits of the preceding valve. It is therefore necessary to have this valve carefully neutralised. For 1 mA. rectified current the writer normally uses a 1 : 1 high-frequency transformer, the primary having a neutralising winding and the secondary tuned by a 0.001 mfd. variable condenser.

To overcome the necessity of neutralising, some experiments were carried out with the use of a pentode preceding the Kirkifier. The ordinary screened valve has an insufficient linear power output to work the rectifier, whereas it was thought that a pentode might just do the trick, and also provide slightly more amplification than was obtained with the ordinary 3-electrode valve. It was found that the pentode direct coupled (tuned anode) was about 2½ times as sensitive as an L.S.5 with a 1 : 1 output transformer. A voltage magnification of the order of 5 to 10 times is thus obtainable from a pentode working into a Kirkifier.

In practice, some preliminary experiments have been carried out, and it would appear that a pentode on 100 volts H.T. works remarkably well.

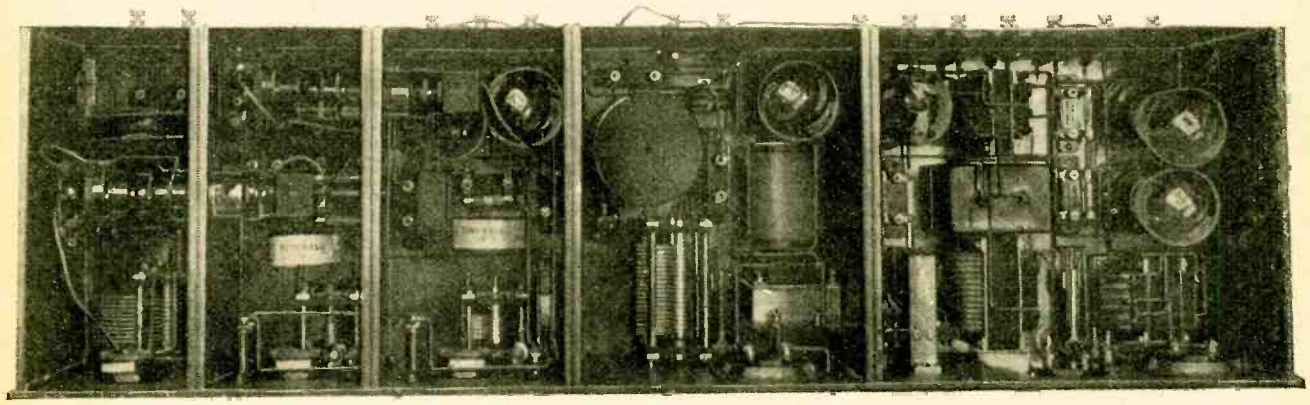
Experiments carried out by Mr. Greenwood on the functioning of a pentode with various values of external anode impedance, and some experimental work on Kirkifier circuits, showed that the impedance of the Kirkifier circuit could be considered as equal to the anode resistance of the Kirkifier in parallel with approximately 50,000 ohms. Therefore, if we use 10,000 ohms in the anode of the Kirkifier the total apparent impedance, looked at from the input circuit, will be just over 8,000 ohms.

A curve in Fig. 2 shows the performance of a pentode under these conditions. It will be seen that, for an output impedance of 10,000 ohms, the pentode is linear over a range of 60 volts output.

It is still preferable to use a low value of L/C in the tuned circuit of the pentode in order to get a measure of selectivity and sufficient by-passing of harmonics.

A circuit which can be conveniently used for the Kirkifier is shown in Fig. 3.

Attention has been drawn to a very important factor in the use of the diode type of rectifier; it is in no way connected to the high-tension supply source, and in consequence it will be unaffected by reactions due to common impedance in any such supply source. This is a considerable advantage where mains units are employed. The writer considers this property to be of the utmost importance, and suggests that the idea should be carried one step further, and that the last, or output, stage of the circuit should be of the push-pull variety, in which the audio-frequency currents do not necessarily have to pass through the high-tension supply system, but can be conveniently localised.



The general layout of the seven-valve receiver.

If a receiver is designed which consists of a distortionless diode rectifier, one stage of low-frequency amplification, and one push-pull power stage, we shall have a receiver which will give excellent quality, and will be practically free from any interaction due to common impedance in the H.T. supply circuits. The rectifier may be preceded by a pentode when normal sensitivity is required, and this, in turn, may be preceded by an ordinary type of screened valve where still greater sensitivity is required.

Grid Battery must Supply Current.

As an illustration of the order of sensitivity of the neutralised space charge diode, plus pentode H.F., using an ordinary sort of aerial (height about 25 to 30 ft.), it was possible to obtain a rectified current of ½ milliampere from 5GB, the receiver being situated in South London.

A great disadvantage of the distortionless diode is that the grid polarising battery has to supply quite a considerable current, especially when large inputs, which automatically require a high grid polarising voltage, are to be handled; about 20 mA. at 24 volts is a usual value. If the grid polarising potential is being supplied from a mains unit a certain amount of care should be taken in the design of the associated filter circuits, as the grid current will vary in the process of rectification, i.e, with

The Diode Rectifier.—

the amplitude of the potential applied to the anode, and if there is impedance in the grid circuit some potential will be dropped across this impedance, and the potential on the grid varied during rectification. This may, or may not, have a bad effect. The writer has been unable to experiment up to the present; but if the impedance in the grid circuit is different at different frequencies, placed in such a position that the run of the leads in each case was as short as possible. This is particularly necessary in the case of the screens of the screened-grid valves.

Volume control was effected by damping resistances across each of the tuned circuits except the last. With this form of volume control very high quality with no sideband cut-off can be obtained where signals are very

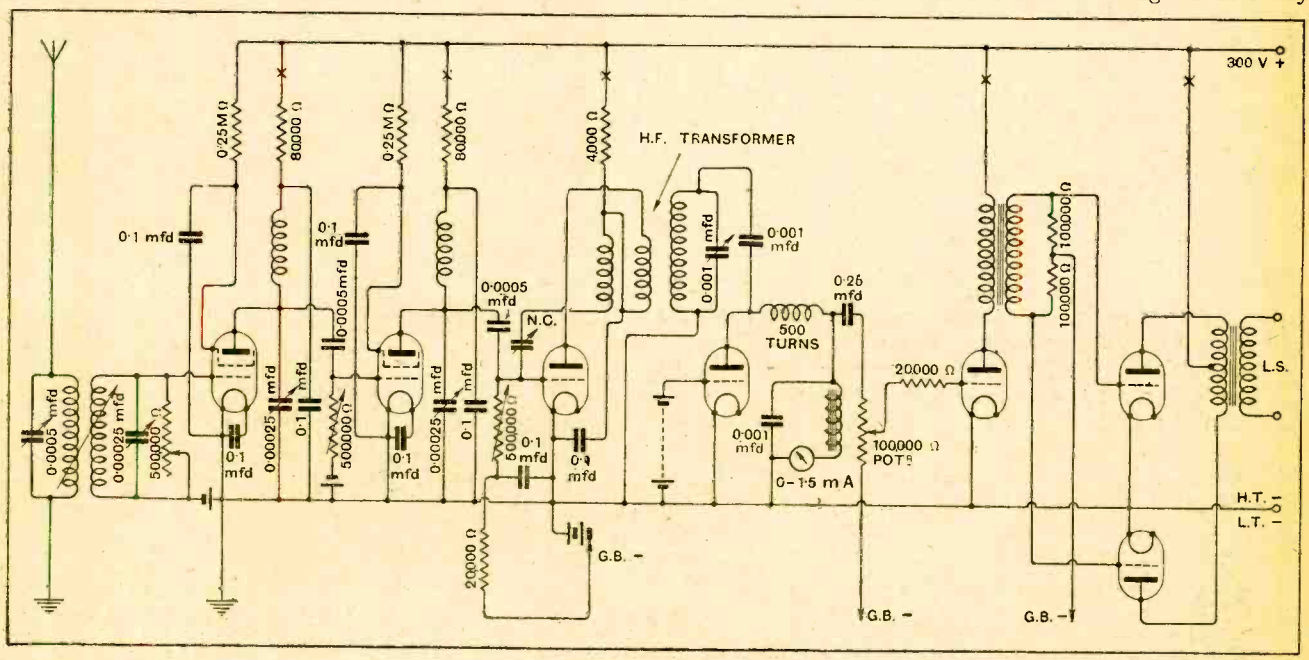


Fig. 4.—A highly specialised receiver embodying a diode rectifier. The 3-valve high-frequency amplifier contains two screened-grid valves followed by a pentode or L.S.5.

then there will probably be a certain amount of frequency characteristic distortion, apart from any possible form of amplitude distortion due to this reaction.

The writer understands that there will shortly be on the market electrolytic condensers of high capacity which will withstand a working potential of the order of 40 volts. These condensers should assist materially in solving the problem of grid polarising potential from the mains.

A Distortionless Receiver.

The diagram in Fig. 4 shows a general type of circuit that the writer would advise for use in connection with a diode rectifier.

The receiver shown photographically in the text and title illustration was originally developed using a neutralised L.S.5 preceding a Kirkifier, but is now being changed to a pentode.

The circuit normally comprises two screened valves type S.625, one L.S.5 or pentode, one L.S.5B Kirkifier, one L.S.5 as first L.F., and two L.S.5s in push-pull as output circuit, the output transformer being centre-tapped and its impedance arranged to suit the particular loud speaker. Each stage, including the screens of the screened valves, was fed through a resistance from a common H.T. supply source (an M-L converter), suitable filter condensers being used in each case to provide a short path to earth. The condensers were actually strong and interference small, as in local station work; selectivity combined with high sensitivity is obtained where necessary, with a certain amount of reduction of quality due to cutting off sidebands.

In practice the receiver was worked in a small van with an aerial of only a few feet high. Rectified currents of the order of 1 mA. were easily obtainable at about 40 to 50 miles from 5GB. With a fair aerial excellent reception is obtainable from such stations as Langenburg, even in daylight.

The whole set was run off a 12-volt 120 a.h. accumulator, which supplied current to the filaments, current to the M-L converter, and polarising current for a moving-coil loud speaker which was used for these particular tests.

It has been found that for use in a medium-sized room the high-tension voltage can be reduced to about 200 or 180, when valves of considerably lower filament consumption than the L.S.5 can be used in most cases, such, for instance, as the P.M. 256, P.625, or P.X.650 for the power stages, and a P.M.6, D.E.5, or the equivalent for the first L.F., also for the valve preceding the Kirkifier.

In the receiver just described the inter-valve transformer between first L.F. and power stage was choke-capacity coupled, as the particular transformer was wound on a Mu-metal core, and no D.C. was permissible.

THE MICROPHONE and the VOTER.

Lessons from the U.S. Presidential Election.

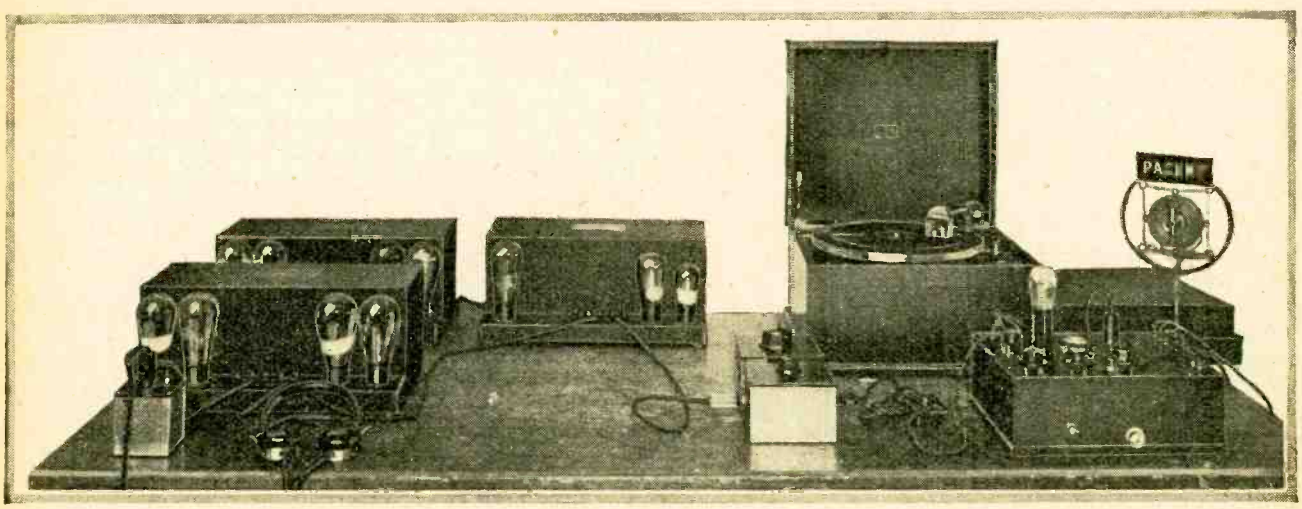
WITH war clouds already piling up on the British political horizon, our statesmen are fortunate in having received, as recently as November last, an object lesson in the value of broadcasting and speech-reproduction systems in the education and direction of public opinion on the points at issue. For a period of nearly twelve years the voters of the United States have been surprisingly indifferent to political campaigns. In the presidential elections of 1920 and 1924 the percentage of citizens who went to the poll was extraordinarily low. In 1928, however, nearly forty million votes were cast out of a possible forty-three million. This gratifying increase is attributed almost entirely to the use of broadcasting.

From the first day that Mr. Hoover and Governor Smith began their active radio campaign, interest in the election became more and more marked. Chain broadcasting was carried out to an unprecedented extent. Governor Smith's final plea, delivered on election eve, was broadcast by both the National and Columbia systems, embracing fifty-eight stations.

Open-air Listening.

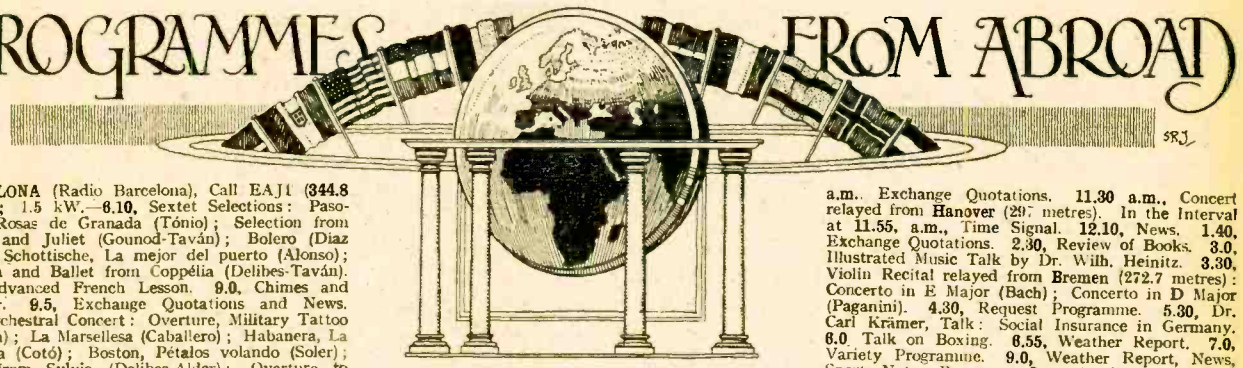
On Election Night, November 6th, practically every station devoted its entire time to the transmission of election results. Many people, too excited perhaps to remain at home with their sets, listened to the results on loud speakers in the streets. The biggest open-air gathering took place in Times Square, New York, where 350,000 people, jammed in an area of four square blocks (there are twenty-one of these to the mile), listened to election announcements on the moving-coil loud speakers shown in the photograph. The amplifiers were specially installed for the occasion on the fifth floor of a neighbouring building, connected by telegraph and telephone with the leading press associations. The election results were dictated over the microphone, and, during intervals in the announcements, gramophone records of popular election songs were reproduced.

LOUD SPEAKERS ADDRESS 350,000 PEOPLE. A corner of Times Square, New York, showing the coil-driven loud speakers which announced the U.S. election results to a record crowd.



THE AMPLIFYING EQUIPMENT used to operate the loud speakers shown in the upper photograph. Gramophone records were reproduced during intervals in the announcements.

PROGRAMMES FROM ABROAD



SATURDAY, JANUARY 12th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**6.10,** Sextet Selections: Pasodoble, Rosas de Granada (Tónio); Selection from Romeo and Juliet (Gounod-Taván); Bolero (Diaz Giles); Schottische, La mejor del puerto (Alonso); Fantasia and Ballet from Coppélia (Delibes-Taván). **8.30,** Advanced French Lesson. **9.0,** Chimes and Weather. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Concert: Overture, Military Tattoo (Raurich); La Marsellesa (Caballero); Habanera, La costurera (Cotó); Boston, Pétalos volando (Soler); Ballet from Sylvia (Delibes-Alder); Overture to Egmont (Beethoven). **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**5.30,** Programme for Children. **6.0,** Programme for Girls. **7.0,** Orchestral Concert. **7.20,** Organ Recital by Birger Anrep Nordin: Sonata in G Minor (Lindberg); Choral Fantasia on Eja mitt hjärta (Wideen); Three Legends (Sjögren). **7.50,** Topical Talk. **8.0,** Georg Dahl, Talk: Monaco. **8.30,** Orchestral Concert. **9.0,** Weather Report, News and Time Signal **9.15.** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,649 metres**); 40 kW.—**12.45** Phototelegraphy Transmission. **1.30,** Programme for Children. **2.0,** Herr B. K. Graef, Talk: Elocution. **2.30,** Weather Report and Exchange Quotations. **2.40,** Talk for Women, by Dr. Elly Heuss-Knapp. **3.0,** Shorthand Lesson. **3.30,** Programme relayed from **Hamburg.** **4.30,** Legal Talk, by Dr. A. Richhardt. **5.0,** Peter Leistenschneider, Talk: Dangers and Safety Measures in the Mining Industry. **5.30,** Elementary Spanish Lesson. **5.55,** Alf Due, Illustrated Talk: Norwegian Folk Songs. **7.0,** "Agricultural" Concert: "Kirmesmusik," (a) Pepita Marsch (Neumann), (b) March, Gruss an Kiel (Spohr), (c) Landjägermarsch (Rixner); Altenburger Kirmeswalzer; Zweibelsdorfer Schottisch; Polka, Der Herr Amtmann tanzt; Reading, Der tolle Bomberg; Signal Waltz; Slow Waltz, Old Inhabitant; Country Dance, Den Herrn Posthalter sein Lieblingstanz. **8.0,** Programme from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Programme of Gramophone Records. **10.30 a.m.,** Exchange Quotations. **11.55 a.m.,** Time Signal. **12.30,** Weather and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations, Agricultural Report and Time Signal. **2.30,** Franz Winninger, Talk: Dankali—A Native Tribe of Central Africa. **3.0,** Willy Möbus, Talk: Aviation. **3.30,** Theatre Anecdotes by Max Grube. **4.0,** Concert from the Café Vaterland: Waltz, Künstlerleben (Strauss); Potpourri of Overtures (Englemann); Boston, Amra (Bransen); Selection from Cavalleria Rusticana (Mascagni); Was Blümen träumen (Translateur); Waltz Fantasia, Deutscher Liederschatz; Humoresque, Strauss im Himmel (Rösch); Es waren zwei Königskinder (Ailbout-Niels); Advertising Notes in the Interval. **5.40,** Theodor von Lerch, Talk: Hunting in Winter **6.5,** Dr C. Kassner, Talk: The Householder's Responsibilities in Frosty Weather. **6.30.** Prof. Esau, Talk: Introduction to the Technique of Short Waves. **7.0,** Programme relayed from **Königswusterhausen.** **8.0,** Programme of Duets, followed by Weather Report, News, Time Signal, Sports Notes and Dance Music from the Hotel Esplanade. **11.30** (approx.), Close Down.

BERN (**411 metres**); 1.5 kW.—**3.0,** Orchestral Concert from the Kursaal. **3.30,** Humorous Interlude. **4.0,** Orchestral Concert from the Kursaal. **6.29,** Time Signal and Weather Report. **6.30,** Talk on History. **7.0,** Symphony Concert, relayed from **Basle** (1,010 metres). **9.0,** News and Weather Report. **9.15,** Orchestral Concert from the Kursaal. **9.35,** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—**2.45,** Review of Books, by Martin Darge. **3.15,** Thé-dansant Programme. **4.45,** Film Review of the Week, by Dr. Heinz Hamburger and Hans Baldung. **5.25,** Esperanto Talk by Hans Plehn. **5.35,** Fritz Seemann, Music Talk: The Wireless and Operetta. **5.55,** Programme relayed from **Königswusterhausen.** **6.20,** Shorthand Lesson. **6.50,** Topical Dialogue by Marianne Bruns. **7.15,** Das Scheidungssouper"—Operetta in Three Acts (Karl Cvancara). **9.0,** News. **9.30,** Dance Music. **11.0** (approx.), Close Down.

BRUNN (**441.2 metres**); 3 kW.—**3.30,** Programme for Children. **4.30,** Talk on Music. **4.45,** German Programme: News and Melodies. **5.15** Weekly Report for Journalists. **5.25,** Talk on Czech History. **6.0,** Programme relayed from **Prague.** **9.25** Programme from **Prague.**

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0,** Programme of Dance Music from the St. Sauveur Palais de Danse. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Selections for Piano. **7.0,** Gramophone Selections of Dance Music. **7.30,** "Radio-Chronique." **8.15,** Gramophone Selections **8.30,** Concert: Symphony No. 5, From the New World (Dvorak); Violin Concerto (Beethoven); Musical Adaptation of Macbeth (Dupuis); Two Elegiac Melodies (Grieg); Overture to Charlotte Corday (Benoit); Followed by News and Announcements in Esperanto. **10.15,** Orchestral Concert from the Palace Hotel. **11.0** (approx.), Close Down.

BUDAPEST (**556.6 metres**); 20 kW.—**4.10,** Talk. **4.45** Selection of Gramophone Records. **5.50,** Talk for Scouts. **6.30,** Readings from the New Book by the Archduke Joseph on the Great War. **7.0,** Relay of part of the Opera "Madame Butterfly" (Puccini). **8.40,** Time Signal, Weather Report and News. **9.0,** Selections of Tzigane Music from the Café Emke.

CRACOW (**566 metres**); 1.5 kW.—**4.0,** Mr. J. Fudakowski, Talk: Our Winter Fauna. **4.25,** Mr. J. Regula, Talk: The Foreign Politics of the Past Week. **4.55,** Dramatic Reading for Children: "The Just-so Stories" (Rudyard Kipling). **5.50,** Miscellaneous Items. **6.10,** English Reading by Mr. Jean Stanislawski. **6.56,** Time Signal from the Astronomical Observatory. **7.0,** Chimes from the Church of Notre Dame, News and Announcements. **7.30,** Programme relayed from **Warsaw.** **9.0,** Programme relayed from **Warsaw.** **9.30,** Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30,** Weather Report and Concert of Gramophone Selections. **7.20,** News. **7.30,** Talk. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Concert: Overture by the Augmented Station Orchestra; Soprano Solos by Josephine Curran; Ballet from Parysatis (Saint-Saëns) by the Station Orchestra; Tenor Solos by P. Bilsbury.; Orchestral Selections from Mignon (Thomas); Soprano Solos by Josephine Curran; Pianoforte Solos by Fred Stone; Light Opera Songs by P. Bilsbury; Orchestral Selections from The Gondoliers (Gilbert and Sullivan). **9.30,** Light Musical Selections by Cedric May and Company. **10.0,** Vocal Duets by Florence Howley and Thompson Dawson. **10.15,** Selections by the Augmented Station Orchestra. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**2.5,** Programme for Children. **2.55,** Hints for the Housewife by Fini Pfannes. **3.35,** Orchestral Concert with Selections by Maria Pos-Carloforti; in the Intervals News and Announcements. **5.10,** Reading from Doktor Katzenbergers Badereise (Jean Paul), by O. W. Studtmann. **5.30,** The Letter Box. **5.45,** Esperanto Lesson by W. Wischhoff. **6.15,** Talk on Industrial Councils by Alred Gürteler. **6.45,** Prof. Max Flesch, Talk: Poultry. **7.15,** "Die Hausdame"—Comedy in Three Acts (Erik Hostrup), followed by Dance Music from **Voxhaus.** **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—**9.15 a.m.,** News. **10.0 a.m.,** Programme of Gramophone Records. **11.10 a.m.,** Weather Report. **11.15 a.m.,** Exchange Quotations. **11.30 a.m.,** Concert relayed from **Hanover** (297 metres). In the Interval at **11.55, a.m.,** Time Signal. **12.10,** News. **1.40,** Exchange Quotations. **2.30,** Review of Books. **3.0,** Illustrated Music Talk by Dr. Wilh. Heinitz. **3.30,** Violin Recital relayed from **Bremen** (272.7 metres): Concerto in E Major (Bach); Concerto in D Major (Paganini). **4.30,** Request Programme. **5.30,** Dr. Carl Krämer, Talk: Social Insurance in Germany. **6.0** Talk on Boxing. **6.55,** Weather Report. **7.0,** Variety Programme. **9.0,** Weather Report, News, Sports Notes, Report on Snow Conditions and Programme Announcements. **9.30,** "Billbrookens auf dem Bö-Bu-Ba"—Satire (Eugen Tann). **10.50,** North Sea and Baltic Weather and Report on Ice Conditions.

HILVERSUM (**1,071 metres**); 5 kW.—**9.40 a.m.,** Time Signal and Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Trio Music. **1.40,** Concert relayed from the Tuchinski Theatre, **Amsterdam,** Orchestra conducted by Max Tak; Pierre Palla (Organ). **3.40,** Italian Lesson by Mr. Giovanni Rizzi i. **4.40,** French Lesson by Mr. R. Lafont. **5.40,** Trio Concert. **6.25,** German Lesson by Mr. Edgar Grün. **7.25,** Police Announcements. **7.45,** Programme arranged by the Workers' Radio Society: Concert and Talk. **11.15,** Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits on 1,852 metres from 5.40 p.m. **12.10,** Trio Concert. **2.40,** Programme for Children. **5.10,** Programme of Gramophone Records. **6.20,** Talk by M. Gestel. **6.30,** Catholic Bulletin. **6.40,** English Lesson. **7.10,** Lesson in Dressmaking. **7.40,** Talk by M. Feber. **8.0,** Choral and Instrumental Concert from Bois le Duc, including Talk by M. Geffen.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**6.30 a.m.,** Morning Gymnastics. **10.0 a.m.** Weather Report. **11.0 a.m.,** Chimes from the Town Hall. **11.5 a.m.,** Orchestral Concert from Wivel's Restaurant. **2.0,** Programme for Children. **2.30,** Instrumental Concert: Overture to Raymond (Thomas); Waltz, La plus belle (Waldteufel); Selection from Lucia di Lammermoor (Donizetti); Norwegian Dance in A Major (Grieg); Sonata in D Major for Two Violins (Corelli); Waltz from The Dollar Princess (Fall); Spanish March, Curro Cuchares (Metallo); Recitations by Aage Brandt; Selection from Nitouche (Hervé); Waltz, Roses of the South (Joh. Strauss); Orientale (Cui); Minuet in E Flat Major (Mozart); Violin Solo, Méditation from Thais (Massenet); Turkish March from The Ruins of Athens (Beethoven). **5.20,** Kommandant Floridon, Talk: The Savannas of Central Africa. **5.50,** Weather Report. **6.0,** News and Exchange Quotations. **6.15,** Time Signal. **6.30,** Mr. Caja Rude, Talk: Street Silhouettes. **7.0,** Chimes from the Town Hall. **7.2,** Reading by Thomas P. Hejle. **7.30,** Radio Cabaret. In the Interval—News. **9.45,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

KATTOWITZ (**422 metres**); 10 kW.—**3.0,** Concert of Gramophone Selections. **4.0,** Music Lesson by Prof. F. Sachse. **4.25,** Children's Letter Box. **4.55,** Programme for Children. **5.50,** Announcements. **6.10,** Talk by Mr. K. Zienkiewicz. **7.30,** Programme relayed from **Warsaw,** **9.0,** Weather Report and News. **9.30** Dance Music.

KAUNAS (**2,000 metres**); 7 kW.—**3.30,** Musical Selections. **3.45,** "Radio Pataresas." **4.0,** Announcements. **5.0,** Weather Report and News. **5.30,** Agricultural Talk. **6.0,** Aviation Report. **6.30.** Programme relayed from the National Opera House.

LAHTI (**1,522.8 metres**); 35 kW.—**4.0,** Orchestral Selections: Scene orientale (Bird); Selection from Carmen (Bizet); Winterstürme (Fucik). **4.35** Talk. **4.57,** Time Signal and Weather Report. **5.15,** Orchestral Selections: Gallop, Reun (Ganz); Norwegian Bridal March (Grieg); Hirtenknabe (Grieg); Minuet (Grieg). **5.45,** Talk. **6.0,** Concert: Orchestral Selections, (a) Drot og Marsa (Heise), (b) Andante religioso (Henriques), (c) Marche hongroise (Berlioz); Vocal Selections; Talk by Tatu Pekkarinen; Vocal Selections; Talk; Popular Choral Selections; Orchestral Selections. **7.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (**488.8 metres**); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**12.5,** Orchestral Concert: Overture to Halka (Moniuszko); Selections

Programmes from Abroad.—
from The Force of Destiny (Verdi); March of the Dwarfs (Moszkowski); Waltz, Freut euch des Lebens (Strauss); Serenade (Rachmaninoff); Spanish Suite (Girardin); Liebesspiel (Steck); Potpourri, Auf Wiederhören (Weninger). **1.30,** Hints for the Housewife. **2.40,** Talk on Wireless, by Arthur Wurbs. **3.5,** Talk on the Search for Amundsen, by Major Gran. **3.30,** Johanna Krause, Talk for Women: What are we to eat? **3.55,** Line Wallerstein, Talk: German Artists on their Travels. **4.20,** English Lesson, by Prof. F. Hase. **4.45,** Orchestral Concert, relayed from the Breidenbacher Hof. **5.30,** Dr. Salmony, Talk: Ancient Chinese Art and Culture. **5.50,** Lesson in Morse. **6.15,** Prof. Schumpeter, Talk: Economics. **6.40,** Prof. Hessen, Talk on Psychology: What do we know of the Soul? **7.0,** Relay of the Carnival Meeting at the Gürzenich, **Cologne.** **9.0** (approx.), News, Sports Notes and Commercial Announcements, followed by Orchestral Selections and Dance Music. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (365.8 metres); 4 kW.—**2.0,** Weather Report and Concert of Gramophone Selections. **3.30,** Orchestral Concert: Overture to Ascanio in Alba (Mozart); Andante and Minuet from the Symphony in C Major, No. 88 (Haydn); Divertimento à la Hongroise (Schubert); Selections from William Tell (Rossini); Dutch Dances (Aulin); Waltz, Sphärenklänge (J. Strauss). **4.45,** Wireless News and Talk. **5.20,** Weather Report and Time Signal. **5.30,** Programme relayed from **Königswusterhausen.** **6.0,** Prof. Georg Witkovsky: Lessing as Dramatist. **6.30,** Dr. Raphahn, Talk: The Sentiment of Europeanism. **7.0,** Variety Programme. **9.0,** Labour Market Report, News, Sunday Programme Announcements and Sports Notes. **9.30,** Dance Music, relayed from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 **(434.8 metres);** 3 kW.—**7.0,** Chimes, Exchange Quotations and Dance Music. **8.0,** Dr. Zito, Talk: Inventions and Inventors. **8.25,** News and Announcements. **9.45,** Market Report. **10.0,** Chimes and Time Signal, followed by Two Musical Plays: (a) "Los Cadetes de la Reina" (Moyrón and Luna), (b) "Los Descamisados" (Arniches, Silva and Chueca); in the Interval at **12.0 Midnight** (approx.), News and Announcements. **12.30** a.m. (approx.) (Sunday), Close Down.

MILAN. Call 1MI **(549 metres);** 7 kW.—**4.20,** Programme for Children. **4.45,** Agricultural Report and News. **7.25,** Time Signal, Wireless Talk and Announcements. **7.45,** E. M. Ciampelli, Talk: Verdi, with Pianoforte Illustrations by C. Vidusso. **8.0,** Relay of an Opera from the Scala Theatre; in the Intervals: Reading, by Angelo Sodini; News and Industrial Notes.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Böden** (1,190 metres), **Göteborg** (416.5 metres), **Malmo** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**4.0,** Concert of Light Music. **5.0,** Programme for Children. **5.45,** Cabaret Programme, relayed from **Göteborg.** **6.45,** Pianoforte Recital, by Olof Wibergh: Sicilienne (Bach); Minuet in B Flat (Schubert); Moment musical (Schubert). **7.0,** Concert by Military Band, relayed from **Ostersund:** March, Treu Deutsch (Teike); Overture (Conradi); It is written in the Stars (Fétras); Folk Melodies (arr. Lindström); Mazurka, Confidence (Capitani); Selection (Bauer); Mountain Song (Peterson-Berger); March (Widor). **8.0,** Topical Talk. **8.15,** News and Weather. **8.45,** Old Dance Music, by the Möller-Gissiow Orchestra. **9.30,** Dance Music, by Helge Lindberg and his Orchestra. **10.30,** Dance Music, by Zöll's Orchestra and Close Down.

MUNICH (535.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (277.8 metres) and **Nuremberg** (241.9 metres).—**5.0.** Mandoline Recital. **5.30,** Labour Market Report. **6.0,** The Letter Box. **6.15,** Talk on Agriculture in Bavaria, by Dr. Anton Fehr, Minister of State. **6.30,** Alfons von Czibulka, Talk: Stanley, the Explorer and Discoverer. **7.0,** Humorous Anecdotes, relayed from **Nuremberg.** **7.20,** Orchestral Concert: Overture to Boccaccio (Suppé); Waltz, Mein Traum (Waldteufel); Potpourri on Opernball (Heuberger); Overture to The Gipsy Baron (Joh. Strauss); Radetzky March (Joh. Strauss). **8.10,** Victor Hollaender Concert. **9.20,** News. **9.45.** Dance Music. **11.0** (approx.), Close Down.

NAPLES, Call 1NA **(333.3 metres);** 1.5 kW.—**4.0.** Orchestral Concert: The Brandenburg Concerto (Bach); Symphony in C Major (Mozart); The Siegfried Idyll (Wagner); Symphonic Poem, La Procession nocturne (Rabaud); Symphony from Semiramide (Rossini). **4.30,** Time Signal. **4.35,** Talk by R. Lotto. **7.30,** Wireless Notes. **7.40,** Announcements. **7.45,** News and Harbour Notes. **8.0,** Time Signal. **8.2,** Variety Concert: Orchestral Selection, Overture to Banditenstreiche (Suppé); "Una partita a Scacchi," Fable in Verse (Scaturchio); Orchestral Selections, (a) Ricordo di Cairo (Manente), (b) Scena zingaresca (Manente), (c) Misiolite (Manno), (d) Serenata amorosa (Manno); "Il nome della Diva," Comedy in One Act (Carlo de Flavis). **9.0,** Review of the Week's Events. **9.50,** News. **9.55,** Calendar and Programme Announcements. **10.0** (approx.), Close Down.

Saturday, JANUARY 12th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres).—**6.0,** Programme for Children **6.15,** Weather Report and News. **6.30,** Talk on Amundsen. **7.0,** Time Signal. **7.2,** Orchestral Concert: Overture to The Gipsy Baron (Strauss); Soprano Solo from Die Fledermaus (Strauss); Selection from La Bayadère (Kálmán); A Rural Wedding (Södermann); Selection from La belle Hélène (Offenbach); Selection from Lilac Time (Schubert); Un fête d'été (Si de); Waltz, Acceleration (Strauss); Russian Folk Melodies (Slonoff); Waltz (Bolstad); Mazurka (Bolstad); Overture to Poet and Peasant (Suppé). **8.30,** Weather Report and News. **8.45,** Topical Talk. **9.0,** Reading. **9.30,** Dance Music from the Hotel Bristol. **11.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(1,485.15 metres);** 5 kW.—**5.0,** Talk arranged by the C.T.I. **7.10** Weather Report. **7.50,** "Le Journal Parlé."

PARIS (Petit Parisien) **(340.9 metres);** 0.5 kW.—**8.45,** Gramophone Selections, Talk and News. **9.0,** Concert: Overture to The Merrymakers (Coates); Scherzo, The Dryads (Raff). **9.25,** News and Announcements. **9.30,** Symphony Concert: Le Chasseur maudit (Franck); Les Petits Riens (Mozart). **10.0,** News, followed by Concert: Ballet from La Glaneuse (Fourdrain); Lamento (Leo Sachs); Thistledown (Haydn Wood); Les Joyeux gamins (Casadesus).

PARIS (Radio-Paris), Call CFR **(1,750 metres);** 6 kW.—**12.30,** Concert of Gramophone Records: Waltz, Sleepy Town, by the Piccadilly Players; I can't give you anything but love, by The Knickerbockers; Fox-Trot, Hello Montreal, by Ted Lewis and his Orchestra; That's my Weakness now, by Ukulele Ike; Varsity Drag, by Layton and Johnstone; Stay out of the South, by the Trix Sisters; Pianoforte Solo The Thirty-Sixth Romance (Mendelssohn); Soldier's Chorus from Faust (Gounod); Pianoforte Solo, Romance No. 2 (Schumann); Bass Solo, Mephistopheles Serenade from Faust (Gounod), by Alexandre Kipnis; La Procession nocturne (Rabaud), by the Symphony Orchestra under the direction of the Composer. In the intervals: News. **2.0,** Market Prices and Religious Information. **3.45,** Dance Music by the Joss Ghislery Symphonians. In the Intervals: News. **6.30,** Agricultural Report. **6.45,** Musical Selections. **7.30,** Pianoforte Lesson. **8.0,** Talk on the Legends, Customs and People of Madagascar. Followed by Market Prices and News. **8.15,** Concert arranged by "Le Matin," "Le Médecin malgré lui"—Opera (Molière-Gounod). In the Intervals: News.

POSEN (344.8 metres); 1.5 kW.—**4.15.** Talk on Boy Scouts. **4.30,** English Lesson by Dr. Arend. **4.55,** Programme for Children, relayed from **Cracow.** **5.50,** Talk. **6.15,** Musical Interlude. **6.45,** Talk for Women by Mme. Sabina Swidzi ska. **7.5,** Miscellaneous Items. **7.30,** Programme relayed from **Warsaw.** In the Intervals: Theatre and Film Notes. **9.30,** Time Signal and News. **9.45,** Radio Cabaret. **11.0,** Concert arranged by La Maison Philips. **1.0 a.m.** (Sunday), Close Down.

PRAGUE (348.9 metres); 5 kW.—**3.30,** Concert: Selection (Fucik); Selection from The Czarevitch (Lehár); Extase (Ganne); Indian War Dance (Lumbye); On the Sea (Ranzato); Selection from Lakmé (Delibes); Waltz, Broadway (Friml); Twilight in the East (Micheli); Ballet de parfums (Popy). **4.30,** Educational Talk. **4.40,** Technical Talk for Workers. **5.0,** German Programme, News and Programme for Children. **6.0,** "Orpheus in the Underworld"—Opera (Offenbach). **9.0,** Time Signal, News, and Popular Music from the Hotel Rosenbreier.

ROME. Call 1RO **(447.8 metres);** 3 kW.—**4.30,** Vocal and Instrumental Concert: Sonata in G Major (Porpora); Mezzo-Soprano Solos, (a) Le lune blanche (Marta Nervi), (b) Destiny (Rachmaninoff); Bass Solos, (a) Air from The Magic Flute (Mozart), (b) Selection from La Tuive (Halévy); Violin Solos (Dvorak), (a) Humoresque, (b) Slavonic Dance; Mezzo-Soprano Solos, (a) Air from Snegorotchka (Rimsky-Korsakoff), (b) Air from L'Amico Fritz (Mascagni); Bass Solos, (a) Air from Simon Boccanegra (Verdi) (b) Air from Faust (Gounod). **5.30,** Wireless Talk by Mr. Cesi. **5.40,** Lesson in Morse by Mr. Cesi. **6.50,** Announcements, Sports Notes, News, Exchange Quotations and Weather Report. **7.20,** Time Signal. **7.30,** International Labour Office Report. **7.45,** Dramatic Selection from the Studio. In the Intervals: Review of Art and Literature by Lucio d'Ambra and Fashion Talk by Mme. Pompadour, followed by News.

STAMBOUL (1,200 metres); 5 kW.—**3.30,** Concert. **4.30,** Market Prices. **5.15,** Concert of Turkish Music. **7.30,** Weather Report and Time Signal. **7.40,** Vocal and Orchestral Concert: Orchestral Selection, Symphony No. 6 (Beethoven); Songs; Duet for Two Violins (Mozart); Minuet (Mozart). **9.0,** News and Close Down.

STUTTGART (379.7 metres); 4 kW.—**5.0,** Time Signal and Weather Report. **5.15,** Talk by Josef Wittling, relayed from **Freiburg** (577 metres). **5.45,** Herr H. Bühler, Talk: The Planet Mars. **6.15,** Talk on Book-keeping by Dr. Wolf. **6.45,** Time Signal and Sports Notes. **7.15,** Concert of Alsatian Music: Songs (Reysz), (a) Es haben zwei Blumen geblühet, (b) Es steht ein' Lind in jenem Tal, (c) Du bist die Ruh'; Violin Solo, Suite Op. 45 (Erb); Song, Der Morgenstern (Weckerlin); Selections from Op. 25 (Boellmann), (a) Gebet, (b) Gothic Minuet; Sacred Songs for Children (Reysz), (a) Ich bin klein, (b) Ihr Hirten erwacht, (c) Über die Hütte weht der Wind; Violin and Pianoforte Selection, Sonata in A Minor (Hügel); Violin and Pianoforte Selections (Hügel), (a) Liebesklage, (b) Der Traum, (c) Der verschwundene Stern; followed by Variety Concert of Selections from many Nations; Orchestral Selection, Wien-Berlin; Jeder einmal in Berlin; O Wien, mein liebes Wien (Ziehrer); Spanish Christmas Carol (Alid); Heja nasz ar avaron (Kéler-Béla); Russian Street-Singer (Schulrabe); Italian Folk Song, Danza, Danza; American Negro Melodies; Volga Song; "The Heart-Breaker"—Grotesque Scen from the Russian (Avertschenko); Orchestral Selection, Japanese Lantern Dance; Bonjour Suzon (Delibes); Bird in the Cage; Kesö osz van (Janos); Russian Barrel-Organ Songs; Orchestral Selection, Turkish Patrol; Mit keres a teme toben (Arpaa); Folk Dance, A moda gallega; Russian Dance Song; American Song-hits; Bukarest (Kandler); Montevideo (Marrell); One-step, Paris (Padilla); followed by News and Dance Music.

TOULOUSE (Radiophonie du Midi) **(389.6 metres);** 8 kW.—**12.45,** Concert arranged by the Radio Club d'Albret. **8.0,** Market Quotations and News. **8.30** "The Tales of Hoffmann"—Opera (Offenbach), relayed from the Capitol Theatre. In the Intervals: News and Market Quotations. **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (517.2 metres); 15 kW.—**2.15,** Phototelegraphy Transmission. **3.0,** Orchestral Concert: Overture to Das Veilchenmädl (Hellmesberger); Waltz, Zwei Herzen doch nur eins (Richter); Bizet Fantasia (Urbach); Ballet Fantasia for Cornet (Böhme) Divertissement from Wo die Lerche singt (Lehár); Gavotte (Redl); Reich mir die Lippen, du Mädel vom Rhein (Silving); Selection from Die Fledermaus (Strauss); Wien in deinen Gärten (Recktenwald); Lied vom Ra hauspark (Recktenwald); Anno dazumal—Potpourri (Morena); March, Sangesbrüder (Richter). **4.30,** Reading of Fairy Tales for the Old and Young, by Elisabeth Boehmer. **5.0,** Chamber Music by the Gottesmann Quartet, from the Works of Schumann: String Quartet in A Minor, Op. 41, No. 1; Songs, (a) Frühlingsnacht, (b) Volksliedchen, (c) Aufträge; Pianoforte Quintet in E Flat Major, Op. 44. **6.25,** Siegfried Trebitsch reads from his own Works. **7.10,** Time Signal and Weather Report. **7.15,** "Die Stunde"—Three Musical Plays (Lahte) with Prelude and Epilogue. Followed by Phototelegraphy Transmission.

VILNA (435 metres); 1.5 kW.—**3.0,** News in Lithuanian. **3.20** Announcements. **4.35,** Programme for Children by Mlle. Marie Kwolek. **4.0** Concert by Military Orchestra. **4.30.** Recitations by Mme. Helene Romer Ochenkowska. **4.35,** Concert by Military Orchestra. **5.15,** Literary Programme. **5.40,** Recital of Polish Christmas Songs by Mme. Sopaie Bortkiewicz-Wyiezynska (Soprano), Mr. Sigismond Lolega (Piano). **6.10,** Programme relayed from **Warsaw.** **6.35,** News and Time Signal. **7.0,** Talk by Mr. V. Charkiewicz. **7.30.** Programme relayed from **Warsaw.** **10.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**4.0,** Prof. Sikorski, Talk: French Music. **4.25,** Talk by Dr. Henzel. **4.55,** Programme for Children. **5.50,** Miscellaneous Items. **6.10,** "Radio-Chronique" by Dr. M. Stepowski. **6.56,** Time Signal. **7.0,** News. **7.30,** "Madame Pompadour"—Operetta in Three Acts (Fall). **9.0,** Aviation and Weather Report. **9.5,** News Announcements, Police Information and Sports Notes. **9.20,** Dance Music from the Oaza Restaurant. **10.30** (approx.), Close Down.

ZÜRICH (583 metres); 1 kW.—**6.0,** Chimes from the Zürich Churches. **6.15,** Time Signal and Weather Report. **6.17,** Concert by the Orfeo Mandoline and Guitar Orchestras. **7.0,** Programme relayed from **Vienna.** **9.0,** Weather Report and News.

SUNDAY, JANUARY 13th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Programmes from Abroad —

ALGIERS, Call PTT (353 metres); 1 kW.—12.30, Concert of Instrumental Music by the Station Orchestra: Prelude and Allegro (Pugnani-Kreisler), rendered by M. A. Gonzalès.

BARCELONA (Radio Barcelona), Call EAJ1 (344.8 metres); 1.5 kW.—11.0 a.m., Relay of Cathedral Chimes. 11.5 a.m., Weather Conditions and Forecast for Spain and Europe, followed by Aviation Notes and Route Conditions. 1.30, Musical Programme by the Iberia Trio; in the intervals, Gramophone Music. 2.45 to 5.30, No Transmission. 5.30, Opening Signal, followed by Relay of Part of an Opera from the Gran Teatro del Liceo; in the Interval, Exchange Quotations and Market Reports. 8.0 to 8.20, Lecture arranged by the Catalonian Institute of Agriculture at San Isidro. 8.20, Concert of Popular Music by the Station Orchestra. 8.40, Sports Chronicle. 9.0 (approx.), Close Down.

BERGEN (370.4 metres); 1.5 kW.—9.30 a.m., Divine Service Relay. 11.30 a.m. Weather Report and Forecast and News Bulletin. 7.0, Orchestral Concert. 7.50, Topical Talk. 8.0, Trio (Arensky) for Violin, 'Cello and Piano, by Herrn Schuster and Kurt Müller and Mrs. Signe Bonneire. 9.0, Weather Report and Forecast, Late News Bulletin and Time Signal. 9.15, Programme of Dance Music. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,649 metres); 40 kW.—7.55 a.m., Chimes Relay from Potsdam Garrison Church. 8.0 a.m., Musical Recital with Address, relayed from **Voxhaus**, followed by Berlin Cathedral Chimes. 10.30 a.m., Orchestral Concert, relayed from **Voxhaus**. 12.45, Experimental Picture Transmission. 1.30 to 2.25, Three Agricultural Talks, from **Voxhaus**. 2.30, Programme of Fairy Tales from **Voxhaus**. 3.0, Talk. 3.30, Musical Programme. 5.0, Talk. 6.0 (approx.), Talk. 7.0, Musical Selections, followed by News and Announcements. 9.30, Dance Music Programme. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (484 metres); 4 kW.—7.55 a.m. Chimes, relayed from Potsdam Garrison Church. 8.0 a.m., Morning Festival of Sacred Music with Choral and Instrumental Selections and Sermon, followed by Relay of Chimes from Berlin Cathedral. 10.30 a.m. (approx.), Morning Concert. 1.0, Elementary Instruction in Morse by Hans W. Priwin. 1.30 to 2.25, Programme of Talks for Agriculturists. 1.30, Practical Advice to the Farmer. 1.45, A Retrospective Glance at the Market Prices and Weather Conditions of the Week. 1.55, Lecture on Farm Topics. 2.30, Programme of Fairy Stories for Children. 3.0, Talk. 3.30, Musical Programme. 6.0, Talk. 6.30, Talk. 7.0 (approx.), Musical or Dramatic Programme, followed by Meteorological Report, Late News and Announcements and Sports Notes. 9.30, Dance Music Programme. 11.30 (approx.), Close Down.

BERN (411 metres); 1.5 kW.—9.30 a.m. to 10.30 a.m., Religious Address. 12.0 Noon, Time Signal and Weather Report and Forecast. 12.5, Musical Programme. 2.0, Richard Flury Festival, relayed from the Saalbau Grosser Saal, **Solothurn**: Artistes—Berthe de Vigier (Soprano), Dino Ghisalberti (Piano) and the Berne Municipal Orchestra, conducted by Richard Flury; The Death of Sappho, for Soprano and Orchestra, First Performance. 6.29, Time Signal and Weather Report and Forecast. 6.30, Reading or Talk. 7.0, Musical Selections. 8.45, Sports Notes, Late News Bulletin and Weather Report and Forecast. 9.0, Concert Programme. 9.40 (approx.), Close Down.

BÉZIERS (158 metres); 0.6 kW.—6.0, Talk on Agriculture, followed by a Concert. 8.30, General News Bulletin and Sports Notes. 8.45, Musical Programme, arranged by the Maison Relin-Minoles at Béziers; Parlé-Art Gramophone Selections. 10.30 (approx.), Close Down.

BRESLAU (322.6 metres); 4 kW.—Programme relayed by **Gleiwitz** (329.7 metres).—8.15 a.m., Relay of Chimes from Christ Church. 1.0, Wireless Guessing Competition. 1.35, Hints for Chess Players by Adolf Kramer. 2.0, Programme of Fairy Tales for Children. 2.30, Talk for Farmers. 2.55, Musical Selections. 3.45, (approx.), Talk. 4.10, Tea-Time Concert. 9.0, Late News Bulletin. 9.30, Dance Music Programme. 11.0 (approx.), Close Down.

BRÜNN (441.2 metres); 3 kW.—3.30, Orchestral Concert. 4.30, Relay from **Prague**. Programme for Workers. 5.0, News and Musical Recital for German Listeners. 5.30, Talk on Sport relayed from **Prague**. 6.0, Concert of Orchestral Music. 9.20, Relay of Dance Music. 10.30 (approx.), Close Down.

BRUSSELS (508.5 metres); 1.5 kW.—5.0, Concert Programme by the Orchestra of the Armenonville Tea Room, Brussels. 6.0, Children's Programme arranged by the Brussels Children's Theatre under the management of M. Léon Leroy. 6.30, Music by the Station Trio. 7.30, Le Journal Parlé de Radio Belgique. 8.15, Concert by the Station Orchestra. 10.15, Late News Bulletin and Press Review. 11.0 (approx.), Close Down.

BUDAPEST (556.6 metres); 20 kW.—8.0 a.m., General News Bulletin and Notes for Women. 9.0 a.m., Relay of Sacred Service with Sermon. 3.15, Wireless Educational Programme of Readings, Talks and Musical Selections. 5.35, Three One-act Comedies of Hungarian Life with Incidental Tzigane Music.

COLOGNE (283 metres); 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres) and **Münster** (250 metres).—6.45 a.m., Course in Self Defence by Dr. Ludwig Bach. 7.25 a.m., Review by Alfred Dormanns of the Week's Programmes in Esperanto. 7.30 a.m., Esperanto Language Lesson by Alfred Dormanns. 8.0 a.m., Church Chimes Relay. 8.5 a.m., Evangelical Festival of Religious Music with Choral and Instrumental Selections and Sermon. 10.0 a.m., Talk by Fritz Worm on the German Language. 11.35 a.m., Agricultural Talk. 12.0 Noon, Orchestral Concert. 1.30, Talk by Arnold Stecher on Wireless Literature. 3.30, Afternoon Concert. 5.0, Talk. 6.45 (approx.), Sports Notes. 8.0, "The Barber of Bagdad," Opéra-comique in Two Acts by Peter Cornelius, followed by Late News and Announcements, Sports Notes and Concert. 11.0 (approx.), Close Down.

CORK, Call 6CK (400 metres); 1.5 kW.—830, Concert of Vocal and Instrumental Music; Organ Recital relayed from St. Fin Barre's Cathedral, Cork. Organist, T. J. Horne, Mus. Bac. A.R.C.O. 11.0, National Anthem and Weather Report and Forecast. 11.15 (approx.), Close Down.

CRACOW (566 metres); 1.5 kW.—9.15 a.m. to 10.45 a.m., Morning Service Relay from a Cathedral. 10.56 a.m., Fanfare relayed from the Church of Notre Dame, followed by Time Signal and Weather Conditions and Forecast. 11.10 a.m., Concert of Orchestral Music relayed from the **Warsaw** Philharmonic Hall. 1.0 and 1.20, Agricultural Talks. 1.40, La Chronique Agricole by Dr. St. Wasniewski. 2.0, Weather Conditions and Forecast. 2.15, Relay of Concert of Orchestral Music by the **Warsaw** Philharmonic Society. 6.56, Time Signal from the Astronomical Observatory. 7.0, Fanfare Relay from the Church of Notre Dame, followed by Sports Notes. 7.30, Evening Concert arranged by the Students of the Drum and Mandoline Circle conducted by M. Kostecki with the assistance of Mlle Molisiasse Dolega-Bursa (Singer) and Mme. Mela Sacewicz (Pianist), Chant sans paroles (Tchaikovsky). 9.0, Late News and Announcements from **Warsaw**. 9.30, Concert relayed from the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN. Call 2RN (319.1 metres) 1.5 kW.—8.30, Programme relayed from **Cork**. Concert of Vocal and Instrumental Music. Violoncello Solos by I. Walters. 11.0, National Anthem and Meteorological Report. 11.15 (approx.), Close Down.

HAMBURG. Call KA (in Morse) (394.7 metres); 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres), and **Kiel** (254.2 metres).—7.25 a.m., Time Signal. 7.30 a.m., Weather Report and Conditions, followed by News and Announcements. 7.50 a.m. (approx.), Talk on Contemporary Economic Questions. 8.0 a.m., Legal Review of the Week. 8.15 a.m., Morning Service. 10.0 a.m., Talk. 11.55 a.m., The International Time Signal from **Nauen**. 12.5 (for **Hamburg** and **Kiel**), Sunday Concert. 12.5 (for **Bremen**), Concert by the Station Orchestra. 12.5 (for **Hanover**), Selections of Gramophone Music. 1.0, Entertainment for Children. 10.50 (for **Hamburg**, **Bremen** and **Kiel**), Weather Conditions and Forecast for the North Sea and Baltic. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—12.10, Concert by the Station Trio. 1.40, Musical Programme. Recital of Pianoforte Selections rendered by Aglaia von Zech. 7.40, Time Signal. 7.42, General News Bulletin, 7.55, Musical Programme. 10.40 (approx.), Close Down.

HUIZEN (340.9 metres); 4 kW.—Transmits from 5.40 on 1,852 metres.—8.5 a.m., Church Service. 9.20 a.m., Divine Relay. 12.10, Programme by the Station Trio. 5.30 (approx.), Relay of Church Service (on 1,852 metres) and Sermon from the Ned. Herv. Church at Oosterend. Preacher: Doctor H. Gisutter. Organist: G. Froentjes. 7.10, Talk. 10.25, Epilogue by the Choir, conducted by Mr. Jos. H. Pickkers. 10.40 (approx.), Close Down.

KALUNDBORG (1,153 metres); 7 kW.—Programme also for **Copenhagen** (337 metres). 9.0 a.m., Divine Service Relay and Address from a **Copenhagen** Church. 10.30 a.m. to 10.40 a.m. (**Kalundborg** only), Weather Conditions and Forecast from the Copenhagen Meteorological Institute. 5.50 (**Kalundborg** only), Weather Conditions and Forecast from the Copenhagen Meteorological Institute. 6.0, Press News and Information. 6.15, Time Signal. 6.30, Talk. 7.0, Chimes Relay from Copenhagen Town Hall. 7.5, Musical Programme. 9.0, Concert of Folk Music from Many Lands, rendered by the Station Orchestra, conducted by Launy Grondahl. Fantasia on Russian Gipsy Songs (N. Artemlev). 10.0 (approx.), Programme of Dance Music by the Palace Hotel Orchestra, conducted by Teddy Petersen. In the interval at 11.0, Relay of Chimes from Copenhagen Town Hall. 11.30 (approx.), Close Down.

KATTOWITZ (422 metres); 10 kW.—9.15 a.m., Relay of Church Service. 10.56 a.m., Time Signal. 11.0 a.m., Weather Report and Forecast. 11.15 a.m., Concert of Popular Music rendered by the Station Quartet. 1.0, Talk. 1.20 and 1.40, Two Talks for Farmers. 2.0, Weather Conditions and Forecast. 2.15, Relay of Symphony Concert by the **Warsaw** Philharmonic Orchestra, conducted by B. Szulc; Concerto for Violin in G Minor (Bruch), rendered by A. Kontorowicz (Violinist) and the Orchestra. 6.0, Miscellaneous Announcements. 6.20, A Humorous Programme by Professor St. Ligon. 6.56, Time Signal. 7.30, Evening Concert relayed from **Warsaw**. 9.0, Weather Conditions and Forecast, Press Bulletin and Sports Results and Notes. 9.30, Dance Music Programme. 10.30 (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—2.30, Programme for Children. 3.0, Selections for Young People. 3.30, Talk on Health by Doctor Jurgelionis. 4.0 Talk by J. Ardickas: Economics and Daily Life. 4.55, Weather Conditions and Forecast and Press News Bulletin. 5.0, News and Announcements in the Polish and Lithuanian Languages.

KÖNIGSBERG (303 metres); 4 kW.—Programme relayed by **Danzig** (272.7 metres).—8.0 a.m. (**Königsberg** only), Sacred Festival with Choral and Instrumental Music, Solo Items and Sermon. 10.0 a.m. (**Königsberg** only), Weather Report and Forecast. 11.55 a.m., The Nauen International Time Signal followed by Weather Conditions and Forecast. 3.15, Concert of Orchestral Music. 7.0, Light Musical Programme. 8.0, "The Toreador"—Operetta by Adolf Adam. German Translation by René Schickele and Franz Rumpel. Produced by Kurt Lessing and conducted by Erich Seidler. 9.15, News Bulletin and Sports News. 9.30, Dance Music Programme 11.0 (approx.), Close Down.

LAHTI (1,522.8 metres); 35 kW.—Programme also for **Helsingfors** (375 metres).—7.0 a.m., Divine Service Relay. 9.50 a.m., Press News and Announcements. 10.5 a.m., Musical Programme. 10.59 a.m., Meteorological Report and Time Signal. 3.0, Programme by the Station Orchestra, Conductor, Erkki Linko. 3.50, Talk. 4.57, Time Signal and Meteorological Report. 6.20, Musical Programme. 7.10, Concert of Popular Music by the Wireless Orchestra, conducted by Erkki Linko. Die Sonnenuntergang (Olson). 7.45, News and Announcements in Finnish. 8.0, News and Announcements in Swedish. 8.30 (approx.), Close Down.

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—6.45 a.m., Self-Defence Lesson, by Dr. Ludwig Bach. 7.20 a.m., Survey in Esperanto of the Programmes of the Week, by Alfred Dormanns. 7.30 a.m. to 7.55 a.m., Esperanto Lesson, by Alfred Dormanns. 8.0 a.m., Church Chimes Relay. 8.5 a.m., Evangelical Recital of Sacred Music with Sermon in the Interval. 10.0 a.m., Lecture on the German Language by Fritz Worm. 12.0 Noon, Concert of Sacred Music, relayed from the Reinoldekirche, **Dortmund**. 1.30, Wireless Literary Talk. 3.30, Afternoon Concert. 6.45 (approx.), Sports Notes. 8.0, Late News and Announcements. 11.0 (approx.), Close Down.

LEIPZIG (365.8 metres); 4 kW.—Programme relayed by **Dresden** (275.2 metres).—7.30 a.m., Organ Music Recital. 8.0 a.m., Morning Musical Programme. 10.0 a.m., Talk. 10.30 a.m., Talk. 11.0 a.m., Musical Selections. 12.0 Noon, Time Signal. 12.2, Agricultural Talk. 12.30, Veterinary Talk. 1.0, Review of the Foreign Press and Foreign Policy. 2.0 (approx.), Gramophone Music. 3.0, Literary or Dramatic Programme. 4.0, Musical Selections. 5.30, Talk. 6.0,

Sunday, JANUARY 13th.

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Programmes from Abroad.—

Talk. **6.30**, Concert. **8.0**, Scenes from "Miss Sara Sampson," by Gotthold Ephraim Lessing, produced by Hans Peter Schmiedel. **9.15** (approx.), Sports Notes and Press Information and News, followed by Dance Music Programme, relayed from **Berlin**. **11.30** (approx.), Close Down.

LYONS (Radio Lyon) (**291 metres**); 1.5 kW.—**7.30**. The Radio Lyon "Journal Parlé," consisting of News Bulletin, Press Review, Theatre Notes and Announcements. **8.0**, Concert of Light Music with the collaboration of Madame Ducharne (Pianist), M. Camand (Violinist) and M. Testanière ('Cellist): Menuet des Mousquetaires (Simon). **10.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**434.8 metres**); 1.5 kW.—Programme relayed by **Salamanca**, EAJ22 (405 metres).—**2.0**, Chimes Relay and Time Signal. **2.5**, Orchestral and Instrumental Concert, with Interlude by Luis Medina. **3.30 to 7.0**, No Transmission. **7.0**, Chimes. **7.5**, Musical Programme. **8.0**, Talk and Reading: "Famous Journeys—Extracts from the most interesting Narratives of Great Travels." **8.30 to 10.0**, No Transmission. **10.0**, Chimes and Time Signal. **10.5**, Musical Programme. **12.0 Midnight**, Relay of Chimes, followed by Programme of Dance Music by the Palermo Orchestra, relayed from the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, MI (**549 metres**); 7 kW.—**9.0 a.m.**, Opening Signal and Lesson in English. **9.30 a.m. to 10.30 a.m.** (approx.), Concert of Sacred Music, Vocal and Instrumental Programme. **11.30 a.m.**, Time Signal. **11.35 a.m.**, Musical Programme by the Station Quartet. **12.1**, Vocal Recital by Scholars of the Elementary Schools: Traditional Italian Songs (Oddone). **3.5**, Musical Selections. **4.15**, Programme from the Fiaschetteria Toscana by the Tzigane Orchestra. **5.0 to 6.55**, No Transmission. **6.55**, Opening Signal. **7.0**, Press Notes. **7.15**, History Talk. **7.25**, Sports Notes. **7.30**, Time Signal. **7.35**, Relay of an Opera; in the interval: Sports Notes, News and Announcements. **10.30** (approx.), Close Down.

MOTALA (**1,380 metres**); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmo** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.6 metres).—**10.0 a.m.**, Relay of a Religious Service from a Church in **Stockholm**. **4.0**, Entertainment for Children. **4.55**, Relay of Chimes from **Stockholm** Town Hall. **5.0**, Relay of Church Service. **6.15**, Relay of Play or Literary Programme. **7.45**, Programme of Choral Selections. **8.15**, News Bulletin and Weather Report and Forecast. **10.0** (approx.), Close Down.

MUNICH (**535.7 metres**); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (277.8 metres) and **Nuremberg** (241.9 metres).—**10.0 a.m.**, Chimes Relay from the Town Hall at Munich. **10.10 a.m.**, Relay of the Bavarian Wireless Weather Chart. **10.26 a.m.**, Time Signal and Meteorological Report. **5.20**, Song Recital by Irma Drummer; Richard Staab at the Piano. **7.0** (approx.), Concert Programme. **9.5**, Concert Relay and News. **10.30** (approx.), Close Down.

NAPLES, Call 1NA (**333.3 metres**); 1.5 kW.—**8.30 a.m.**, Elementary Instruction in French, by Prof. Etienne Verdier. **9.0 a.m.**, Concert of Religious Music. **3.45**, Children's Corner. **4.0**, Variety Concert. **4.30**, Time Signal. **7.30**, News Bulletin. **7.50**, Notes by the Harbour Authorities at Naples. **8.0**, Time Signal. **8.2**, Concert of Operatic Music: Duet from A Masked Ball (Verdi); Teco io sto, gran Dio, rendered by E. Blandi (Soprano) and G. Ferrero (Tenor) with Orchestral Accompaniment. **9.0**, Sports News. **9.50**, Calendar and Review of Forthcoming Programmes. **10.0** (approx.), Close Down.

OSLO (**461.5 metres**); 1.5 kW.—Programme relayed by **Fredrikstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**4.50**, Carillon. **6.15**, Weather Report and Forecast followed by Press News Bulletin. **7.0**, Time Signal. **7.10**, Concert of Orchestral Music. **8.30**, Weather Report and Forecast and Press News and Announcements. **8.45**, Topical Talk. **9.0**, Musical Programme. **9.30**, Programme of Dance Music. **11.30** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**1,485.15 metres**); 5 kW.—**7.56 a.m.**, Time Signal on 32.5 metres. **9.26 a.m.**, Time Signal on 1,485.15 metres. **5.0**, Relay of Pasdeloup Concert. **7.10 to 7.20**, Weather Report and Forecast. **7.5** (approx.), "Le Journal Parlé par T.S.F." with Talks by its Contributors on Health and Medicine, Police Memoirs, Sports News and Racing Results. **7.56**, Time Signal on 32.5 metres. **8.0 to 9.0**, Concert of Orchestral Music with Vocal and Instrumental Solos. **10.26**, Time Signal on 1,485.15 metres. **11.15** (approx.), Close Down.

PARIS (Petit Parisien) (**340.9 metres**); 0.5 kW.—**8.45**, Latest Gramophone Selections. **8.50**, Talk. **8.55**, News Bulletin from the Press. **9.0**, Concert of Orchestral Music with Soloists. **9.25**, News Bulletin. **9.30**, Half an Hour of Symphony Music conducted by Professor Estyle of the Paris Conservatoire: Adagio for Violin and Orchestra (Mozart), rendered by M. Bellanger, Soloist of the Colonne Concerts. **10.0**, Late News Bulletin. **10.15**, Concert of Orchestral Music. **11.0** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (**1,750 metres**); 6 kW.—**8.0 a.m.**, General News Bulletin and Review of the Press. **8.30 a.m.**, Daily Lesson in Physical Culture. **12.0 Noon**, Sermon followed by Sacred Festival of Instrumental and Vocal Music. **12.30**, News Bulletin. **12.45**, Concert by the Albert Locatelli Orchestra with interlude by Bilboquet. **4.30**, Programme of Gramophone Selections arranged by "L'Industrie Musicale." In the interval: News and Announcements. **6.30**, Agricultural Report. **6.45**, Gramophone Music. **7.30**, Press News and Announcements. **7.45**, Radio Paris Circus: "A Model Farm": a Scene of Burlesque rendered by the Entire Troupe, Messieurs Cordial and Macaron. **8.15**, Concert Programme. In the Intervals: News Bulletin and Evening Press Review followed by Announcements. **10.30** (approx.), Close Down.

POSEN (**344.8 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Divine Service. **11.0 a.m.**, Time Signal. **11.15 a.m. and 11.35 a.m.**, Two Agricultural Talks. **2.15**, Concert of Symphony Music relayed from **Warsaw**. **4.30** (approx.), Talk. **6.0**, Programme arranged by the Catholic Polish Youth Association. **6.20**, Talk relayed from **Warsaw**. **7.5**, Programme of Miscellaneous Items. **7.30**, Concert of Baritone Songs by Brahms and Wieniawsky rendered by Herr Sigismund Sablonsky of Berlin. **9.0**, Time Signal. **9.5**, News and Announcements. **9.15**, Lesson in Dancing by Mr. Starski. **9.40**, Programme of Dance Music. **11.0** (approx.), Close Down.

PRAGUE (**348.9 metres**); 5 kW.—**8.0 a.m.**, Concert of Sacred Music. **9.0 a.m.**, Talk. **3.30**, Concert Programme. **4.30**, Programme for Workers. **5.0**, Programme for German Listeners, News and Music. **5.30**, Sports Talk. **6.0**, Orchestral Concert of Popular Selections. **9.0**, Time Signal and Late News and Announcements followed by Dance Music. **10.30** (approx.), Close Down.

RABAT, Call PTT (**414 metres**); 2 kW.—**12.30 to 2.0**, Concert by the Station Orchestra. **4.0 to 5.0**, Programme of Military Music. **8.15**, News and Announcements. **8.20**, General News Bulletin. **8.30**, Programme by the Station Orchestra. In the Interval at **9.30**, Sports Notes and Results by M. Barrier. **10.30**, Dance Music Programme relayed from the "Chaumière de Rabat." **11.0** (approx.), Close Down.

ROME, Call 1RO (**447.8 metres**); 3 kW.—**8.30 a.m.**, Opening Signal, followed by German Language Lesson. **9.0 a.m.**, Festival of Sacred Music. Vocal and Instrumental Items. **9.45 a.m. to 12.0 Noon**, No Transmission. **12.0 Noon**, Opening Signal. **12.5 to 1.0**, Concert by the Station Trio. **1.0 to 4.0**, No Transmission. **4.0**, Opening Signal. **4.5 to 5.30**, Variety Concert. **6.50**, Press Bulletin and Review. **7.10**, Talk for Farmers. **7.15**, Sports News and News and Announcements. **7.29**, Time Signal. **7.31**, Topical Talk. **7.45**, "Miss Puck"—Operetta in Three Acts by Walter Kollo, rendered by the Station Orchestra. In the Interval: Reading of a Short Story. **9.50**, Late News and Announcements. **10.0** (approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (**375 metres**); 2 kW.—**2.0 to 3.0**, Concert of Light Music by the Seville Wireless Orchestra, followed by Gramophone Records. **9.30**, Orchestral Selections. **11.0**, Flamenco Songs and Dance Music Programme. **11.30** (approx.), Close Down.

STAMBOUL (**1,200 metres**); 5 kW.—**3.30**, Musical Selections. **4.30**, Stock Market Quotations and Prices of Cereals. **5.15**, Programme of Turkish Music. **7.30**, Weather Conditions and Forecast and Time Signal. **7.40**, Talk on the History of Music. **8.0**, Concert of Popular Music. **9.0**, Late News Bulletin and Announcements. **9.30** (approx.), Close Down.

STUTTGART (**379.7 metres**); 4 kW.—Programme relayed by **Freiburg** (577 metres). **11.0 a.m.**, Concert of Popular Orchestral Music, followed by Latest Gramophone Records. **1.0**, Programme for Children. **2.0**, Talk or Reading. **2.30**, Concert. **5.0**, Time Signal and Sports Results. **7.0**, Musical or Dramatic Programme, followed by Late News Bulletin and Sports News. **10.30** (approx.), Close Down.

TALLINN (**408 metres**); 2.2 kW.—**8.0 a.m.**, Relay of Divine Service. **12.30**, Programme of Orchestral Music. **4.45**, News Bulletin from the Press. **5.0**, Evening Concert. **5.20**, Talk. **6.0**, Concert of Instrumental and Vocal Music. **9.0** (approx.), Close Down.

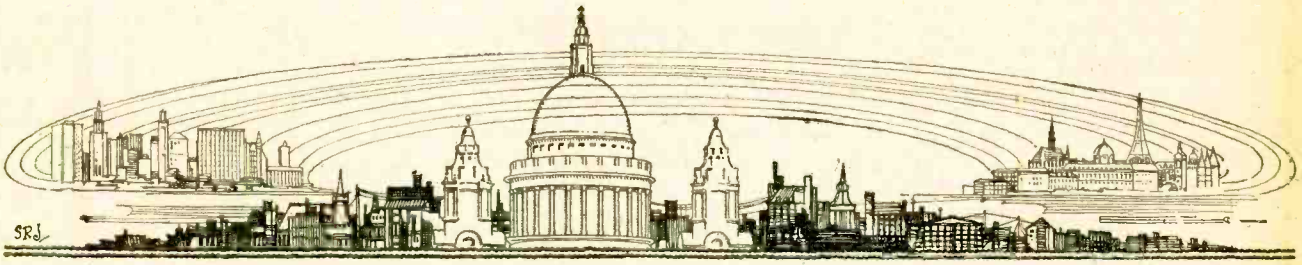
TOULOUSE (Radiophonie du Midi) (**389.6 metres**); 8 kW.—**12.45**, Concert Programme. **1.0**, Time Signal **1.9**, Concert (continued). **1.45**, News and Announcements supplied by Le Télégramme, l'Express and Le Midi Socialiste. **8.0**, Stock Exchange Notes and Cereal Prices from Paris supplied by l'Agence Fournier. **8.15**, News and Announcements supplied by the Parisian Press. **8.30**, Orchestral Concert. **9.0**, Concert arranged by "L'Association des Commercants Radio-Electriciens du Midi." The Warblings of Blackbirds, Canaries, Finches, Nightingales and Warblers. In the Interval at **9.0**, Time Signal. **10.15**, North African News and Late News and Announcements. **10.30** (approx.), Close Down.

VIENNA (**517.2 metres**); 15 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres).—**9.20 a.m.**, Choral Programme rendered by the Vienna Boys' Choir under Professor Hans Müller. **10.0 a.m.**, Concert of Instrumental Music by the Vienna Symphony Orchestra and Soloists. **2.30**, Experimental Picture Transmission. **3.0**, Concert of Orchestral Music. **5.20**, "On Winter and the Ice," Programme of Recitations and Music rendered by Margarethe Witzmann and Franz Horch (Elocutionists) and the Viennese Concert Orchestra conducted by Max Greiger. **6.55**, Time Signal, Weather Conditions and Forecast. **7.5**, Dramatic Programme followed by Dance Music Programme and Experimental Picture Transmission. **10.30** (approx.), Close Down.

VILNA (**435 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Morning Service from a Cathedral. **10.56 a.m. to 4.30**, Relay of Warsaw Programme. **10.56 a.m.**, Time Signal followed by Fanfare from the Church of Notre Dame at **Cracow**. **11.5 a.m.**, Aviation Notes and Weather Forecast and Report. **11.10 a.m.**, Symphony Concert by the Warsaw Philharmonic Orchestra. **1.0 to 2.0**, Three Talks for Farmers. **2.15**, Concert of Symphony Music. **4.30** (approx.), Talk in the Lithuanian Language. **5.0**, Gramophone Selections. **5.20**, Programme for Children. **5.45**, Programme of Zither Music by Professor Witold Jodko. **6.0** (approx.), Humorous Programme. **6.30**, Selections of Zither Music by Professor Witold Jodko. **6.50** (approx.), Time Signal. **7.0 to 10.30**, Programme relayed from **Warsaw**. **7.0**, "Divertissements intellectuels." **7.30**, Popular Concert: Aria from the Opera "Halka" (St. Moniuszko), sung by M. Gruszczynski (Tenor) of the Warsaw Opera. **9.0**, Aviation Notes and Weather Report and Forecast. **9.5**, News Bulletin supplied by the Polish Telegraph Agency. **9.20**, Sports Notes and Police News. **9.30**, Dance Music Programme relayed from the "Oaza" Restaurant, **Warsaw**. **10.30** (approx.), Close Down.

WARSAW (**1,111 metres**); 10 kW.—**9.15 a.m. to 10.45 a.m.**, Church Service relayed from a Cathedral. **10.56 a.m.**, Time Signal. **11.0 a.m.**, Relay of Fanfare from the Church of Notre Dame, **Cracow**. **11.5 a.m.**, Report on Aviation Routes and Weather Conditions and Forecast. **11.10 a.m.**, Concert of Symphony Music arranged by the Committee for Education and Culture of the Magistracy of **Warsaw**. **1.0 to 2.0**, Three Agricultural Talks. **2.0**, Weather Report and Forecast. **2.15**, Relay of Concert of Symphony Music by the Warsaw Philharmonic Society. **4.30**, Talk. **4.55**, Talk. **5.20** (approx.), Popular Concert. **6.0**, Miscellaneous Items. **6.20**, Talk. **6.45**, News Bulletin. **6.55**, Time Signal. **7.0**, Talk by C. Jablonowsky, entitled "Divertissements intellectuels." **7.30**, Popular Programme by the Polskie Radio Orchestra, conducted by J. Oziminski, Mme. M. Zalewska at the piano: Waltz from the Opera "Eugen Onegin" (Tchaikovsky). **9.0**, Aviation News and Weather Report and Forecast. **9.5**, News and Information supplied by the Polish Telegraph Agency. **9.20**, Police News and Sports Results. **9.30**, Dance Music Programme relayed from the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZÜRICH (**583 metres**); 1 kW.—**10.0 a.m.**, Concert Programme. **3.0**, Concert relayed from the Carlton Elite Hotel by the Castellano Orchestra. **6.30**, Time Signal. **6.33**, Protestant Sermon. **7.30**, Evening Entertainment—Artistes: Mia Martini-Sandrock (Viennese Songs). Herman Ernst (Swiss Songs), and the Station Orchestra. Otto Strauss at the Pianoforte. **9.0**, Late News Bulletin and Press Report from the Neue Züricher Zeitung. **9.30** (approx.), Close Down.



CURRENT TOPICS

Events of the Week in Brief Review.

FREE LICENCES FOR INVALIDS?

It is understood that a private Bill will shortly be introduced in Parliament to provide free wireless licences for the sick and aged.

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RAILWAY TIME BY WIRELESS.

A wireless-controlled clock has been installed in a New York railway station. Synchronising signals are received at intervals from the transmitting station at Arlington. The clock controls others in different parts of the station.

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NEW TOWER OF BABEL?

A radio tower, 1,312 feet high, will, it is stated, be erected at Barcelona for the forthcoming radio exhibition in that city. According to present plans, the tower will have a circumference of 600 feet and will contain an hotel, a theatre, a museum, and a library, as well as a broadcasting station and commercial transmitter.

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SETS FOR BEDRIDDEN POOR.

The provision of wireless receivers for the invalid poor of Manchester and Salford is the object of a society which has just been formed under the auspices of the local branch of Toc H. The society already has £250 in hand, and is aiming at a total of £1,000. The hon. treasurer is Mr. D. W. Marsden, Union Bank, St. Mary's Gate, Manchester. Besides monetary donations, the society is glad to receive wireless sets, which should be addressed to the hon. secretary, Toc H, Mark XIV, 1, Eccles Old Road, Pendleton.

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AERIALS AND ELECTRIC CABLES.

The second fatality within a fortnight caused by a wireless aerial coming into contact with an overhead electric cable was the subject of an inquest conducted by the Nottingham district coroner on January 1st. While the deceased, Thomas S. B. Martin, of Langwith, was erecting a pole for an aerial on December 29th he took hold of the wire with the intention of fastening it to a stake in the ground. Apparently the wire touched an overhead electric cable carrying 6,000 volts. Martin received a severe shock and burns. He died later in Mansfield Hospital.

It was stated on behalf of the company owning the cable that on each pole bearing the overhead cable was attached a danger warning.

Several members of the jury said that they thought the cables should be safeguarded, but the coroner, pointing out that warnings were displayed, said it was foolish to put up a wireless pole so close to a live cable.

The jury returned a verdict that death was due to electric shock and attached no blame to anyone.

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LECTURE ON PICTURE TRANSMISSION.

"Picture Transmission" is the title of a lecture and demonstration to be given at 7 o'clock this evening (Wednesday) by Mr. Priechenfried at a meeting of the Institute of Wireless Technology at the Engineers' Club, Coventry Street, London, W.

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A FIVE-DAY WIRELESS COURSE.

An amendment to Fleet Orders provides that when any ship carrying an aircraft, the crew of which does not include a telegraphist air gunner, is about to commission, arrangements are to be made for a naval telegraphist to undergo a five-day course in aircraft radio telephony at the Royal Air Force Base, Gosport.

NEW STATIC STOPPER.

The latest inventor of an "atmospheric eliminator" is a convict in the Nebraska State Prison. Our tame cynic remarks that each of his predecessors ought to be.

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AN INVENTORS' YEAR.

The year 1928 has scored a record in the number of patent applications filed, according to a report issued by Messrs. Gee and Co., the patent agents. The number filed reached the total of 38,593, an increase of 3,214 over the year 1927. The previous record was made in 1920, when 36,672 patent applications were filed.

A large number of inventions during 1928 related to television, talking films, and gramophone pick-ups.

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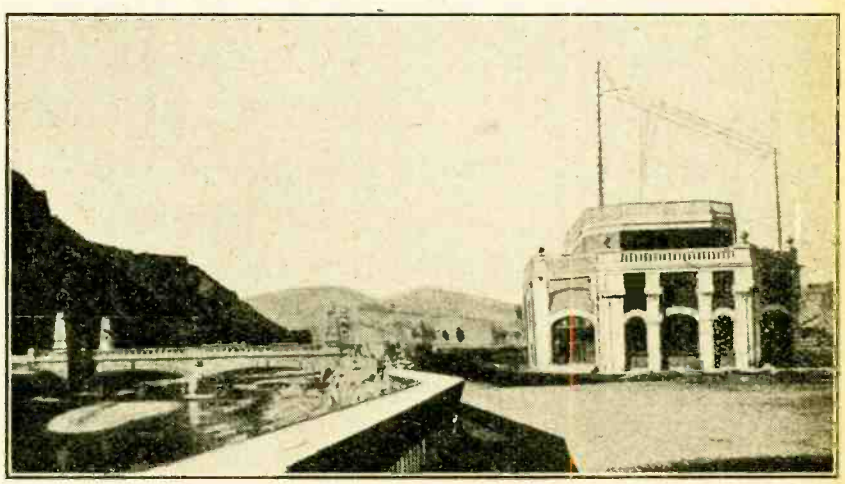
WIRELESS TO THE RESCUE.

Broadcast listeners in the Fleetwood district will be profoundly thankful when repairs are completed to the Manx submarine cable. An interruption to the service has led the Post Office to install an obsolete spark transmitter at Hutment Barracks, Fleetwood, and this is used to preserve communication between Isle of Man and the mainland. Considerable interference is being caused to broadcast



HOSTILITIES IN AFGHANISTAN. The wireless station at Kabul which, owing to the severing of cables, is the only link between the Afghan capital and the outside world.

reception in the neighbourhood, and it is stated that not one of the B.B.C. stations can be received without spark "mush." Continental listening is badly upset.

The temporary station is, however, maintaining an excellent telegram service, and we understand that the normal telegraph traffic is being handled. The Post Office is also employing the wireless station at the Royal Engineers' barracks at Edge Hill, Liverpool.

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RECEPTION ON THE ISLAND.

Emergency receiving apparatus was sent to the Isle of Man on December 29th. The equipment, which is of the Territorial portable type, is installed in the Douglas recreation ground and works in conjunction with the temporary transmitter at Edgehill. A receiver for the Fleetwood signals is installed at the Villa Marina, Douglas.

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FRENCH RADIO BILL RESENTED.

French broadcast listeners are showing hostility to the new radio Bill which, if it receives the sanction of the Chamber next month, will introduce taxation on all wireless sets.

It is proposed to tax sets according to the number of valves. The crystal user is not forgotten; according to the schedule he must pay 10 francs (about 1s. 8d) per annum. The scale for valve receivers progresses from 20 francs for a single-valve set up to 80 francs as maximum for multi-valve sets.

Objections are raised regarding the uses to which the money is likely to be put. It is contended that, after allowing for expenses of collection and the distribution of an agreed sum to the smaller regional stations, there will be a surplus of 20 million francs. It is feared that this sum will be employed to build up a State-monopolised network of stations on the B.B.C. pattern. The average Frenchman seems to resent the notion.

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A CHRISTMAS "EKCO."

Over three hundred guests were present at the annual dinner of "EKCO" (E. K. Cole, Ltd.), the mains unit manufacturers, held at the Palace Hotel, Southend-on-Sea, on December 22nd.

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FIRE AT AUSTRALIAN BEAM STATION.

A fire at the Ballan beam station, 50 miles from Melbourne, indirectly affected thousands of broadcast listeners in Britain on New Year's Eve. The B.B.C. had announced that greetings broadcast by 2ME, the Amalgamated Wireless (Australasia) short-wave station at Pennent Hills, would be relayed if circumstances permitted. Owing to the fire at Ballan, however, the traffic of that station has been diverted through 2ME, operated from Melbourne by a 500-mile land-line, and the latter station is at present too busy with commercial messages to handle broadcasting.

The fire at Ballan destroyed the roof of the engine room, but was mastered before any damage was done to the new and costly beam equipment.

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"BUS AND COACH."

A sister-journal of *The Wireless World* makes its debut this month under the title *Bus and Coach*. The new journal, which is the first in this country to be devoted entirely to the growing industry of passenger vehicle operation on roads, is a monthly publication, excellently printed and illustrated, including among its contributors a number of well-known personalities in the sphere of travel. In the January number Lieut.-Colonel J. T. C. Moore-Brabazon, M.P., discusses the speed limit on roads.

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BOOK RECEIVED.

"The All-Europe 'Three,'" by C. M. R. Balbi.—A brochure containing intructions and wiring diagram for building a simple three-valve set. (London: Sir Isaac Pitman and Sons, Ltd. Pp. 24. Price 6d.)

NEWS FROM THE CLUBS.

The New Year Session.

A reliable indication that the wireless societies may expect to enjoy a flourishing session during the remaining winter months is to be found in the generally attractive tone of their programmes. It often happens that a club's joyous re-birth in October is followed later in the session by an insidious form of creeping paralysis which reveals itself by a gradual diminution in attendance and a look of distress on the face of the treasurer. More often than not the malady is almost entirely attributable to a lack of foresight in framing the syllabus, the "plums" being placed too early in the programme.

This year secretaries have wisely reserved some of the most attractive fixtures to the closing months of the session, and it may be confidentially hoped that the interest of members will be sustained at a high pitch.

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Stepney Radio Society.

The Stepney and District Radio Society holds meetings twice a week—on Mondays from 7.30 to 9.30 p.m., and on Wednesdays from 8 to 10 p.m. The headquarters are at Ocean Street L.C.C. School. Full particulars can be obtained from the Hon. Secretary, Mr. H. Schneider, at the School.

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In Edinburgh.

This evening (Wednesday), at 7 o'clock, members of the Edinburgh and District Radio Society will be conducted over the Telegraph Room of the Edinburgh G.P.O., while on Friday Mr. Youle, of the Marconiphone Company, will give a lantern lecture before the Society on "Public Speech and Music Amplifiers."

Hon. Secretary, Mr. E. I. Robertson, 10, Richmond Terrace.

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London, N.W.

The Kentish Town and District Radio Society opens a new session on January 18th with a programme designed to appeal to advanced workers as well as beginners. The meetings are held every Friday at 8 p.m. at the Carlton Road Schools, under the direction of Mr. A. F. Hembury (6AY).

Hon. Secretary, Mr. A. H. Sartain (2ACN), 40, Harrington Street, Regent's Park, N.W.

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Demonstrations by Manufacturers.

The Holloway Radio Society opened the new session on Monday last, January 7th. The programme for the coming months comprises demonstrations by the leading manufacturers. Full particulars of membership, etc., can be obtained from the Hon. Secretary, Mr. H. Panter, Holloway School, Hilldrop Road, Camden Road, N.7.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 9th.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Lecture-Demonstration: "The Ether Spectrum," by Mr. R. F. G. Holness.

Edinburgh and District Radio Society.—At 7 p.m. Visit to the Telegraph Room of the Edinburgh G.P.O.

THURSDAY, JANUARY 10th.

Slade Radio (Birmingham).—At 8.15 p.m. At the Parochial Hall, Broomfield Road, Erdington. Lecture: "Eliminators," by a representative of Messrs. H. Clarke and Co.

FRIDAY, JANUARY 11th.

South Manchester Radio Society.—At the Co-operative Hall, Wilmslow Road, Didsbury. A Debate as to the Best Set for Distance and Purity, with Demonstration.

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Lecture: "Public Speech and Music Amplifiers," by Mr. F. Youle, of The Marconiphone Company, Ltd.

MONDAY, JANUARY 14th.

Newcastle-upon-Tyne Radio Society.—At 7.30 p.m. At 11, Saville Row. Lecture: "The History of Radio Batteries," by Mr. G. C. Patterson.

Holloway Radio Society.—At 7.30 p.m. At the Holloway Evening Institute, Holloway School, Hilldrop Road, N.7. Demonstration by representative of Messrs. S. G. Brown, Ltd.

TUESDAY, JANUARY 15th.

The Bee Radio Society.—At 7.30 p.m. At the Streatham and Tooting Literary Evening Institute. Demonstration by The London Electric Wire Co., and Smiths, Ltd.

The Lighter Side of Territorial Signals.

Those who have ever thought of joining the Territorial Army and have not done so, and those who have never thought at all, are probably not aware what a good club a Territorial unit is, especially when, as in 47th Divisional Signals, there is added to it the great technical interest of wireless.

The unit is as much a club as military unit. There are club rooms, sports and entertainment committees, rifle shooting, boxing and other competitions.

The headquarters is about to be rebuilt, and by May or June there will be a really first-class "club house," although one must not call it so officially.

First in the interest of the readers of *The Wireless World* will, no doubt, be the wireless workshop, in which repairs to the unit's own wireless stations are carried out and where instruction is given in wireless technique, and where experimental work is to be conducted on the lines on which all keen amateurs are working. This costs the amateur a good deal of money when carried out in his own home, but in the 47th Divisional Signals it would cost him nothing beyond some of his spare time.

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The Social and Sporting Sides.

The club rooms will consist of a general room, a refreshment room, billiard room, etc. There is already a magnificent hall in which fortnightly dances, boxing competitions, etc., are held, in addition to putting it to its legitimate use. If any reader of *The Wireless World* would like to attend one of the dances, he has only to apply to the Dance Committee, 47th Divisional Signals, T.A., Fulham House, Fulham High Street, S.W.6.

On the sporting side, there is competition with other units in the Division in cross-country running, boxing and athletic sports. The hall is fitted up for boxing, and a short distance away is the magnificent athletic ground at the Duke of York's Headquarters, which is at the unit's disposal when required.

After passing through a course in the riding school, those who are keen on riding organise Sunday morning rides in Richmond Park, for which the horses are supplied in the spring and summer.

If any reader would like to join such a live and cheerful "club," he should call at Fulham House (50 yards from Putney Bridge Station on the Underground), and there he will be told all about it.

USEFUL DATA CHARTS. (No. 19. Stage 3.)

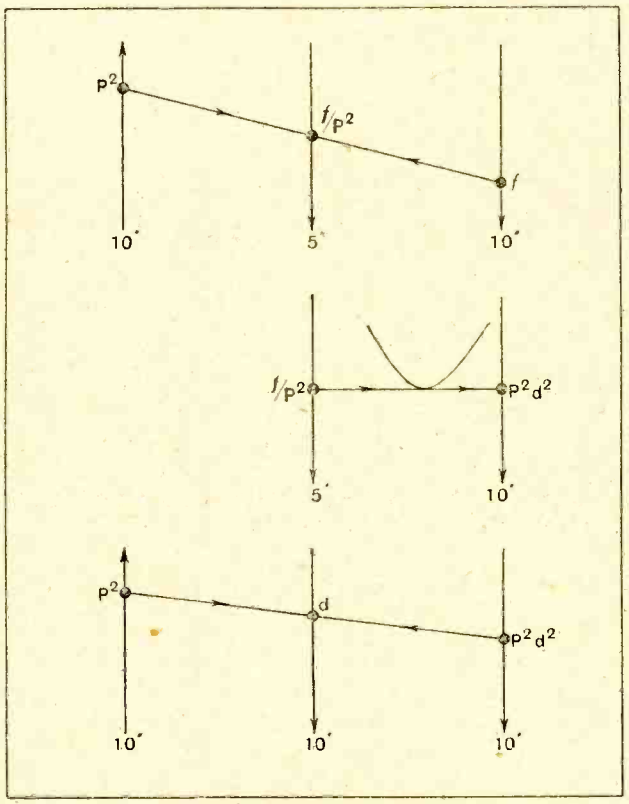
Diameter of Wire or Strand to give Coil of Minimum H.F. Resistance.

HAVING obtained P^2 from Stages 1 and 2, we now embark on the last chapter of the search for d, the best gauge of wire or strand for our coil. As already mentioned, Butterworth has found the curve relating f/P^2 to Pd, and this curve forms the basis of Stage 3.

The centre figure shows the abac taken to pieces to show the method of construction. First we scale off P^2 and f on 10″ scales, whereupon f/P^2 will be given by the middle 5″ scale. Then we draw the curve connecting f/P^2 and P^2d^2. Lastly, since P^2 and P^2d^2 are on 10″ scales, the middle line will give d on a 10″ scale.

Once the constructional work is finished the scales of f/P^2 and P^2d^2 can be eliminated and they do not appear on the actual abac.

Owing to the great range of P^2, it is necessary to split Stage 3 into two abacs, which are here given consecutively. The first deals with the range $P^2=0.004$ to $P^2=4$, the second with the range 4–4000.



Successive processes in the construction of the abac.

Examples

For a single-layer solid wire coil, L=200 microhenrys, $l=2''$, D=4″. We have previously found that $P^2=0.044$. Find the best value for d when $f=10^6$ cycles/sec. On working through Stage 3 we find that $d=0.034''$, the nearest gauge to which is 20 or 21 S.W.G.

If, however, we wish to use a 9-strand wire, P^2 becomes 6.86 from Stage 2, and we find $d=0.0059''$: hence we require 9/38 Litz wire.

Again, for a multi-layer solid wire coil with L=20,000 microhenrys, $D=l=t=10''$, we find $P^2=0.015$. Hence at a frequency of 50,000 cycles/sec. the best wire diameter is 0.0336″ (20 or 21 S.W.G.). Now try a short-wave coil. $l=1\frac{1}{2}''$, D=3″, N=12. The inductance will be 11.4 mics (abac 17), and the coil will be suitable for 60 metres. Assuming solid wire, we find from Stage 1 that $P^2=0.00595$, and since $f=5$ megacycles, Stage 3 shows that $d=0.085''$ (13 or 14 S.W.G.).

If 27 strand Litz is used in this coil, we find $P^2=14.7$ (from Stage 2), and $d=0.00318''$ (from Stage 3): hence we require 27/44 Litz.

The Values of *d* are Approximate.

The high-frequency losses in a coil are partly due to the skin effect and partly to the magnetic field caused by neighbouring turns. In the theory it is assumed that the optimum wire diameter is that which makes these two losses equal and this assumption, while giving correct results for solid wire coils at high frequencies, gives a somewhat too large diameter for coils of large inductance working at low frequencies and may be wrong by a gauge or two for stranded wire coils.

Hence it is desirable when accurate results are required to take the value of d found from abac 19 as an approximation, and to calculate the resistance for gauges on either side from the complete formula.

This calculation is tedious, and it will be our task in the next abac to give a simple graphical method for performing it.

Comparative Results.

Readers who wish to test the values of d given by the abac will find a wealth of material in a series of papers[1] giving the best wire gauges for coils of various diameters suitable for the medium, long and short wave bands. The coil dimensions are given in inches so that no conversion from the metric system is required.—R. T B.

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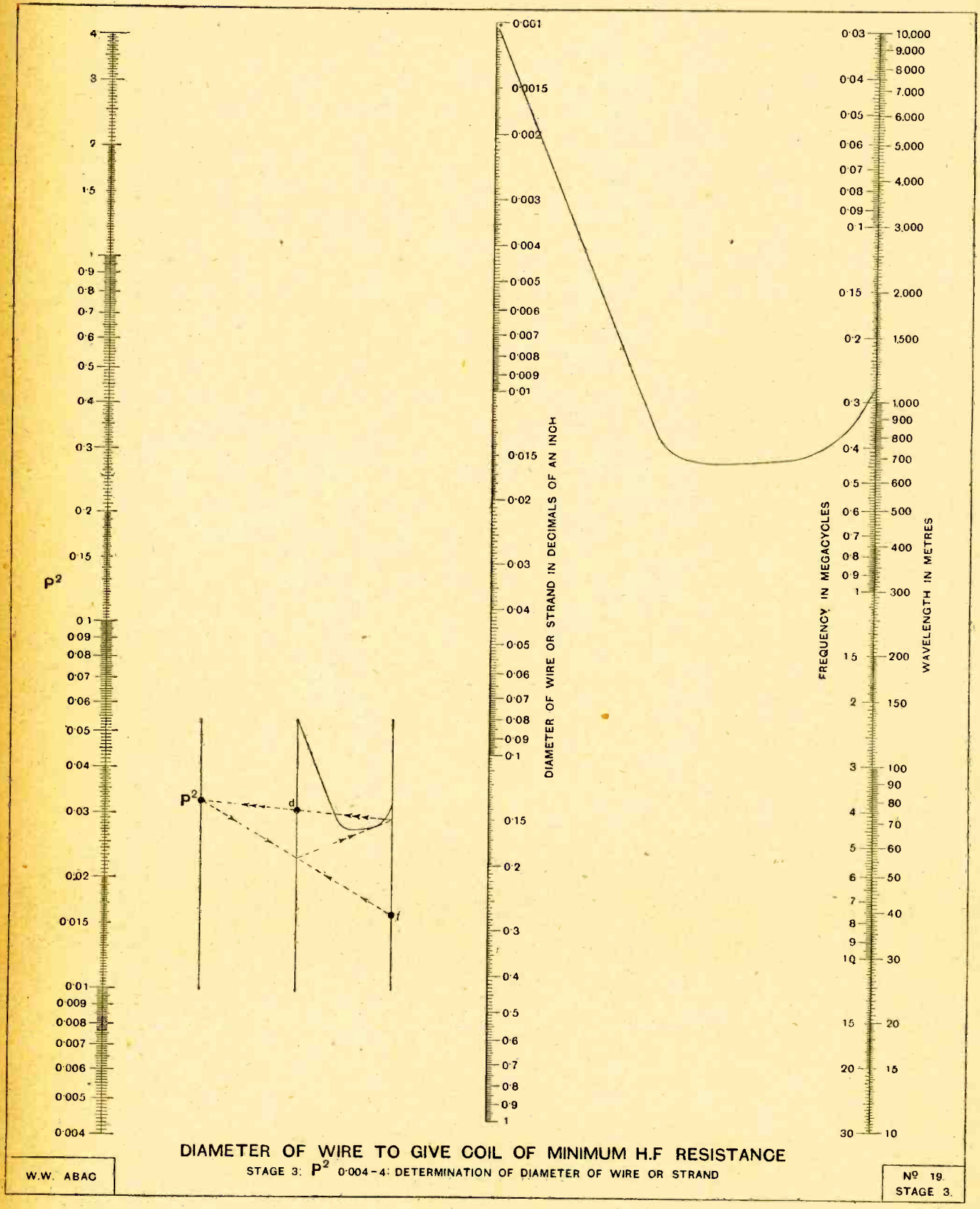
An Invitation to Readers.

Dr. R. T. Beatty, who is contributing this series of Useful Data Charts, has suggested that some of our readers may like to propose subjects to be dealt with on the same basis as the charts which have already appeared. There are probably a number of useful calculations which could conveniently be put into the form of abacs, and any reader who may have suggestions to make is invited to forward them.—Ed.

[1] *The Wireless World*, Vol. 22, 1928, pp. 48, 394, 466

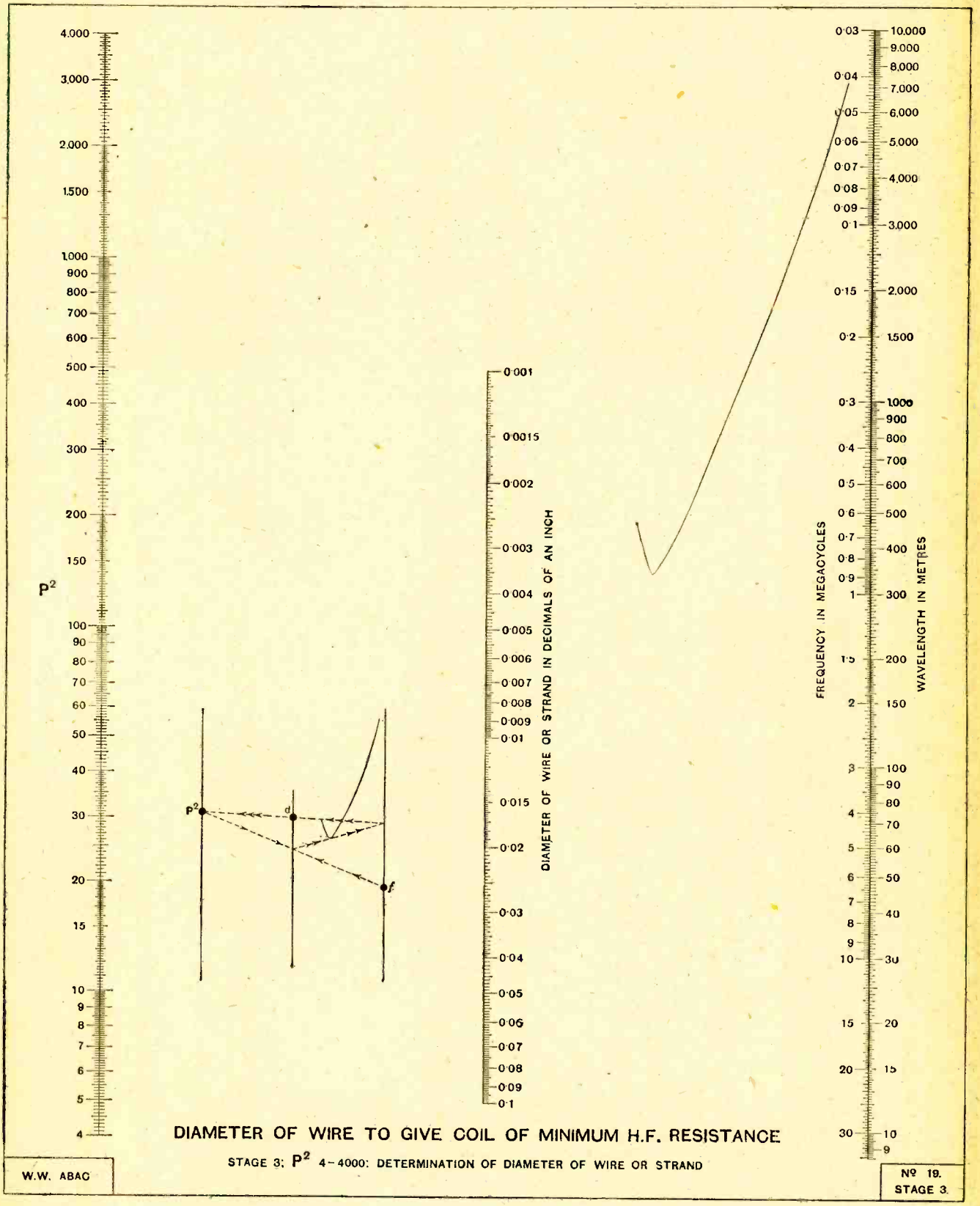


DIAMETER OF WIRE TO GIVE COIL OF MINIMUM H.F RESISTANCE

STAGE 3: P^2 0·004 – 4: DETERMINATION OF DIAMETER OF WIRE OR STRAND

W.W. ABAC

Nº 19. STAGE 3.

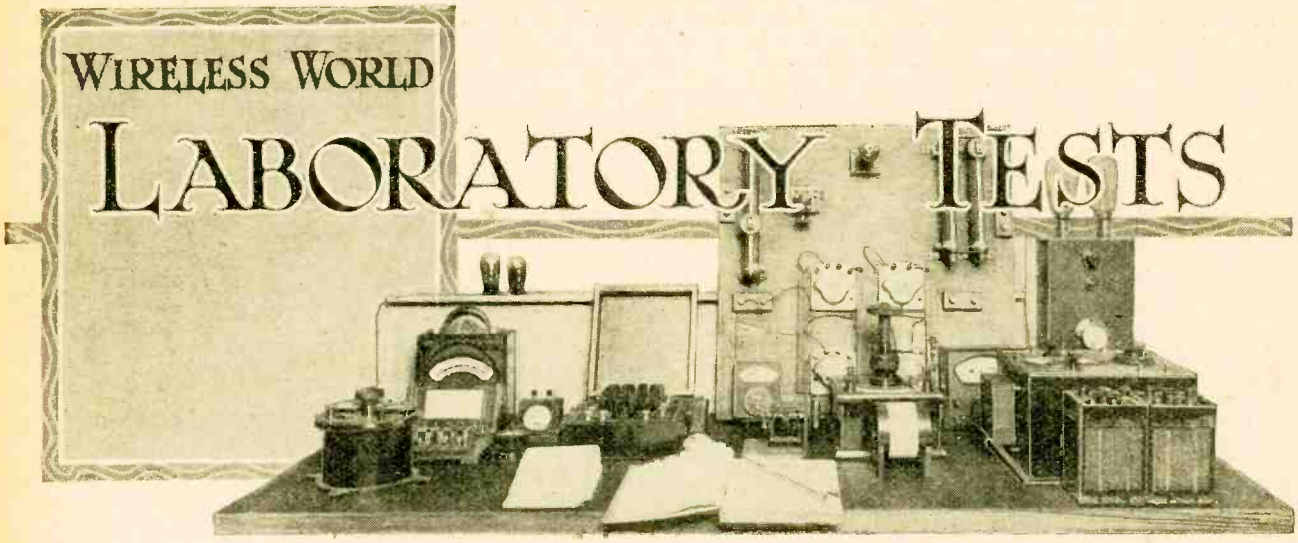


DIAMETER OF WIRE TO GIVE COIL OF MINIMUM H.F. RESISTANCE

STAGE 3: P^2 4–4000: DETERMINATION OF DIAMETER OF WIRE OR STRAND

W.W. ABAC

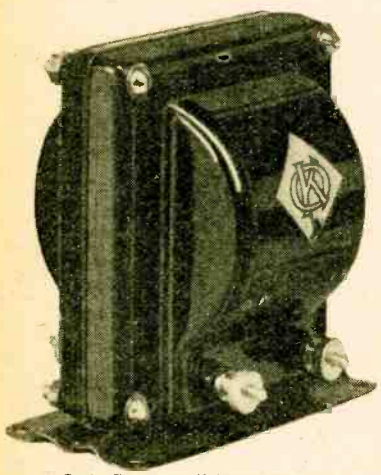
Nº 19. STAGE 3.



A Review of Manufacturers' Recent Products.

"O.K. SUPREME" TRANSFORMERS.

These transformers have been put into production recently by F. Toubkin, 33, Long Millgate, Manchester, and are made in three ratios, 3 : 1, 4 : 1, and 5 : 1. One model only was available for review, this being the 5 : 1 ratio, and the measured primary inductance was found to be 45.4 henrys without D.C. flowing.



"O.K. Supreme" Transformer.

The inductance is high considering the step-up ratio, and the transformer would appear to be suitable for use with valves having an A.C. resistance of between 20,000 and 30,000 ohms. All models are enclosed in a metal case, and the price is 12s. 6d. each.

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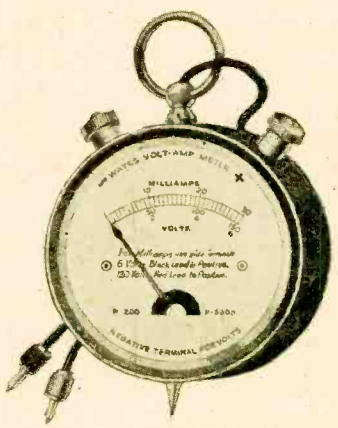
WATES UNIVERSAL TEST METER.

No doubt the majority of readers are familiar with this useful instrument, as we described it on the occasion of our review of apparatus exhibited at Olympia during September last. It was again illustrated on page 618 in our issue of October 31st last in our review of the Manchester Show exhibits, but, owing to an unfortunate error, it was in this case referred to as a two-range instrument. The meter is provided with three scales, one range covering 0-30 milliamps., and two voltage scales, 0-6 and 0-150 respectively.

We have recently had an opportunity of testing a sample instrument against laboratory standards. On the milliamp. scale there was an error of 6 per cent. at 5 milliamps., and this decreased progressively over the scale until at 30 milliamps. the error was 1.6 per cent. only. Measurements on the 6-volt scale showed an error of 15 per cent. at 1 volt, 8 per cent. at 4 volts, and 6 per cent. at 6 volts. At 25 volts the standard laboratory meter read 20 volts, or 20 per cent. lower than the Wates meter, while at 150 volts the error had decreased to 5 per cent. In all cases the model under test showed a tendency to read high.

The D.C. resistance on the 150-volt range was found to be 5,000 ohms., and this agrees with the makers' figures, while on the 6-volt scale our measurements indicated a resistance of 202 ohms. This is within 1 per cent. of the makers' figures. On the 30-milliamp. scale an unusually high resistance of 200 ohms. was indicated; however, as the meter will probably only be used for measuring anode current, a high internal resistance can be tolerated. On both voltage scales the resistance per volt is 33.3 ohms., and while this is quite satisfactory when accumulators are in use we consider that care should be exercised when measuring the voltages of dry batteries, especially the small-capacity type, as the instrument will draw 30 milliamps from the battery It should be used, therefore, for checking the voltage only, and not left connected across the cells for an appreciable time.

The instrument comes within the category of the moving iron type, is dead beat and polarised. The armature is swung between the poles of a small permanent magnet, and the needle is held in the zero position by the effect of the magnetism. Therefore, there are no springs to go out of adjustment, and as the magnet should not deteriorate with normal handling it is possible that any slight error each instrument may have will remain constant for a long period.



Wates universal test meter. A 3-range instrument.

Now with regard to the function of the various leads : the small stud contact on the lower side of the case is the negative contact for both voltage scales. The red flexible lead is the positive connection for measuring voltages between 0 and 150, and the black lead the positive for the 6-volt range. For measuring milliamps, the two small terminals on the side should be employed, the left-hand one being the negative, and the right-hand the positive.

The scales are marked with red and

black figures on a silver-faced dial, the red figures being the high-voltage divisions, and the case is finished in crystalline black. The instrument is very compact, being 2in. in diameter and 1in. in depth. The makers are The Standard Wet Battery Co., 184, 188, Shaftesbury Avenue, London, W.C.1, and the price is 8s. 6d.

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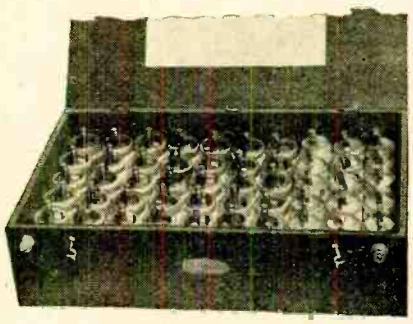
RIPAULT WET H.T. BATTERY.

The battery under review consists of 60 cells and has a nominal voltage of 90. It is contained in a black wood case measuring 19¼in. × 11⅜in. × 5in., complete with insulated terminals. The glass containers of the cells measure 2⅜in. × 1½in. diameter and are enclosed in cardboard cylinders to give a tight fit in the case. To prevent creeping of the electrolyte its top is coated with paraffin wax. The sacs are fitted with



Ripault wet Leclanché H.T. battery, nominal voltage 90.

terminals to facilitate wiring when renewing the elements, and the inter-cell connecting wires are protected by glazed sleeving.

Full instructions for preparing the electrolyte are printed on the inside of the lid, and the solution should consist of a mixture of 80 per cent. of No. 1 quality sal ammoniac and 20 per cent. of zinc chloride free from iron or lead. For normal use 4oz. of the above mixture should be dissolved in each pint of water, but for abnormally high discharge currents a saturated solution should be used.

It may be inferred from the discharge curve that 10 or 12 mA. would be an economical current to draw from the battery. In the actual test the initial current was 15.3 mA., and under this load the initial terminal voltage per cell was 1.52. After the first rapid drop to 14 mA. the current was well maintained for the first 170 hours, after which it fell steadily until exhausted. The voltage per cell fell to 0.75 at 340 hours, and at this point the addition of more cells, or the replenishment of the battery, would be necessary to maintain good quality of reproduction in the receiver.

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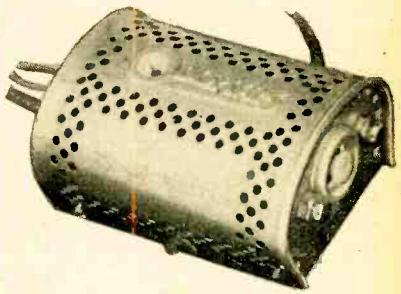
OLDHAM H.T. BATTERY CHARGER, TYPE D.C.H T.1.

This unit has been designed primarily for replenishing high-tension accumulator batteries, and the charging rate is approximately in the order of the drain imposed on the cells during use. The model reviewed conforms with the safety recommendations of the I.E.E. in that it is housed in a well-ventilated metal case provided with a terminal for attaching an earth lead. When charging from a D.C. supply it is essential that the battery be connected so that like poles from mains and battery are joined together, and it is generally necessary to ascertain first the polarity of the sockets in the wall plug or lamp holder. The designers, foreseeing this difficulty, have fitted a pole indicator which enables the user to ascertain in a few moments the correct position for the adaptor. This takes the form of a small compass provided with a card on which is marked a sector in red. If the adaptor is inserted correctly, the compass needle moves towards this sector, but away from it if inserted the wrong way round. The advantages of this will be obvious, as it obviates the necessity of marking the lamp holder, and, moreover, enables the unit to be attached to any convenient point without first testing for polarity.

A thick rubber-covered twin-wire cable terminating in an adaptor connects the unit to the electric supply, and two



Oldham H.T. trickle charger for D.C. mains.

separate leads, each fitted with a wander plug, are provided for the battery. On one end of the charger is mounted a small flash-lamp bulb which glows when current is passing to the battery. As this is a special type which requires only a very small current to produce a glow, it also acts as a fuse, thereby safeguarding both the unit and the battery against damage should an excessive current pass due to a short circuit.

A few measurements were made with batteries of different voltages connected to the unit, the supply being 220 volts D.C. These are tabulated below.

Battery Voltage.	Charging Current.
144 volts.	27 milliamps.
120 ,,	35 ,,
72 ,,	49 ,,
48 ,,	58 ,,

If the battery is of relatively low voltage, it will be seen that the charging current may be greatly in excess of the drain when operating the receiver; therefore the duration of charge should be arranged just to replenish the cells. Full instructions regarding the length of time batteries should be charged are given on an instructional leaflet which accompanies each unit. The price of this useful accessory is 40s., and the makers are Messrs. Oldham and Sons, Ltd., Denton, Manchester.

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TRADE NOTES.

Messrs. J. B. Woodroffe, manufacturers of the gramophone pick-up of this name, have moved to new premises at 59, Norbiton Avenue, Kingston-on-Thames. The telephone number is Kingston 4905.

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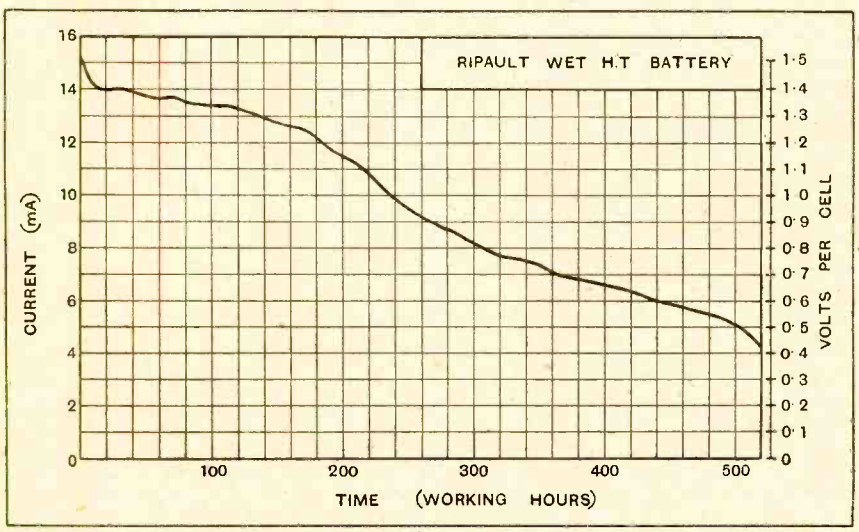
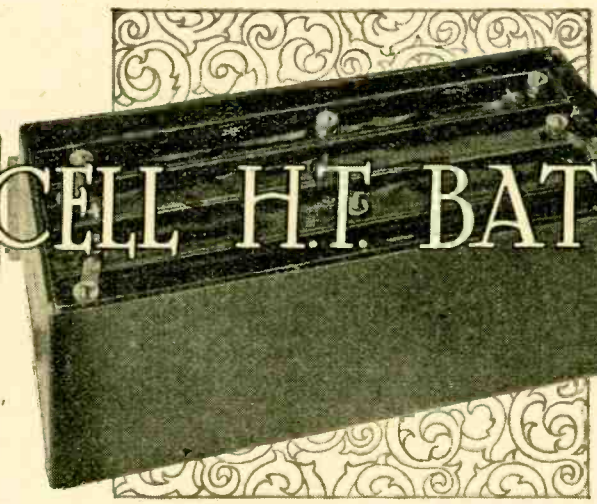
Messrs. Greenhill and Sons, Ltd., Pontifex House, Shoe Lane, London, E.C.4, will in future be trading as the Acetate Products Corporation, Ltd., at the same address. The telephone number is unchanged (Central 1306-1307).



Discharge curve of the Ripault wet H.T. battery.



DRY CELL H.T. BATTERIES

By
R. W. W. SANDERSON,
M.Sc.

(*Concluded from page 817 of December 19th issue.*

Choosing the Correct Capacity for a Receiver.

IN the first instalment of this article consideration was given to the general characteristics of the Leclanché cell, it now remains to examine how the greatest efficiency can be obtained when using this type of battery to supply the H.T. requirements of a receiver. In Fig. 3 the anode currents corresponding to the voltage in Fig. 2 are shown.

It is obviously difficult to estimate the life which will be given by a battery which is discharged under such peculiar conditions, that is with a very rapidly diminishing load. A discharge on constant resistance is quite inaccurate, as in that case a diminution of 20 per cent. in volts means a 20 per cent. drop in current, whereas in this case it means a 50 per cent. drop or more.

The Effect of Falling Anode Voltage.

For purposes of test it has been found that a very fair estimate of life may be based upon the average current throughout life, although this is considerably less than the initial current. An estimate of this average current can only be deduced by someone having expert knowledge of the characteristics of the set in question and the type of battery used. Very approximately the average current of any set is between 0.5 and 0.6 of the initial current.

	Anode Voltage.		
	140.	120.	100.
Two-valve	10.6 mA.	7.3 mA.	4.4 mA.
Three-valve, screened grid	10.0 ,,	7.0 ,,	4.4 ,,
Three-valve, ordinary	15.4 ,,	9.8 ,,	5.3 ,,
Three-valve, two power valves	20.0 ,,	13.7 ,,	8.0 ,,
Four-valve, screened grid	30.0 ,,	26.0 ,,	15.0 ,,
Four-valve, stab lised	36.0 ,,	22.7 ,,	10.0 ,,
Five-valve, portable	—	16.4 ,,	10.5 ,,
Six-valve, stabilised	56.0 ,,	39.0 ,,	22.0 ,,

A battery such as B in Fig. 1, which falls in voltage in the early part of its life, may reduce the current so much more rapidly than battery A that it may last considerably longer on the set. The distortion and lack of power in the set, starting at an early stage, will easily outweigh this fictitious advantage.

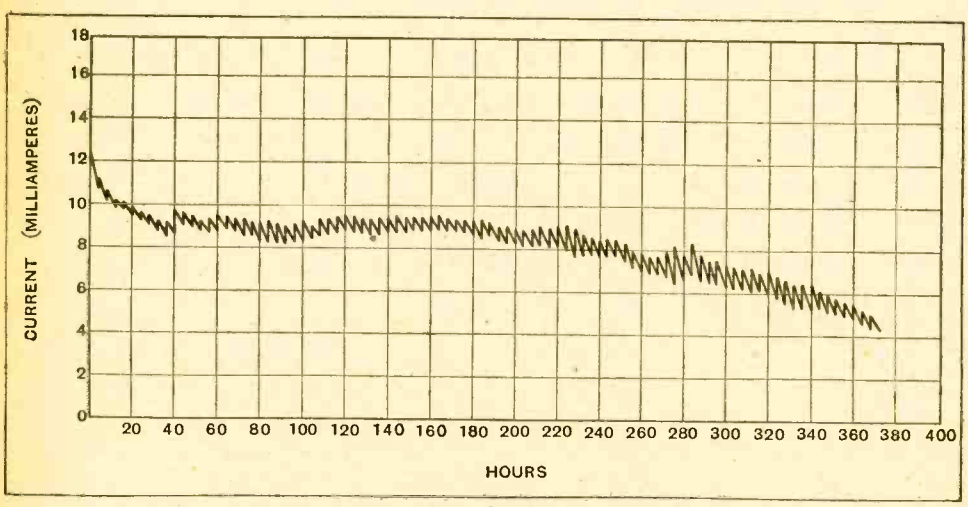


Fig. 3.—Current discharge curve corresponding to the voltage curve of Fig. 2.

The accompanying table will show the effect of falling voltage on the current taken. In every case the grid bias has been adjusted for the initial voltage, and thereafter not changed. The receivers concerned are those made by a well-known firm and include all their standard sets.

Safe Discharge Rates.

In order to get satisfactory results from a set, with a minimum of trouble, it is advisable not to overload the battery. A battery discharge at too high a rate will not give quite as high a capacity as that dis-

Dry Cell H.T. Batteries.—

charged at the proper rate, and although the diminution of capacity (on intermittent tests) in the case of well-made batteries is not serious, being roughly about 20 per cent. for each trebling of the current rate above normal, it is clear that the battery at, for example, three times the normal current rate will only last for about a quarter of the time. This will mean frequent replacements of batteries, involving unnecessary waste of time and more trouble. It is also true that the larger batteries give rather more ampere hours or watt hours per penny than the smaller ones. It is therefore an economy in every way to use a suitably large battery.

Figs. 4 and 5 illustrate this point. They are discharge curves of the two chief sizes of battery, the standard small one and the "triple capacity," each being discharged intermittently (for four hours per day) at the constant currents shown.

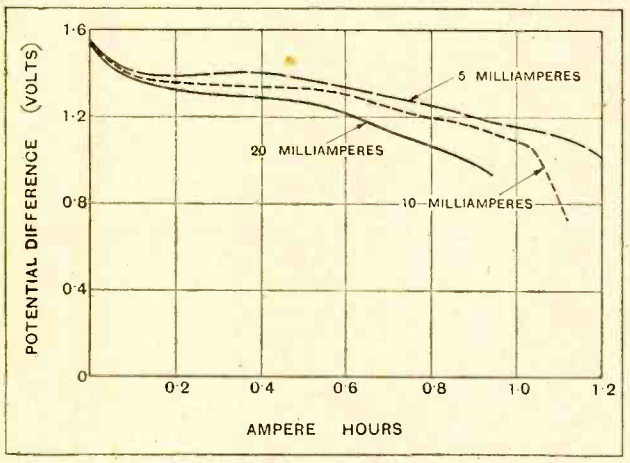


Fig. 4.—Curves for the small-size cell, showing the influence of the discharge rate on the ampere-hour capacity.

For simplicity the average voltage of the day's run has been recorded to avoid serrated curves which would intersect.

When to Use Triple-capacity Batteries.

In order to be able to make comparisons easily, the results have been plotted against the ampere hours given rather than against the time. It is obvious that the cell discharged at 10 milliamperes, for instance, will last rather more than twice as long as the one discharged at 20 milliamperes, and rather more than half as long as the 5-milliampere test. It will be noted that there is not a serious difference in capacity upon increase of current rate in either case, but that in the case of the larger cell discharged at 5 milliamperes, the tests upon which extend over a period of nearly six months, there is a tendency for the capacity to diminish as a result of the effect of very slow discharge and standing.

It will be seen that with the larger batteries, as would be expected, there is a slower rate of fall of voltage for a given current than with the smaller ones.

On the other hand, where sets taking very small anode currents, 5 milliamperes and under, are considered, it would not be wise to use the larger batteries, as they might conceivably last, say, for a year or more, during which time the very slow intermittent discharge may render it impossible to obtain from them their full capacity. Most makers list two sizes of battery only, though some have only one, generally the smaller size, and some as many as four. These are of different shapes, but they are almost invariably composed of standard units. If you are in any doubt as to which type you have, the following figures should be of service. The ordinary small unit taken by itself is $2\frac{1}{4}$in. high, and the diameter is $\frac{3}{4}$in., the larger unit being the same height, but having a diameter of $1\frac{1}{4}$in. In made-up units with cardboard, pitch, terminals, etc., the small unit occupies about 0.24 cubic inch per rated volt, the figure for the larger one being 0.46 cubic inch.

The smaller unit should not be discharged at higher initial currents than 10 milliamperes, and the larger one (sometimes called "triple capacity") should be employed for initial currents exceeding 10 and not exceeding 30 milliamperes. At higher currents than these an uneconomical life will be obtained.

Parasitic Noises.

Where portable sets are considered, the question of space and weight will normally forbid the use of the larger type of battery. In these cases, listeners must not be surprised if their batteries want frequent renewals. The very fact that a portable wireless set has to carry only a small aerial, means that the incoming signals must be amplified to a great degree. Consequently, a powerful set, requiring usually a heavy anode current is required.

Where portability is not really essential, an ordinary set with an ordinary aerial is much more economical.

From time to time one hears complaints of the crackling caused by dry cells, which almost always suffer for the sins of other components of the set. Crackling caused by batteries can take place, but it is extremely rare, and will only take place when there has been a considerable amount of corrosion of the soldered joints, etc., or where there is a bad connection. Batteries alleged to give rise to crackles have been

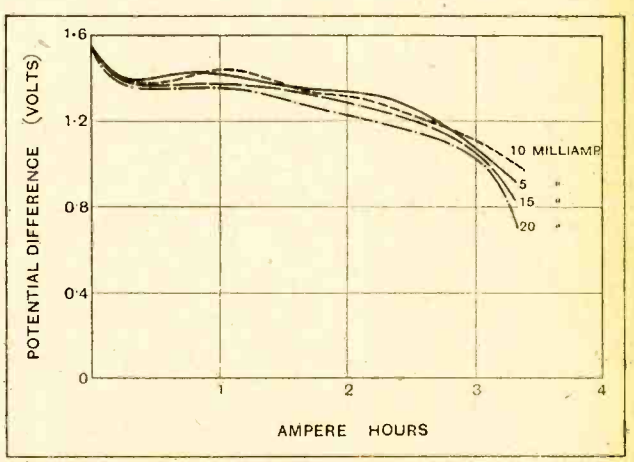


Fig. 5.—Effect of discharge rate on ampere-hour capacity of triple-capacity cells.

Dry Cell H.T. Batteries.—

tested frequently, but invariably with negative results. Crackles on a set are generally due to a defective transformer or other defective part, or to causes external to the set.

That crackles are frequently caused outside the set may be recognised from the fact that the intensity varies from time to time, the trouble often disappearing entirely; furthermore, sets with eliminators are not immune. Frequently, two sets independently supplied will crackle in unison. (This particular effect has been noticed by the writer.)

In many houses it is customary for wires to be run into several rooms in each of which a loud speaker may be plugged. This is a fruitful source of trouble where high tension supply is concerned. If the loud speaker is put direct into the H.T. circuit, it follows that if the set is switched off in the usual way by switching off the filaments of the valves, one or both of the wires to feed the loud speaker is at a high potential above earth. After a period of years or months, unless great care is taken both when the installation is made and later, to keep the apparatus in order, leaks will develop and act as a steady drain upon the high tension battery during the "off period." Cases of this sort have come under the writer's notice. It must be realised that the sort of installation which may be quite good enough for a lighting circuit where power costs about, say, 6d. per kilowatt hour, is not good enough for a circuit where leaking current is paid for at the rate of about £5 per kilowatt hour, which is the price paid even where a battery with the most satisfactory performance is concerned.

The remedies for this particular trouble are simple, one being to switch off the H.T. supply from the positive end, and the other being to feed the loud speaker through a transformer or choke-capacity circuit so that the loud speaker terminals are practically at earth potential. In this case, leaks will obviously be eliminated.

Conclusion.

Briefly the rules to be observed in the use of dry cell H.T. Batteries are:—

(1) *Size of cell.*

Choose a cell as large as possible for reasons of economy (cost per watt hour) and constancy of voltage over long periods, the limiting factor being the effects of standing upon deterioration.

(2) *Maintenance.*

There are two alternative methods.

(*a*) Ideal. Add sections to keep the voltage constant using high grade voltmeter for check purposes.

(*b*) Compromise. Use large cells and ignore the volt drop as it will probably not affect quality very seriously until the cut-off point is reached.

LETTERS TO THE EDITOR.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

CONTROL.

Sir,—Much has been written lately on the subject of transmission from 5XX being spoilt by the efforts of someone in the control room at Savoy Hill trying to improve on the music from the studio. I have been listening to Chelmsford first and then to 5XX since June, 1925. My experience shows that having an A1 set the causes of bad reception are three:—

(1) Local interference, i.e., loud and silent oscillation, etc.

(2) Bad land line.

(3) Over-amplification, resulting in a hiss and distortion, due to bad control at Savoy Hill.

No. 1: You must endeavour to remedy yourself.

No. 2: Is unusual and not the fault of the B.B.C.

No. 3: Is the fault of the B.B C., and the remedy is to do away with the control except to prevent blasting.

Recently we had a very good example of what frequently takes place. Three songs sung by May Huxley came through perfectly and gave me very great pleasure; the announcer's voice informing us that the orchestra would now play a selection, "Cavalleria Rusticana," was so good he might have been in the room. I settled down to enjoy the selection. It started O.K., and then to my disgust the Ham Handed Henry in the control room came to life and thought he could improve on it, a hiss started at the back of the music, and this together with the music became louder until all was distorted. Tuning down does not improve matters, volume is reduced, but the hiss and resultant distortion is still present. It is this *hiss*, due to over-amplification, which causes bad reception. I implore you to continue the campaign to do away with this control.

If you consider the addition of one more letter may be a help please forward this to the B.B.C. I wrote to them twice or thrice in 1926 on the same matter, giving concrete cases, and pointing out that over-control was absent from practically all outside broadcasts, viz., lunch-time music from restaurants, church services, etc., and the total result was better than from the studio.

B. H. JONES.

Folkestone.

MORSE INTERFERENCE.

Sir,—With reference to Mr. I. Barclay's letter in the issue of December 12th, may I state my views on the Morse interference question?

The shore station at Wick, GKR, appears to be the broadest tuned transmitter in the British Isles, and here in Bradford, 300 miles south, the supposed 600m. wave can be heard right down to 460m. when using a single circuit tuner. Port Patrick, GPK, also using an ancient spark, has another broad wave down to 500m. These two stations and others never reduce their power because they cannot, as they have only one fixed voltage input. Now the two I.C.W. transmitters at GLV and GKZ cannot be heard outside about 15 miles of 600 metres, and hence cause no interference to broadcasting. However, when a few Continental I.C.W. stations are also working there is a jamming on the 600m. wave, and operators cannot receive their messages. What it will be like when all the British and Continental coast stations are working on 600m. with I.C.W. time alone will tell. At present it is possible to read the required station through interference when it uses a characteristic spark which tunes within 40 metres of 600m., but it will be absolutely impossible when even only three or four stations are working I.C.W. with a sharp 600 wave unless the receiving station is pretty near to the required transmitter. As an example at present, try to read KAV when PCH is working. It can't be done at any great distance.

Thus while an I.C.W. station is perfect when working by itself, the moment another starts up on the same wave it is no good and repetitions must be demanded. This is where a good spark set has the advantage, and I am in favour of retaining spark transmission for a number of stations where it is going to be essential.

Finally, don't always blame the operator, it may be the ancient "fool-proof" set designed perhaps some ten or twelve years ago.

"JIGGER."

Bradford.

By Our Special Correspondent.

A Control Muddle.—Programmes for the Regional Stations.—Wireless Pictures to Stay.—Military Band Problems.—The Ideas Department.—A Difficult Relay.

Music for the "Extraordinary Listener."

"Muddly" would, I think, be a better word than "medley" (the B.B.C.'s own choice) to describe the queer assortment of sounds with which British broadcasting greeted the New Year. This was the first time that the effects department has attempted to mingle music from two different sources. Side by side with the muffled chimes of St. Michael's we heard Sir Walford Davies' "Solemn Melody," and the result was a racking discord of sweet sounds.

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Talk Blending.

To show their consistency of purpose, the control people might now try the equally sensible experiment of blending two talks. If Mr. G. K. Chesterton were superimposed upon Mr. Bernard Shaw (and vice versa) truth would prevail with double sway.

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Political Possibilities.

Or a start might be made with the proposed political debate on de-rating. Let all three Parties speak simultaneously with the boom of Big Ben in the background. We should then have an impressive sound picture, which might well take the form of a Big Surprise Item.

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Brookman's Park.

Work at Brookman's Park has slowed up a little in the last week or two. The difficult task of laying the concrete foundations has now been completed, but some time must elapse before the concrete has sufficiently "set" to carry heavy machinery.

I hear that the official announcement that the station will be working in the summer is regarded as highly optimistic by some of the engineers.

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The Work Ahead.

Not even 5XX, which has quite a large machinery hall, entailed anything like the amount of work which must be got through before the London Regional can send out a signal.

Anxiety in the Pennines.

The B.B.C. mobile transmitter is still roaming the Pennines, but no site has yet been chosen for the Northern Regional. The result is that each of the towns in the neighbourhood is being tantalised in turn. The sight of the mobile transmitter is not a welcome one, everyone having decided that distance lends enchantment to the sound where a twin-wave regional transmitter is concerned.

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Delay in Manchester.

Meanwhile a delay has occurred in the opening of the new regional broadcasting H.Q. at Piccadilly, Manchester, which were to have been opened at the end of December. Now it seems that the B.B.C. cannot go into occupation until the end of February.

The B.B.C. premises occupy the main part of the building over the Manchester and County Bank. Of the three studios, one is of the "gallery" type, the first in this country. It is two storeys high, and measures 54ft. by 35ft.

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The Programme Problem.

Each of the regional centres will have new headquarters before the scheme comes into being.

I wonder whether the B.B.C. fully realises the magnitude of its task on the programme side when the five regional transmitters are in operation? According to the plan, at least six exclusive programmes must be produced daily.

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Exclusive Material.

London will produce two programmes, and each of the other regional centres will be responsible for one. Except in the case of London, each station will be at liberty to take its alternative from the transmissions of other stations, but even on this basis far more original material will be called for than is required to-day.

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Preventing Clashes

It is unlikely that the extra work will mean additions to the B.B.C. staff. There are numbers of people at the relay stations and smaller main transmitters who will lose their present jobs with the introduction of the regional scheme, but they will be readily absorbed by the colossal programme department.

Not the least important task will be to prevent duplication of items. With the cornucopea pouring out six programmes simultaneously, there will be heavy odds in favour of some awkward clashes. Unless a special watch is set, there is always the chance, however remote, that all stations might send out the "William Tell" overture at the same moment, with results too awful to contemplate.

FUTURE FEATURES.

London and Daventry.

JANUARY 16TH.—"The Fantastics," a play by Rostand.
JANUARY 17TH.—"Clothes Props," a Preposterous Programme.
JANUARY 18TH.—B.B.C. Symphony Concert, relayed from the Queen's Hall.

Daventry Experimental (5GB).

JANUARY 14TH.—Antwerp Concert.
JANUARY 16TH.—"Memories of Shaftesbury Avenue," a Programme of Musical Comedy Excerpts.
JANUARY 18TH.—"How It Strikes Me," by Sir Gerald du Maurier, relayed from the Private Theatre of the Royal Academy of Dramatic Art.
JANUARY 19TH.—"Left! Right! Left!" a Programme of Marches and Marching Songs.

Cardiff.

JANUARY 15TH.—Welsh Programme.

Manchester.

JANUARY 13TH.—Light French Music.
JANUARY 18TH.—Inter-University Debate.

Glasgow.

JANUARY 15TH.—Recital of Scottish and Hebridean Songs.
JANUARY 17TH.—Programme of Music and Verse.

Aberdeen.

JANUARY 14TH.—"Extra Speshul!!!" a "special" edition of the Radio Revue, "Impertinent Waves."

Belfast.

JANUARY 15TH.—"The Legend of Faustus."
JANUARY 16TH.—Bach and Sibelius Programmes.
JANUARY 19TH.—"Geneviève de Brabant," an operetta, music by Jacques Offenbach.

Wireless Pictures to Stay.

The B.B.C.'s decision to make "Fultograph" pictures a permanent feature of their transmissions will supply the necessary inducement to the general public to invest in picture receivers.

A contract has just been signed under which the transmission of pictures begun on October 30th, 1928, will now continue until October 30th next.

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Fultographic Cartoons.

This decision by the B.B.C. has enabled Wireless Pictures (1928), Ltd.—the company controlling the 'Fultograph" patents—to go ahead with its plans for producing novel picture programmes for transmission each day. These plans, an official of the company explained to me, include the transmission daily of cartoons by famous artists illustrating the events of the day. Photographs illustrating such topical events as occur each day will also be included in its programme, together with novel puzzles. Illustrations of the people taking part in the daily wireless programme are also to be sent.

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C-c-c-cricket!

One of the heroes of last week's cricket match on Broadhalfpenny Down, Hambledon, was Walton O'Donnell, the conductor of the Wireless Military Orchestra.

He tells me it was a cold job; if he had said it was a hot one I should have remained polite, but . . . He was a member of the "Invalids" team, captained by J. C. Squire, which won the day with 89 runs to the 78 scored by their opponents, the Hampshire Eskimos.

I believe O'Donnell can claim honours for being the first member of the B.B.C. staff to play cricket in England on New Year's Day.

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The Wireless Military Band.

Reverting to the more or less serious side of life, he told me that the Military Band gives 156 performances a year, each containing six or seven selections. This would be a strain on anybody's repertoire, but it is particularly so with a military band, as the number of pieces written *specially* for this medium does not exceed twenty at the most, including the latest band compositions of Gustav Holst.

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Friendly Overtures.

However, military bands are wonderfully adaptable to almost all classes of music, from fugues to fantasies on popular airs, so listeners need not fear a drought. Last year the Wireless Military Orchestra played 160 overtures, not to mention hundreds of marches, arrangements of pianoforte works, and selections from opera.

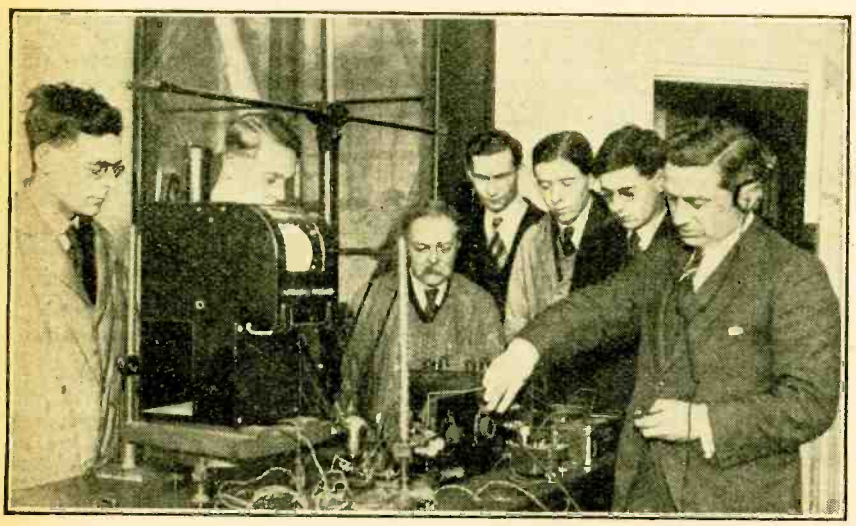
PICTURE BROADCASTS BY THE FULTOGRAPH METHOD.

Daventry—		
5XX	Daily from 2 to 2.30 p.m. except Sunday and Monday.	
1,562.5 metres		
		p.m.
Berlin—	Sun.	12.45 — 1.30
Königswusterhausen	Mon.	12.45 — 1.15
1,649 metres	Tues.	9.45 — 10.15
	Wed.	12.45 — 1.15
	Thurs.	12.45 — 1.15
	Fri.	9.45 — 10.15
	Sat.	12.45 — 1.15
Vienna—	Daily, 2.15 to 2.45 p.m., and two pictures after conclusion of programme.	
Radio-Wien		
518 metres		

o o o o

Kilohertz.

Ever since Captain Eckersley published his exposition of the *Plan de Bruxelles*, no one at Savoy Hill has dared to utter the word "kilocycles." The more comprehensive term "Kilohertz" (kilocycles per second) is on every lip. Fortunately, the word is always used in the plural; nobody seems quite certain how to utter it in the singular.



MEASURING SIGNAL STRENGTH. Professor E. V. Appleton is here seen measuring the signal strength of 5GB before a group of students of King's College, London.

Willie Rouse.

The news of the death of Willie Rouse, or "Wireless Willie," must have caused regret to many listeners. He was one of the pioneers of humorous broadcasting, and at one time held a position on the B.B.C. staff as adviser on concert party broadcasts. It was soon decided, however, that his talents were best employed in the studio itself.

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The Ideas Department.

Mr. R. E. Jeffrey, who has relinquished his post of Dramatic Director to found the new "Research Programme" department, tells me that the first fruits of the new scheme may be expected in about two months' time.

Ideas, with a capital "I," are the staple food on which the department hopes to thrive. The difficulty is that ideas and inspirations are not easily manufactured.

"Therefore," says Mr. Jeffrey, "we invite the aid of listeners. Sometimes a man who can boast of no skill in dramatic writing is visited by an idea which the B.B.C. staff can turn into a presentable play."

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Inspirations that Pay.

It is the fine but fugitive idea for which the B.B.C. is willing to pay. I commend this thought to all who see visions, to all who have grand ideas while they shave, to all who see pictures in the fire. There are cheques in the air.

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Return of the Soliloquy.

Mr. Jeffrey believes that radio drama of the future will contain more psychology than action. He prophesies a return of the soliloquy, long abandoned by the legitimate stage, but still the best vehicle for enabling the audience to "see" the mind of the player. The very intimacy of broadcasting, in Mr. Jeffrey's opinion, gives it a field of action which neither the stage nor the screen can enter effectively.

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To-morrow at York Minster.

In addition to the fourteen microphones which are to be used at to-morrow's enthronement of the new Archbishop of York, approximately two miles of wire will be in circuit in the cathedral and its precincts.

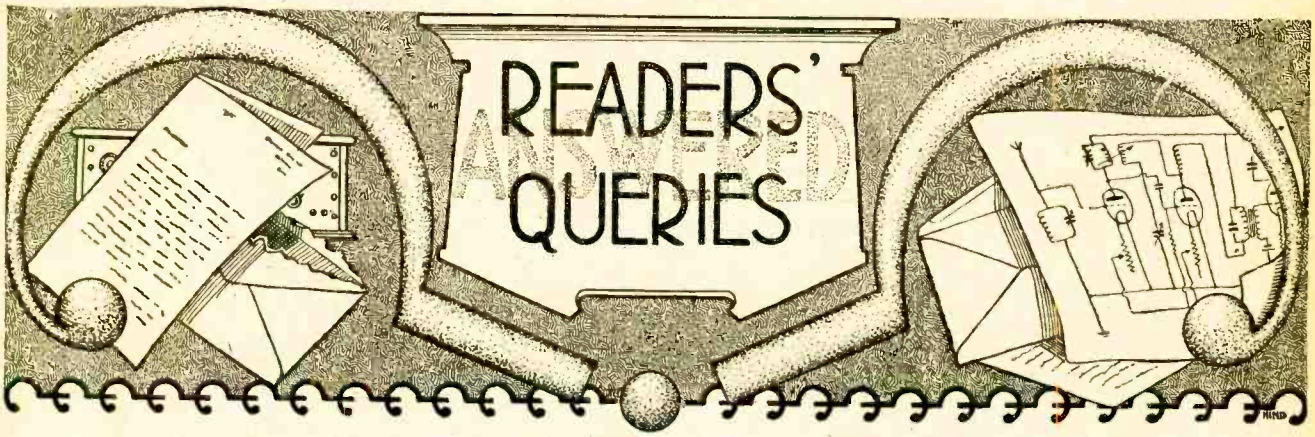
The task of wiring, carried out by Post Office engineers, proved unusually difficult, as every length of wire had to be concealed. To do this it has been necessary to run the wire up and down pillars and to take it up into the Tower—at a height of 300ft.

o o o o

Blind Control.

To complicate matters during the relay, all the control work will be done out of sight of the ceremony in a small control room. There will be no engineers at the microphone points.

The ceremony is to be broadcast from 5XX and the stations of the northern grouping.



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

The Output Choke.

What would be a suitable value for a choke intended for use in the anode circuit of a P.M.256 valve? You will understand that it is to form part of a filter output arrangement.
B. R. G.

Strictly speaking, the choke should be chosen in relation to the inductance of the loud speaker winding and not to the valve characteristics. It is assumed that its D.C. resistance will not be sufficiently high to cause a serious reduction in the actual H.T. voltage applied to the valve. It is sufficient that the choke inductance should be several times greater than that of the loud speaker, and in practice a value of from 20 to 30 henrys will be satisfactory.

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A Mysterious Fault.

Your assistance would be appreciated in tracing a fault which, to me, is quite inexplicable. My four-valve set, after working well for many months, seems to have developed an intermittent disconnection; after it has been in operation for an hour or so a crackling sound is produced in the loud speaker, and at times signals die away altogether. Now comes the strange part of the affair: if I switch off the electric light in the room matters seem to be temporarily put right, and signals are again heard at something approaching full strength. I must add that the mains are not connected directly to the receiver, although I use them for charging my H.T. accumulators.
S. T. F.

Several readers have reported a similar effect, and we have come to the conclusion that the trouble will almost always be traced to a defective winding in an L.F. transformer or choke, which will be found to have a broken wire with a microscopic gap between the ends. Under certain conditions continuity will be restored by induced surge voltages brought about by interrupting the lighting circuits.

The "Pentode Two."

Please give me a diagram showing how the "Pentode Two" may be modified in order to use "parellel feed" throttle-controlled reaction—provided this method is suitable. M. N.

The circuit you require is given in Fig. 1; in this diagram the reference

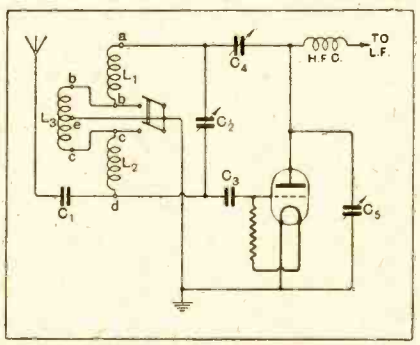

Fig. 1.—Modified reaction control system for the "Pentode Two."

lettering corresponds with that in the original descriptive article, except that C_4 and C_5 replace the reaction condenser. The first-mentioned may have a maximum capacity of from 0.00005 to 0.0001, and the second 0.0003 mfd.

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Electric Supply Regulations.

I am thinking of making up a D.C. eliminator, and, as the negative side of my mains is earthed, presume it will not be necessary to add a condenser in the earth lead, as is sometimes recommended. Is this correct?
R. T. N.

No, the addition of an extra "earth" connection to the mains is not permissible, and you must either insert the usual series condenser or use an aerial-grid transformer in which the primary and secondary windings are not in metallic connection.

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Where Decoupling Scores.

Is it a fact that the inclusion of decoupling resistances and wiring will enable one to reduce the amount of screening in an H.F. amplifier?
D. E. P.

Up to a point this is correct, but a sweeping general statement on the subject would perhaps be misleading. As a rule, however, it will be found that an H.F. amplifier which, with a given screening system, is just on the verge of self-oscillation will be completely stable when modern decoupling devices are added.

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A D.C. Eliminator.

Is the Megavox eliminator described in your issue of December 19th suitable for use with D.C. mains (240 volts), provided the rectifier is omitted?
E. C.

Speaking generally, the smoothing and voltage-reducing arrangements of this eliminator would be suitable for use on D.C. mains, but certain precautions should be observed, and we would ask you to wait for an article on the subject which will be published in the near future.

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Two-volt Valves for the "Megavox."

Is it essential to use 4-volt valves in the "Megavox" receiver? If not, will you please specify suitable types in the 2-volt Mullard range? F. W. S.

Good results can be obtained with 2-volt valves, and we suggest you should use, in the order given, P.M.12, P.M.2DX, and P.M.22.

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Fading.

My 4-valve receiver is satisfactory enough, except that fading of signal strength is sometimes troublesome. Can you suggest a cure? A. R. R.

If the effect you have noticed is true fading, and is not due to imperfect and varying connections, etc., we are afraid that there is no real cure, although the use of a receiver with a large "margin of safety" in the matter of sensitivity does a great deal to overcome the trouble. Obviously, such a set would be normally operated in a comparatively insensitive condition; during periods of fading, decrease of signal strength would be compensated by use of the volume control adjustment.

Devices for automatic regulation of H.F. input to the detector have been suggested, but we have no information that they are perfectly satisfactory in practice.

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A Sensitive "Diode" Receiver.

Will you suggest a suitable arrangement of diode detector and L.F. amplifier to follow two screened grid H.F. amplifiers? M. D. W.

This subject is rather too involved for adequate treatment in a letter, but assuming that your requirements as to volume are not abnormal, we suggest the arrangement shown in Fig. 2. The range of the set will be considerably less than that obtainable from the same number of valves with, say, an anode bend detector; but, provided the H.F. stages are really good, we do not think you will have any real cause for complaint on the score of sensitivity.

Telephone in Series.

I wish to connect five pairs of telephones (installed in three different rooms) to my receiver, which has a choke filter output. Should these be connected in parallel or in series? H. S. L.

As the total impedance of five pairs of phones in series is likely to be less than that of your output choke, we recommend you to connect them in series.

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H.T. for the Tropics.

I understand that dry batteries are unsuitable for use in the tropics. As I am going to East Africa, taking a short wave receiver with me, will you suggest a reliable source of H.T. supply? C. P. B.

Ordinary dry cells have an extremely short life in hot countries, and you would be well advised to use H.T. accumulators, provided that there will be facilities for recharging. If these are lacking, then we suggest "inert" dry cells, or wet primary batteries, and advise you to get in touch with the principal manufacturers, who, in some cases, have devoted attention to the needs of wireless users in the tropics.

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Common Batteries.

Is there any serious objection to feeding two entirely separate receivers installed in adjoining rooms from one set of batteries? If you consider this plan to be permissible, will you describe any special precautions which may be necessary? H. L. M.

Provided the total current taken by the two sets is not beyond the capabilities of the batteries, there is no serious objection to your scheme, but it will be desirable that one, or, better, both, of the receivers should be fitted with decoupling resistances in each anode circuit. If these precautions are taken, no difficulty should result from the use of common batteries, but there may be interaction between the two aerials and sets of tuned circuits.

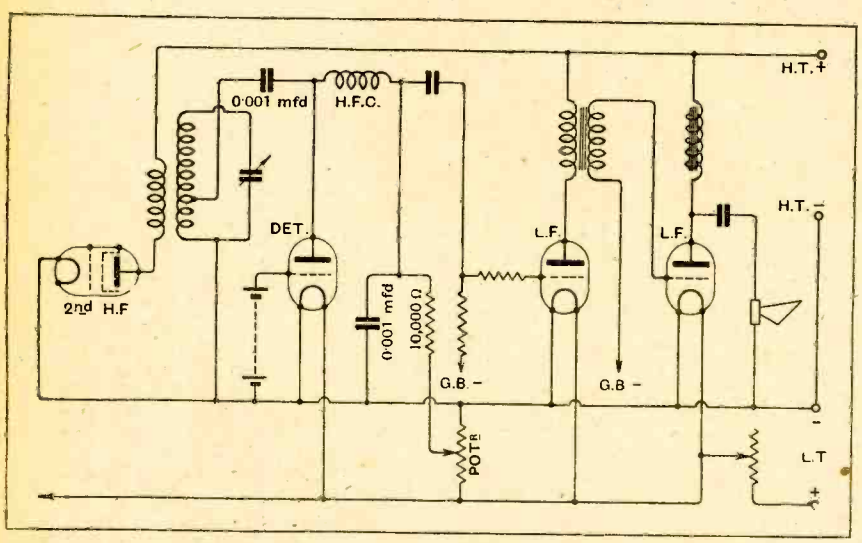

Fig. 2.—Connections of a diode detector and L.F. amplifier following two H.F. stages.

Pentode and Pick-up.

Will a pentode valve with a pick-up in its grid circuit give sufficient magnification for good loud speaker reproduction, or would it be better to precede it by another valve? C. H. J.

This depends a good deal on one's interpretation of the expression "good loud speaker reproduction." It may be stated, however, that the voltage output of the ordinary pick-up is not sufficient fully to "load up" the grid circuit of a pentode, and we recommend you to add another L.F. stage, which may be of the low-magnification type.

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Loading Coils.

In adding a loading coil to an existing receiver, which at present covers only the medium wavelengths, should the added inductance be inserted in the lead joining the present coil to the grid, or should it be at the other end of the winding? B. M. S.

As a general rule you can take it that a loading coil should be inserted at the low potential end of the present tuned circuit (the end of which is joined to valve filament).

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The Choke Filter.

I am told that it is an easy matter to add an output filter circuit by joining an L.F. choke across the existing loud speaker terminals of my set, then connecting across it the loud speaker and a 2-mfd. condenser, these latter being in series. Is this simple form of connection as satisfactory as any other? J. R.

The type of filter you describe really serves no other useful purpose than that of keeping D.C. currents out of the loud speaker windings. We consider it to be inferior to the other arrangement in which the choke is also connected across the loud speaker terminals; a lead is then taken from the end of the choke which is joined to the anode of the stopping condenser, the other side of which is taken to the negative L.T. terminal through the loud speaker windings. By deflecting signal frequency currents from the common source of H.T. supply, this type of filter confers an important advantage.

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Power Transformers.

My A.C. mains deliver current at a voltage of 110, which I understand is very much lower than the usual figure. I am thinking of making an eliminator, but before starting work I should like to know if it would be necessary for me to buy an extra transformer to step up this voltage to the usual value. M. H. H.

A large number of commercial transformers have tapped primary windings in order that they may be suitable for a wide range of input voltages. Accordingly, you should either obtain one of these, or else a component specially designed for your supply voltage. There should be no difficulty in this matter, and in any case it is quite unnecessary to interpose a second transformer.

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CONTENTS OF THIS ISSUE.

NOT A PRIVATE QUARREL.

THE proposal of the B.B.C. to publish yet another journal under the title of *The Listener* has raised a storm of protest in every section of the Press, and the question is now being asked whether the B.B.C. is not guilty of flagrant abuse of the privileges which the monopoly of broadcasting has conferred upon the Corporation.

Whilst we are entirely in sympathy with the efforts of the Press to prevent the publication of this new journal by the B.B.C., we are surprised to find that this instance of rival activity by the Corporation seems to be treated as if it were the first and only instance of encroachment by the B.B.C. into the legitimate sphere of activities of private enterprise. Our readers will remember, no doubt, that we have repeatedly had occasion to draw attention to the persistence with which this organisation has sought occasions for entering into competition with a variety of different industries.

If we investigate the reasons why the old British Broadcasting Company, with a board of directors composed mainly of representatives of the wireless industry, was superseded by a Corporation with a board of governors appointed by the State, we find that one of the principal arguments in favour of that change was that broadcasting had reached a stage when it was desirable that it should be controlled by an organisation uninfluenced by commercial considerations.

A Questionable Gain.

Now to us it seems questionable whether in the transfer of the responsibility for the broadcasting organisation from a group of wireless manufacturers (The Broadcasting Company) to the British Broadcasting Corporation we have really attained the commendable objective which we had in view, and removed broadcasting from the temptations of commercial interests and entrusted it to a totally disinterested body.

The wireless Press of this country was allowed the opportunity of giving evidence before the Commission appointed to consider the future of broadcasting prior to the formation of the British Broadcasting Corporation. In their evidence before that Commission the wireless Press asked that a limitation should be set upon the publishing activities of the organisation. This request, however, was not acceded to, with the result that the Corporation began almost at once to extend their publishing activities, and, particularly, in the case of *World Radio* permitted that publication to compete more directly with the privately owned wireless journals by the inclusion of a similar type of matter in the editorial pages.

A Simple Definition.

We contend that the dispute in regard to *The Listener* is not a private quarrel between the Press and the B.B.C. limited to the question of the publication of yet another journal, but that it is a matter of much wider importance and one of principle which deserves the fullest consideration; so that we cannot refrain from hoping that the dispute may lead to a proper definition of the scope of the Corporation.

We have repeatedly stated, as our opinion, that the B.B.C., having been granted the privilege of monopoly in broadcasting should be confined to the microphone as the only direct means of contact with the public, permitting an exception in respect of the publication of the bare programmes of the British stations. This simple definition of the legitimate scope of the Corporation provides a reply to every criticism, and removes once and for all any doubt as to what may or may not be a proper activity.

WATER RIPPLES and WIRELESS WAVES

An Interesting Analogy Explaining Certain Direction-finding Phenomena.

By A. H. DAVIS, D.Sc.,
Physics Department, The National Physical Laboratory, Teddington, Middlesex.

MANY features of wireless waves may be illustrated by experiments with water waves. Naturally there are limitations to any analogy between electric waves, which permeate the whole ether, and water waves, which are chiefly a surface phenomenon confined to the region near a definite plane. Nevertheless, we are usually concerned on land and sea with the manifestations of wireless waves which have travelled directly over the earth's surface, so that the parallel with water waves is not without relevance.

Waves from a Point Source.

Wireless waves from a vertical antenna spread out over the surface of the earth, being propagated equally in all directions. Such propagation may be represented in plan by Fig. 1, which is a photograph of ripples spreading out equally from a point source. The ripples represent the carrier wave, and an object floated at any given point on the surface of the water would be subject to vertical oscillations under the action of the waves corresponding to the electrical oscillations set up in a receiving aerial. In the wireless case the oscillations are of such high frequency that they cannot be detected by audible means, and the incoming waves are consequently modulated—*i.e.*, in the simplest case are divided into groups, some of which are more intense than others. In this way the high-frequency waves " carry " a lower frequency pulsation, which may be detected by suitable means. The propagation of wireless phenomena and their directional characteristics depend essentially upon the high-frequency carrier wave, and no attempt has been made to introduce periodic variations in the amplitude of the ripple source to correspond to any modulation of the carrier wave. On the ripples the distance from crest to crest of the wave corresponds to the " wavelength " of the sending " station." For instance, taking the scale of magnitudes to be given by the scale of miles attached, Fig. 1 corresponds to the carrier wave from a station with a wavelength of 300 metres. On the same scale Fig. 2 is analogous to a station with a wavelength of 500 metres.

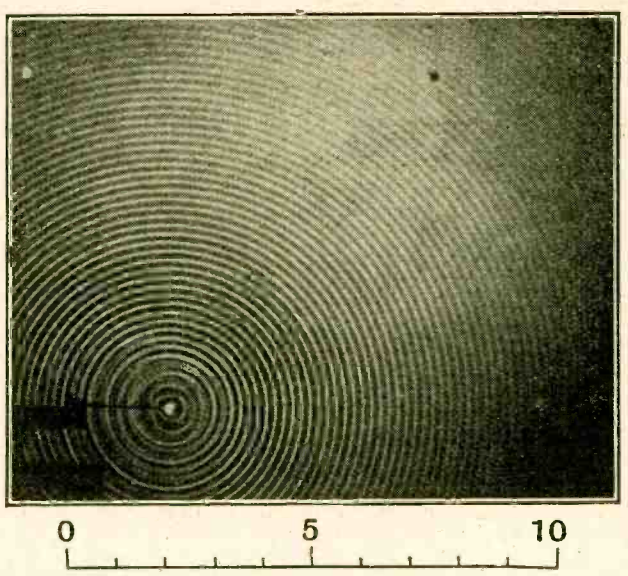


Fig. 1.—Ripple photograph showing uniform propagation of waves in all directions from the source. On the scale shown the ripples correspond to wireless waves of 300 metres wavelength.

Direction Finding.

From observation of the ripples at any point, one can clearly locate the direction of the source. The source is the centre of the outgoing circles, and at any point is in a direction perpendicular to the wave front. Undoubtedly there are many methods of locating this perpendicular at any point without knowing the direction of the wave-front. For instance, when a small boat on a lake or river is subject to the waves, it rocks least when the axis of the boat from bow to stern lies perpendicular to the waves. Even in the dark the direction of a continuous series of waves could be located to some degree of accuracy from this fact. Again, with ripples in a small tank of water a floating match will sometimes act as a direction indicator. If it is pivoted in the middle about a vertical axis it will set itself parallel to the waves—*i.e.*, " broadside on " to the direction of propagation and thus show the direction of source.

Keeping, however, rather closer to the actual analogy with wireless direction finding, we may note that if, at any point, we had means of observing the direction of motion of a particle of water as the wave passed overhead, we should know the direction of the source, for each particle executes a short oval excursion in a vertical

Water Ripples and Wireless Waves.—

plane lying in the direction of propagation of the waves at the point. This is illustrated in Fig. 3 (*a*).

There is nothing mysterious, therefore, in the fact that the electrical oscillations set up in a frame aerial should be more vigorous when it is oriented in some directions than in others. Indeed, it is found that the circulation of electricity in a coil due to a distant aerial is greatest when the plane of the coil is vertical and lies in the direction of propagation of the waves. Thus at the earth's surface the electrical field from an aerial tends to circulate electricity in a vertical plane through the source,

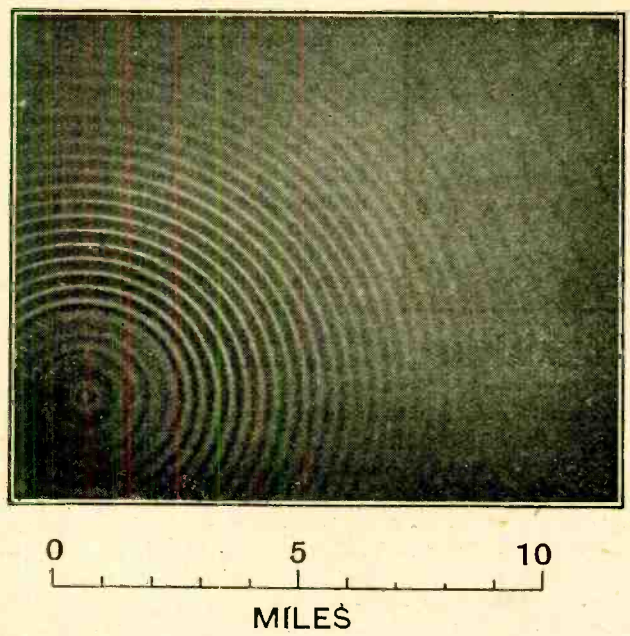


Fig. 2.—Photograph showing ripple on a scale to correspond with wireless waves of 500 metres wavelength.

just as ripples tend to circulate water. Fig. 3 (*b*) has been drawn to bring out the correspondence.

It is upon this property of wireless waves that the radio direction finder is based. It consists fundamentally of a plane loop—or its equivalent—capable of being rotated about a vertical diameter. The strength of the received signal is greatest when the plane of the loop is parallel to the direction of propagation of the waves, and falls off to a minimum in conformity with a cosine law as the loop is rotated to be parellel to the wave fronts. Since the rate at which signal strength changes during rotation is greatest at the minimum position, this position is used in direction finding.

In practice a simple loop or frame aerial is subject to certain disadvantages, particularly when the loop is small, and more complicated arrangements of crossed coils are, in fact, used. In some the aerial is rotated, but in the Marconi-Bellini-Tosi arrangement a large fixed system of two frame aerials at right angles is connected electrically to two smaller coils, also at right angles. The two smaller coils thus set up a field corresponding to that of the incoming waves, and a small rotating search coil enables this to be located.

The importance of direction finding is indicated by the number of special reports relating to the subject which have been issued by the Radio Research Board of the Department of Scientific and Industrial Research. It appears that the accuracy of directional receivers under best conditions is of the order of 1°. Errors may arise, however, from stray or indirect fields.

Stray fields may have their origin in electrical currents induced by the primary wireless waves in local trees, overhead wires, or metal work near the receiving apparatus. Generally speaking, these local errors may be avoided or allowed for. Direction finders on ships are naturally subject to them, owing to the metal employed in the construction of the vessel and in the masts, stays, etc.

Local and Night Effects.

A special type of error which occurs chiefly at night is due to indirect waves which have passed upwards into the upper atmosphere and have then been deflected back to earth by, it is supposed, an ionised or semi-conducting layer. In suitable circumstances the boundary of the layer is relatively sharp, and it acts more or less as a reflector. Fig. 4 shows how ripples reaching a partially reflecting surface may be deflected, and illustrates how waves which have proceeded into the upper atmosphere could be returned by a sharply bounded and highly conducting layer. It is not necessary, however, for the change in the properties of the atmosphere to occur suddenly to its full extent at a definite height. If a region of more or less gradual transition is involved, the wireless waves entering the layer may traverse a curved path and emerge again into the lower atmosphere as if reflected from some definite boundary at a rather greater height. Fig. 5 compares the path of reflection at a sudden discontinuity with such deflection arising from refraction. To those familiar with the explanation of

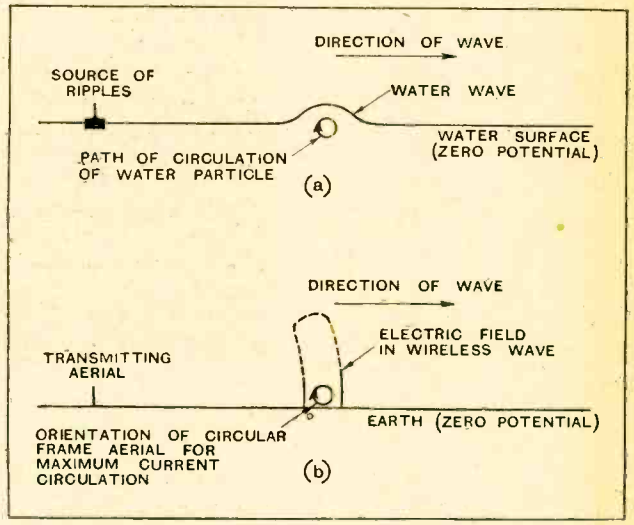


Fig. 3.—Diagram comparing water circulation in ripples with circulation of current in a frame aerial. (a) Water ripples, (b) wireless waves.

mirage in a desert, Fig. 5 (*b*) recalls the bending of rays of light by layers of hot air near the sand. In this optical case the bending gives rise so strongly to the appearance of reflection that the illusion of a definite reflecting surface of still water is created.

Water Ripples and Wireless Waves.—

In the case of wireless waves, the " Heaviside layer " —as it is called after Heaviside, who first suggested its existence—is somewhat variable and irregular. In consequence, waves reflected from it are changeable, they are not necessarily deflected in a perfectly regular manner, and when they return to the earth's surface they are liable to interfere in an uncertain manner with the readings of direction finders.

At night only the upper layers of the atmosphere referred to above are ionised, but during day-time, owing to the action of the sun, the lower atmosphere also is ionised to some extent. In day-time, therefore, the whole atmosphere is more homogeneous, the deflecting boundary disappears, and direction finding becomes more reliable. At sunrise and at sunset conditions are in turmoil, the boundary is irregular, and exceptionally large errors in direction finding occur, even as great as 90°. Fortunately, night errors being variable, an average bearing taken over a period of some minutes is much more reliable than a single observation.

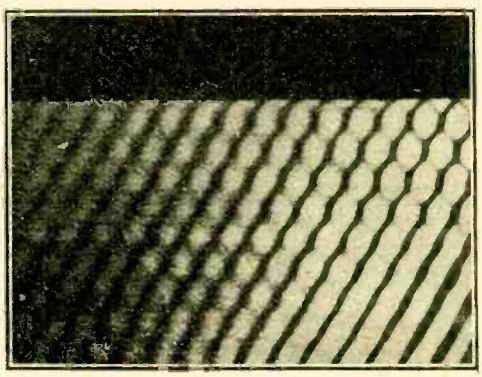


Fig. 4.—Ripple photograph illustrating deflection of waves at a partially reflecting boundary.

We may note that the disturbing influences which return from upper space are not of sufficient strength compared with the direct waves to affect direction finding at ranges of less than thirty miles over land from the sending station. Over sea an even greater range of eighty miles is free from interference, for the primary waves are subject to less attenuation over sea and remain comparatively powerful over a longer range.

Coastal Effects.

During the last few years many ships have been fitted with direction finders, so that when fog or other causes

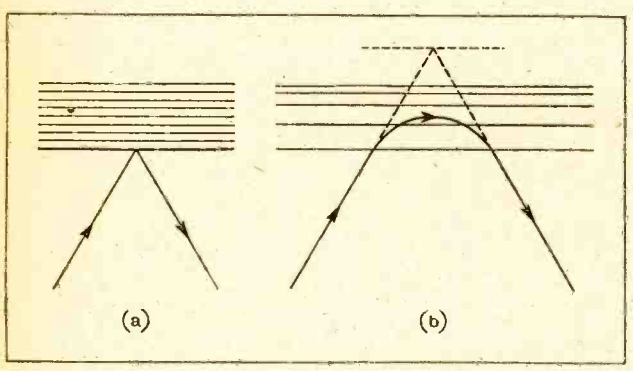


Fig. 5.—Deflection of wireless waves by ionised layers in the upper atmosphere. (a) Reflection from homogeneous layer; (b) apparent reflection due to refraction in a non-homogeneous layer.

render ordinary navigational methods impracticable they can obtain bearings from wireless stations on land and thus fix their positions with some precision. It is interesting, therefore, to consider another effect which arises near a coast line. Waves crossing from sea to land change their direction slightly so as to appear to proceed from a station, say, some 3° to 5° farther to seaward than the actual source. Sometimes even greater errors are experienced. This refraction of waves would arise it the velocity of wireless waves were greater over sea than over land. Unfortunately, there is some theoretical difficulty here as calculations based upon plausible assumptions predict a result in just the opposite direction. Nevertheless, the experimental result definitely appears to be of the type mentioned.

The waves appear then to behave as if they travelled faster over sea than over land. To illustrate this by ripples it is necessary to provide part of a ripple tank with a false bottom, because ripples in the shallower portion are slower than those over deep water. Fig. 6 is a ripple photograph obtained in this way. Approximately plane waves were generated in the deep water to represent the analogy of wireless waves from a ship upon the sea. It is seen that, on crossing into the region of the shallow water representing land, the wave direction was altered, and the wave front observed at O is not at right angles to the true bearing of the ship. According to the figure, the apparent bearing lies seawards of the true bearing, and this is actually observed to be the case with wireless waves.

If, in view of the theoretical difficulty alluded to, any justification were required for presenting an analogy based upon the assumption of greater wave velocity over sea than over land, it lies in another type of coastal error which the ripples reveal. We have just illustrated the error when the waves cross from sea to land. Fig. 7, however, relates to the case where both the source and the observing station are on land, but near a coastal boundary. The photograph shows that the conditions observed at O are complicated by the presence of a train of reflected waves, in addition to the direct wave from the distant land transmitter. These reflected waves introduce into the direction-finding apparatus at O a component apparently coming from the direction of the sea, and, as a result, lead to an apparent displacement of the source towards the sea.

Waves Reflected at the Coast Line.

Generally speaking, the intensity of the internally reflected wave increases as the incidence becomes more grazing, and consequently any error in direction finding would depend upon the real bearing of the source, and would be greatest when the true bearing of the transmitting station lay more or less parallel with the coast line. Error of this type due to coastal reflection is specially interesting in connection with the present article, in that its existence was suggested by the writer after experimenting with ripple analogies to coastal wireless reception. The relevant ripple photographs were subsequently embodied in a letter to " Nature " by Dr. R. L. Smith-Rose, of the National Physical Laboratory, who,

Water Ripples and Wireless Waves.—

in his extensive records of direction finding by various stations as carried out for the Radio Research Board, had definite evidence of coastal error in waves which had travelled entirely over land. It is believed that this was the first occasion on which reflection from a marine boundary had been noticed and made the subject of comment.

It is additionally interesting that, according to a note published this year, Major J. P. G. Worlledge has now obtained further evidence of reflection of wireless waves at a coast line. During the calibration of a direction-finding station he noted that the bearings of certain transmitting stations using more than one wavelength showed abnormal variations, which were discovered to depend upon the frequency of the waves received. This is what one would expect. For with a given position

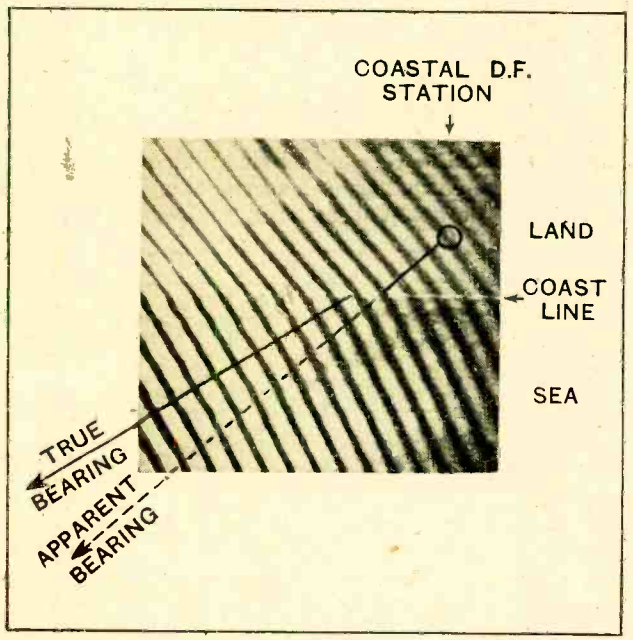


Fig. 6.—Illustration showing how coastal refraction introduces error in marine direction-finding at a coastal land station.

of sending and receiving stations there would be a definite difference in distance between the paths traversed by the direct and reflected rays. The maximum error in bearing would be observed when this path difference was an exact number of wavelengths, for then the direct and reflected waves would arrive in the same phase. For other wavelengths the two sets of waves would be out of phase, and blurred minima would be observed. In the work a considerable number of observations were subjected to analysis and compared with accurate maps of the locality, and, whatever may be the accuracy of the ripple analogy, it is interesting that this later work confirmed the existence of coastal reflection.

Directional Transmission.

In so far as this article is concerned with illustrations of the general directional properties of wireless waves, it deals with the particular point of view of directional

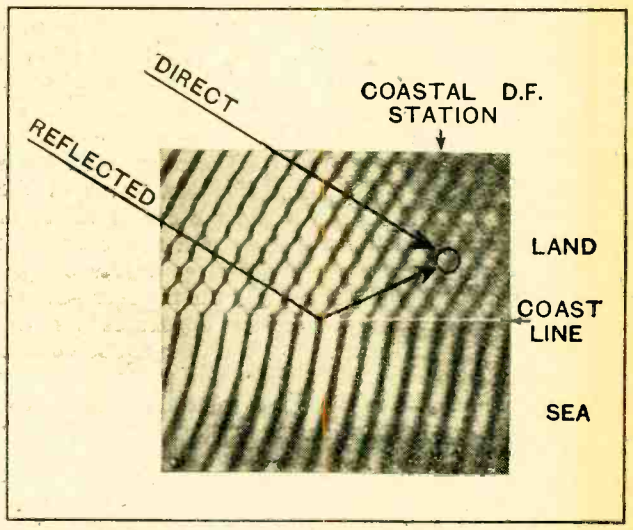
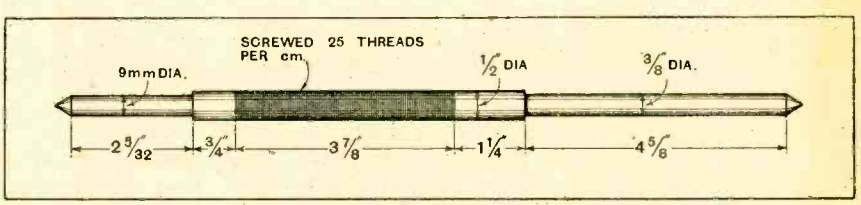


Fig. 7.—Diagram illustrating how coastal reflection complicates overland direction-finding at a coastal station.

reception of waves broadcast equally in all directions from the transmitter. It is therefore desirable to mention briefly in conclusion that there is an application of directional wireless which is more or less the inverse of this. In it the *transmitter* has the frame aerial, and consequently sends out its signals mainly in the direction of the plane of the frame. The aerial is rotated slowly—say, at a rate of once a minute—and in consequence the signal received at any distant receiver varies periodically in strength. The transmitter emits a special signal at the moment it points, say, north, and the direction of the line from the transmitter to any receiving station may be deduced by noticing the time interval between N signal and the moment of maximum signal strength at the station itself. Indeed, by starting a stop watch on the North signal and stopping it when signal strength is a minimum, the bearing is seen directly upon the dial. The accuracy of the method is more or less the same as that in which a directional receiver is employed, and it is liable to the same sources of error.

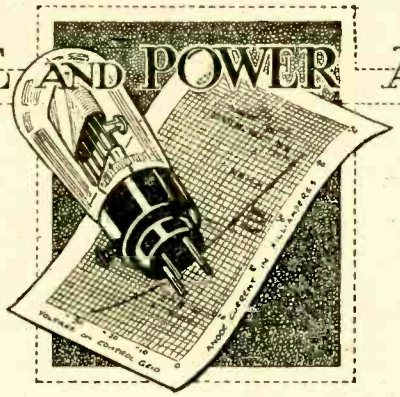
The Wireless Picture Receiver.

Although drawn correct to scale, it is regretted that an error occurred in one of the dimensions given for the construction of the spindle. This dimension was shown as 7 mm., but is actually 9 mm. (*The picture receiver is available for inspection at the Editorial Offices, 116-117, Fleet Street, London, E.C.4.*)



Detailed drawing of the Spindle.

THE PENTODE AND POWER AMPLIFICATION



Some Important Considerations Regarding the Output Circuit.

Precautions Necessary to Avoid Excessive Peak Voltages.

By
L. G. A. SIMS, M.Sc.

THE modern moving-coil loud speaker calls for a large power output from the last valve of the receiver, and this has led to the use of valves of the L.S.5A class, or similar valves with anode voltages of about 350 and correspondingly large values of grid bias. This tendency has meant that the receiver has had to become an expensive piece of apparatus for the amateur to equip and maintain. With the anode voltage needed it has also had a slight element of personal danger associated with it. For these reasons the advent of the pentode valve has been welcomed as the means of feeding moving-coil speakers with considerable power, while using a high-tension battery of only 150 volts.

The general characteristics of this new valve have been explained by other writers,[1] but it is felt that there is room for further investigation of the conditions associated with its large power output. It is a device the characteristics of which differ so materially from those of the well-understood triode that it is only to be expected that there may be radical differences in performance between them. Thus it is believed that the following notes will show that, though the pentode may develop considerable power, it does so under special conditions which call for care in its use.

Dynamic Curves.

Dealing first with a triode of the class usually employed by amateurs for large power outputs, we will assume an anode voltage of 350. This is 50 volts lower than the makers' rated value, but it is the sort of value which the amateur would be likely to have available if using his mains voltage in series with an ordinary H.T. battery of accumulator cells giving about 130 volts. We can, thus, hardly be accused of giving the triode an unfair start! Fig. 1 shows the makers' curves for this valve. In order to work this valve "all out" we may assume a voltage swing of about 140 on the grid, fixing our grid bias at −90 volts in order not to overheat the anode unduly (some overheating is often, in practice, almost inevitable). At the same time our grid swing of 140 volts will not take us too far on to the curved lower portions of the characteristics.

We will consider the usual case of a load fed through an output transformer or choke condenser unit rather than that of a load directly in series with the anode battery. Fig. 2 shows such an arrangement, and it will be clear that the full battery voltage is available at the valve anode if the resistance of the primary winding of the transformer is low, which would usually be the case. It is, of course, well known that the static curves of the valve are not followed when the valve is working, but that another curve, known as the "dynamic curve," comes into operation. The position of the dynamic curve alters for different values of load resistance in the anode circuit and for different methods of feeding the load.

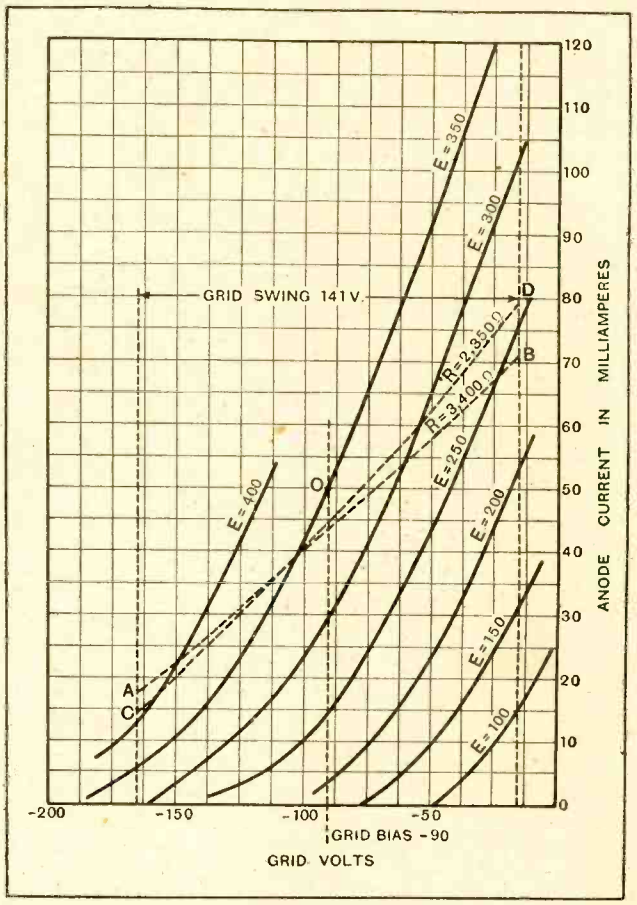


Fig. 1.—Grid volts-anode current curves for a super-power valve. For a grid swing of 141 volts a bias of 90 volts and an anode voltage of 350 is suggested.

[1] *The Wireless World*, July 11th, July 18th, and July 25th, 1928.

The Pentode and Power Amplification.—

Thus the use of a choke-condenser unit or output transformer materially affects the position of the dynamic curves (and the power output of the valve), as we have, for instance, the condition that our 1 : 1 ratio transformer virtually inserts the resistance R in the anode circuit *for alternating currents only*, whereas the insertion of R directly in series with the battery would lead to a steady loss of battery voltage. We represent our loud speaker for the present purpose as a resistance, though in practice it has also inductance. The dynamic curves should all pass through the point marked O in Fig. 1, but they actually fall a little below it, as the transformer primary has a little resistance.

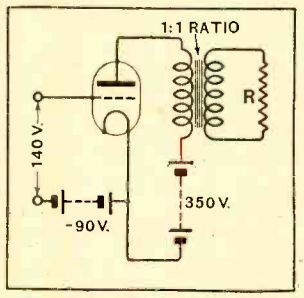


Fig. 2.—A power valve arranged to feed a loud speaker through an output transformer.

Now it can be seen that, if the curves turn about a point such as O, then their lower ends must lie in a region of anode voltage higher than that of the high-tension battery. This is fulfilled in practice, the anode voltage rising above and falling below the value 350, so that the *average value* is 350.

Measuring Peak Volts.

In order to verify this, a circuit was wired up as shown in Fig. 3, using a rectifying valve in conjunction with an electrostatic voltmeter to form a peak voltmeter in order to measure the maximum voltages reached on the anode.[2] The grid was fed from a source of sine-wave voltage, this being adjusted to give a total swing of about 140 volts so as to load the triode fully without causing distortion. In measurements which the writer made it was found that with an effective resistance[3] R of about 3,400 ohms the anode voltage reached 421, although the battery voltage was steady at 350. The dynamic curve for this resistance is the line AB in Fig. 1. The line CD is for 2,350 ohms, and it can be seen that its lower end is also in the region of 400 volts. The actual value reached was 405 volts.

It can be seen that these dynamic curves are nearly straight, and thus that the anode current and the power output will both be very pure sine-wave quantities for a sinusoidal voltage on the grid. The power output is shown in Fig. 4 on the assumption that the transformer has negligible resistance. This reaches a maximum value of about 1.3 watts. There is a wide range of resistance variation, about 4 to 1, over which 85 per cent. of the maximum power will be developed, and we can see that even if, over the range of musical frequencies, the loud speaker acts as a *varying* load, a large proportion of the maximum power will always be developed if the speaker impedance has been chosen correctly at a given frequency.

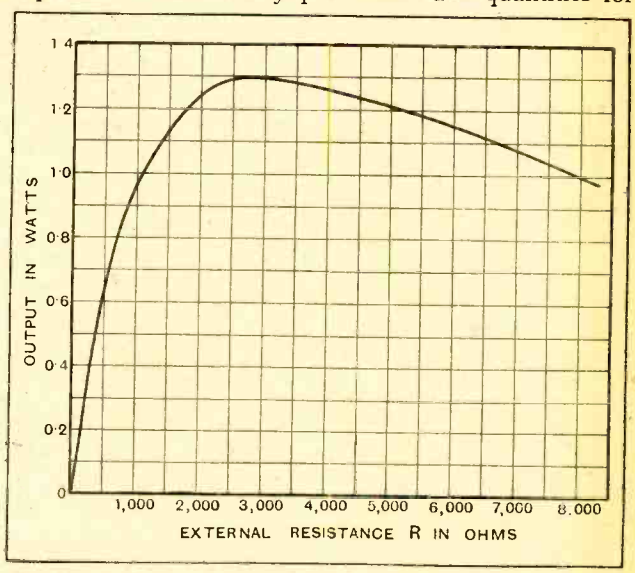


Fig. 4.—A power output curve for a super-power triode for various external resistances.

The Case of the Pentode.

It is very important, in order to follow the action of the pentode with transformer-coupled load, to note that these results can also be obtained from curves of anode voltage against anode current. Thus in Fig. 5 are plotted several of these curves for the same triode, each separate curve corresponding to a definite grid voltage. It will be clear that the operating point of our triode, whose bias was −90 volts, will be on the E_g −90 curve, at the point corresponding to an anode voltage of 350. This point is marked O. We may now draw straight lines at various slopes through this point O to represent the various values of the load resistance R. Thus, taking the 6,000-ohm line we see that everywhere along its length a change of current (vertical height) of 10 milliamps. corresponds to a change of voltage (horizontal length) of 60 volts. The slope of the line is therefore

$$\frac{60 \text{ volts}}{10/1{,}000 \text{ amps}},$$

[2] See Journal Scientific Instruments, Vol. I, No. 9, June, 1924, "*A Small Peak Voltmeter and an Application*," by A. C. Bartlett.

[3] The transformer primary, or a choke, are not of infinite inductance, and there is a shunting action, reducing the value of R.

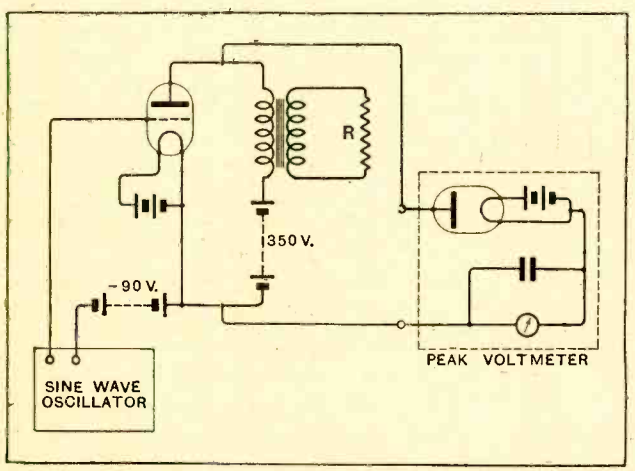


Fig. 3.—The circuit arrangement used to obtain a peak voltage measurement using an electrostatic voltmeter.

The Pentode and Power Amplification.—or 6,000 ohms. That is, the line represents 6,000 ohms. In the same way the second line represents 3,400 ohms. Now with a steady grid bias of −90, our applied signal of 140 carries us down to $E_g = -160$ and up to $E_g = -20$. The 3,400 line cuts the curves for these values of E_g at points corresponding to anode voltages of 405 and 235, and these values of voltage will occur at the anode. Thus, by drawing lines to represent load resistances across the anode voltage-anode current curves we can predict the peak voltages which will be reached on the anode in practice.

Using the peak voltmeter a series of measurements was made with different load resistances fed through a 1 : 1 ratio output transformer, the grid voltage swing and grid bias being exactly as used throughout this article. After making a small allowance for the resistance and inductance of the transformer, the results were always in extremely close agreement with those predicted by this graphical method.

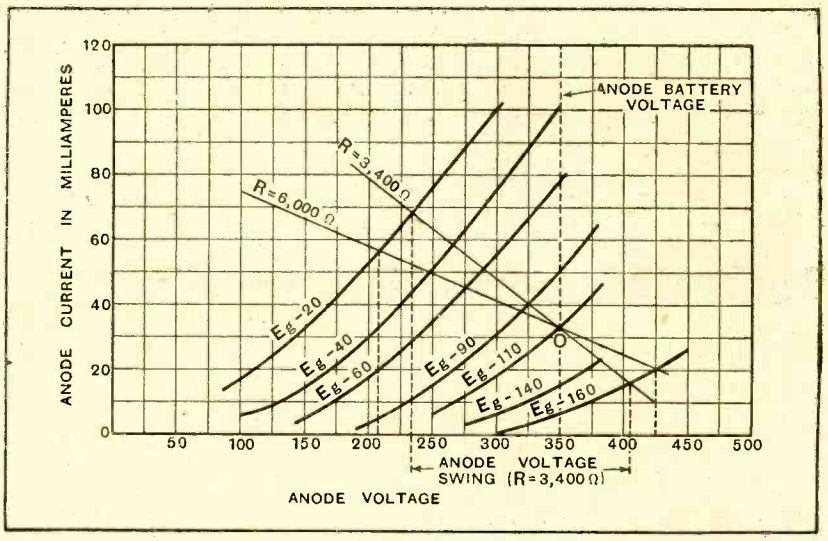


Fig. 5.—Anode voltage-anode current curves for the same triode as used in Fig. 4.

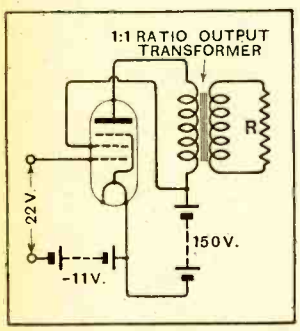


Fig. 6.—A pentode coupled to a loud speaker by a 1 : 1 output transformer.

We may now turn to the pentode valve, feeding a resistance load as shown in Fig. 6. If we use a 1 : 1 ratio output transformer in this case also (this is equivalent in its action to a choke-condenser arrangement), there will be no *steady* loss of voltage in the resistance. Taking as our operating conditions a battery and screen voltage of 150, a grid bias of −11, and a grid swing of 22 volts (which we can see from Fig. 9 will be reasonable values), we have that the operating point is O on the anode voltage-anode current curves shown in Fig. 7, and that the grid swing of 22 volts will carry us down to the curve for $E_g - 22$ and up to $E_g = O$. We may now draw resistance lines through O and find the anode peak voltages as we did for the triode.

Battery Voltage 150, Anode Peak Voltage 500.

A different state of affairs now exists with the pentode from that which applied to the triode, due to the shape of the characteristic curves. The fact that these tend to become horizontal means that the high resistance lines cannot cut the curves for low grid voltage until a region of high anode voltage has been reached. As the resistance is increased the peak anode voltage required to satisfy the resistance line and the 22-volt grid swing becomes extremely high. For instance, the 30,000-ohm line calls for a peak voltage of more than 500, although the battery voltage is only 150.

The importance of this is very great, as serious internal damage to the valve may result if voltages of this order are produced. In order to test the above theory the writer has carried out

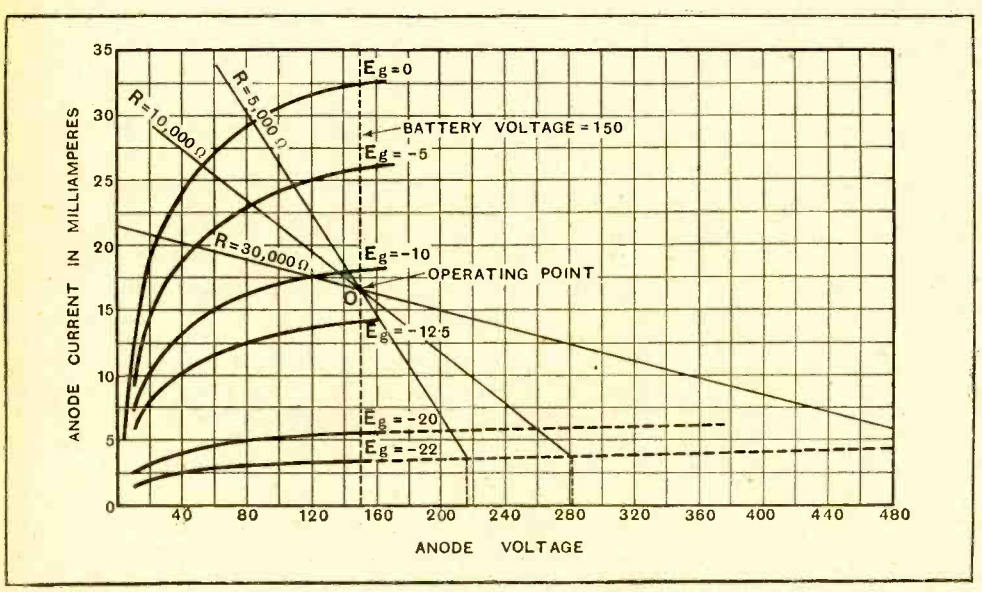


Fig. 7.—Anode voltage-anode current curves for a typical pentode. Owing to the horizontal nature of these curves a dangerously high anode peak voltage may be developed.

The Pentode and Power Amplification.—careful experiments, using the exact conditions assumed in this article, and actually measuring the voltage peaks produced on the anode, using the peak voltmeter. The circuit used was that of Fig. 3, but with the necessary changes of anode and grid battery voltages and of grid swing, and with 150 volts on the screen. There was complete agreement between the results predicted from Fig. 7 and those actually measured, and anode peak voltages of more than 550 were produced. It is unwise to allow voltages of this order to occur in case the valve should break down. There is the danger that large peak voltages may start a gas discharge inside the valve if this is at all soft, and this, if once started, would probably mean destruction of the electrode system of the valve. Furthermore, the electrostatic forces existing between the valve electrodes become considerable with anode voltages of this order.

Safeguarding the Pentode.

Although these dangers exist there is, fortunately, no need to incur them. In Fig. 8 is shown the power output of the pentode calculated on the assumption that the output is sinusoidal. It can be seen that the power is very high for values of resistance of the order 10,000 ohms (compare the power with that obtained from the triode). Now this value of resistance is not likely to be exceeded in practice, as the load, even if of high resistance or inductance, is always shunted by the inductance and capacity of the transformer or choke which feeds it and by its own self-capacity. A satisfactory power output, equal to about one-half of the maximum obtainable from the high voltage triode, can therefore be obtained without running the anode peak voltage above 300, for we see from Fig. 7 that this is about the value obtained for a resistance of 10,000 ohms. This value

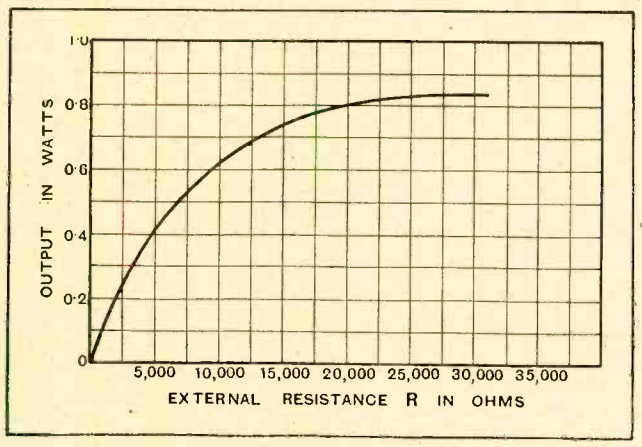


Fig. 8.—Power output curve for the pentode.

of anode peak voltage should be safe for a well-made valve. Another measure of precaution is to include in anode and screen circuits anti-coupling resistances. These have often been advocated in these pages to minimise back coupling and consequent distortion, but in the case of the pentode they would also serve the very useful purpose of limiting any tendency towards a rush of current, in the event of a valve becoming soft.

A reduction of grid swing will also materially reduce the anode peak voltages, as can be seen clearly from Fig. 7, but as this is one of the least controllable factors in a receiver, due to such contingencies as atmospherics, it cannot alone be relied upon to avoid the danger. The best way is to keep the anode impedance (repre-

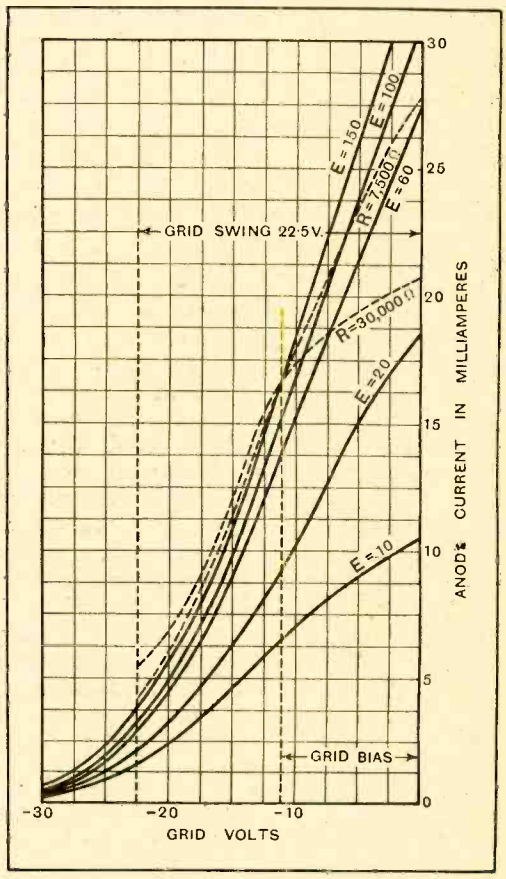


Fig. 9.—Dynamic curves of the pentode for loads of 7,500 and 30,000 ohms. An output transformer was employed.

sented in our work as a sloping straight line, that is, as a resistance) fairly low.

It will be clear from this that the loud speaker should not on any account be disconnected from the pentode while the filament of this is alight, for, should this be done, the output transformer or choke condenser unit at once assumes a very high inductive value which, in turn, will produce dangerously high anode peak voltages.

The moral is: "*Switch off the pentode before changing the output circuit.*"

No dangerous condition can arise if the load resistance R is connected directly in series with the anode battery, that is, without choke or transformer, as the anode voltage can then never rise above 150 volts. But this method of connection may lead to distortion and the power output is less.

In Fig. 9 are shown the dynamic curves of the pentode for loads of 7,500 ohms and 30,000 ohms fed through a 1 : 1 ratio transformer. It is evident from these that distortion will be appreciable for values of resistance much above 7,500 ohms, as the top ends of

The Fentode and Power Amplification.—the curves will begin to droop, thus distorting the output current waveform. We should also notice that the triode dynamic curves are rather superior in every case to those of the pentode, though the difference may be kept small by limiting the pentode load resistance to a value of 7,000 to 10,000 ohms. This, as we saw, is also the condition for maintaining reasonable anode voltage peaks.

To sum up, our results show that a pentode feeding a load through a transformer or choke and condenser may yield large power free from appreciable distortion if the load impedance is carefully chosen, but that a dangerous condition may arise if it is carelessly handled. On the other hand, a high voltage triode, though expensive to equip and maintain, gives a rather purer output of power, is less prone to distortion, and does not call for special precautions in its use.

A NEW LOUD SPEAKER.

The Use of Glow-discharges to Create Sound-waves from Voltage Changes.

THERE have been known hitherto two fundamentally different types of loud speaker; the usual form depending on electromagnetic principles for its operations, and the electrostatic type which has so far only found a small number of users, but which may still, in view of recent improvements, play an important part in the future. It is, however, not without interest that recently still another loud speaker principle, entirely distinct from those mentioned, has proved itself workable. M. Brenzinger and Professor F. Dessauer, of the University at Frankfurt-am-Main, have observed that certain discharge phenomena, which are well known in vacuum tubes as a glow-discharge, but which can also be obtained at atmospheric pressure if sufficiently high voltage is available, give rise to sound-waves under the influence of voltage changes. The process of production of sound has thus a certain similarity to Duddell's singing arc, which can also be used as a loud speaker, as was shown some twenty years ago at physical demonstrations.

The circuit used by Brenzinger and Dessauer is reproduced in Fig. 1. A simple receiver is connected to an amplifier in the last stage of which is incorporated an output transformer. The secondary winding of this transformer is connected to one of the electrodes of the special loud speaker AB. This loud speaker consists of two pieces of metal to which is connected a sufficiently high D.C. voltage to cause a blue glow to spread over the positive electrode. This voltage is provided by a high-voltage transformer with rectifier and condenser.

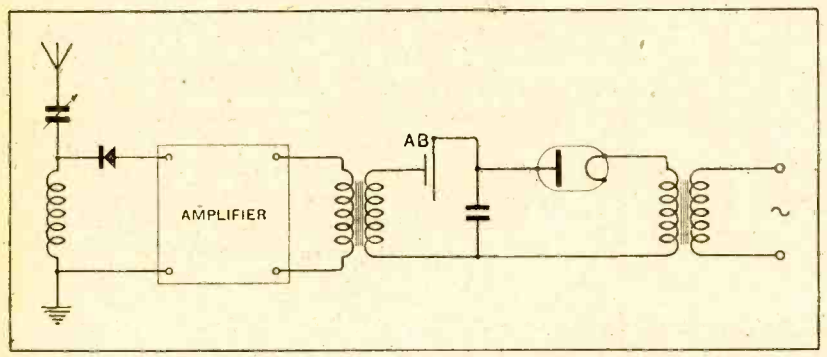


Fig. 1.—The loud speaker AB is connected between an output transformer in the receiver and a source of high voltage D.C. which causes blue glow.

Experiments indicate that the glow converts the low-frequency currents from the output transformer into sound energy.

From the point of view of practical working the shape of the two metal parts of the loud speaker is of considerable importance. All sharp edges and points must be avoided, for they apparently give rise to spluttering discharges, causing noises which mar reception. The construction that has so far proved best consists of a tube with a thin wire stretched through its axis. The connections are so made that the wire is the positive electrode and the tube the negative. About 10,000 volts are required for the steady voltage.

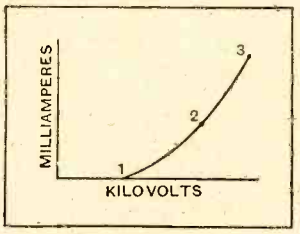
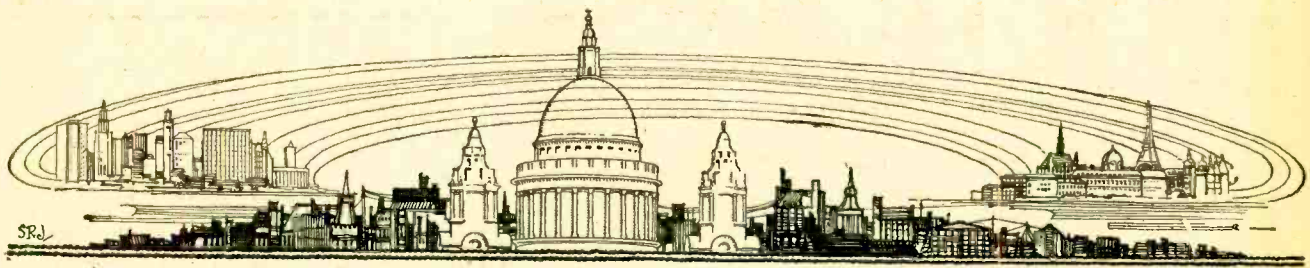


Fig. 2.—Voltage-current characteristic of the loud speaker.

If the voltage - current characteristic of a loud speaker of this type is traced out, a curve such as that of Fig. 2 is obtained. This shows that the discharge sets in at a certain voltage, as at the point marked "1," and that it increases with increasing voltage as far as point 3, where the discharge takes the form of sparks. In the middle of the characteristic is the working point 2, which gives the correct working voltage.

It is reported that with the arrangements described noises practically vanish, and that good and fairly loud reproduction of speech is attained, the clarity of the consonants and "S"-sounds being particularly marked. Since with this type of loud speaker there are no mechanical parts with their attendant inertia, the good reproduction of the highest notes is easily understandable. A further question is whether the new principle, which on account of the high voltage and considerable amplification required is comparatively expensive in use, will find a permanent place in practical use. It may, however, prove well worth while to follow up the line opened by Brenzinger and Dessauer, and we may soon see further developments.



CURRENT TOPICS

Events of the Week in Brief Review.

I.E.E. ANNUAL DINNER.

The Annual Dinner and Reunion of the Institution of Electrical Engineers will be held at the Hotel Cecil, Strand, London, W.C., on Thursday, February 7th next.

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IN THE WEE SMA' HOURS.

Talks on German trade, broadcast at a time "when no other European sender is in operation," are a feature of the service provided by the Stuttgart station. The talks are given on 397.7 metres, usually early on Saturday mornings, and are in English and Spanish.

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NEW DUTCH SHORT-WAVE CONCERTS.

The new 130 kW. short-wave transmitter at Huizen (Holland) is being formally opened to-day (Wednesday) to carry out a daily Morse service to the Dutch East Indies. Apart from telegraph transmissions, the station will give a weekly concert on Wednesdays with a wavelength of 16.88 metres. Huizen's call sign is PHOH1.

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THE GERMAN RELAY SYSTEM.

Apart from one or two alternative programmes weekly, the Zeesen high power station on 1,648.3 metres, in conjunction with Berlin (East), Stettin and Magdeburg, regularly relays the Voxhaus entertainments. The Hamburg broadcasts may be picked up through Hanover, Kiel, Bremen and Flensburg; Munich retaining its relays Augsburg, Kaiserslautern and Nurnberg. As hitherto, the Cologne programmes are available through Langenberg, Muenster and Aachen.

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"DEATH RAY": 1929 MODEL.

Prof. Esau, of Jena, who has already secured publicity by virtue of various wireless inventions, has started the New Year with the discovery of a "death ray." According to his claim, the Professor can radiate ultra-short waves which will kill small animals instantly and exterminate bacillus cultures. Although no aerial is used, transmission is possible up to 250 miles with ordinary wireless valves. A romantic touch is added by the information that the set is contained in a cigar box.

SPARK STATION'S FAREWELL.

Telegraphic communication has now been resumed with the Isle of Man and the Post Office spark wireless gear at Fleetwood has been dismantled, much to the relief of broadcast listeners in the district. During the dislocation of the telegraph service the temporary wireless station dealt with 600 telegrams and thousands of Press messages.

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"ELECTRICAL ENTERTAINMENT" MERGER.

The long-expected gramophone-radio merger in the United States has been finally approved by the directors of the Radio Corporation of America and of the Victor Talking Machine Company.

THE NEW WAVELENGTHS.

IN our pages devoted to "Programmes from Abroad" the wavelength changes involved in the new *Plan de Bruxelles* are included according to the latest information received at the moment of going to press. As a number of stations have not yet conformed with the new plan, certain modifications must be expected during the next two or three weeks.

Mr. David Sarnoff, who is executive vice-president of the Radio Corporation, claims that the agreement will make for greater service to a "single art—electrical entertainment."

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LECTURES ON ALTERNATING CURRENTS.

A course of ten lectures, with demonstrations, on "Alternating Currents and Electrical Oscillations," is being given at the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3, by Prof. D. Owen, B.A., D.Sc., F.Inst.P., on Tuesday evenings, from 7-8.30. The first lecture was given on January 15th and the remainder follow at weekly intervals. Full particulars of the course, the fee for which is 12s. 6d., can be obtained on application.

SHORT WAVES AND THE LEAGUE.

To enable the League of Nations to carry out a new series of short-wave tests in the spring the Netherlands Government is again placing the Kootwijk station at the disposal of the Secretariat for one experiment a week. The tests will be in three series. The first will be an endeavour to reach America. Japan will be the goal in the second series and Australasia in the third.

Similar experiments were carried out with varying success last summer.

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BROADCASTING BY WIRE.

The new "broadcasting" campaign of the Conservative Party is to be opened by Mr. Neville Chamberlain on Friday next, when his speech at Liverpool on rating relief will be relayed by Post Office land line to audiences at Birkenhead, Southport and Widnes. On the following Thursday the Prime Minister's speech at Newcastle will be similarly relayed to another hall in the city, and to Berwick-on-Tweed, South Shields, Stockton, West Hartlepool and Whitley Bay.

The Conservative Party has arranged further relays for the near future, and it will now be interesting to observe whether the other parties bring up the same kind of artillery.

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HOME CONSTRUCTORS' PICTURE RECEIVER.

Since the inclusion of the constructional article describing how to build a picture receiver in the issue of January 9th, it has been learned that component parts are obtainable from several other sources than those mentioned. The following is a list of manufacturers supplying the components specified:—

Collinson's Precision Screw Co., Ltd., Provost Works, Macdonald Road, Walthamstow, London, E.17.

A. Baker, 89, Selhurst Road, South Norwood, London, S.E.25.

Goodmans, 27, Farringdon Street, London, E.C.

C. B. Melhuish, 8, Gt. Sutton Street, London, E.C.1.

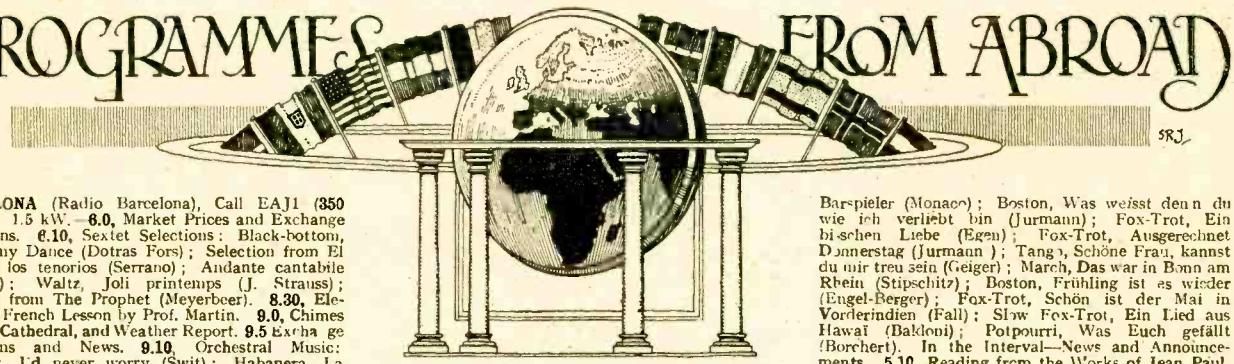
Star Engineering Company, Albert Street, Didsbury, Manchester.

Wilkins & Wright, Ltd., Utility Works, Holyhead Road, Birmingham.

Williams & Moffat, Ltd., Ladypool Road, Sparkbrook, Birmingham.

Wireless Pictures (1928), Ltd., 14-16, Regent Street, London, S.W.1.

PROGRAMMES FROM ABROAD



SATURDAY, JANUARY 19th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (**350 metres**); 1.5 kW.—**6.0,** Market Prices and Exchange Quotations. **6.10,** Sextet Selections: Black-bottom, This is my Dance (Dotras Fors); Selection from El trust de los tenorios (Serrano); Andante cantabile (Raurich); Waltz, Joli printemps (J. Strauss); Selection from The Prophet (Meyerbeer). **8.30,** Elementary French Lesson by Prof. Martin. **9.0,** Chimes from the Cathedral, and Weather Report. **9.5** Exchange Quotations and News. **9.10,** Orchestral Music: Fox-Trot, I'd never worry (Swit); Habanera, La ultima lagrima (Cotó); One-Step (Debroy-Somers); Sardana, L'aplec de Sant Farriol (Carbonell); Selection from Pan y toros (Barbieri); Fox-Trot, How long has this been going on (Davis and Wendling-Skinner). **10.0,** Programme relayed from **Madrid**, EAJ7.

BERGEN (**366 metres**); 1.5 kW.—**5.30,** Programme for Children. **7.0,** Orchestral Concert. **7.30,** Selections by the Wiener Schrammel Quartet. **7.50,** Topical Talk. **8.0,** Orchestral Concert. **8.30,** Talk by Victor Ivarson. **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,649 metres**); 40 kW.—**12.45,** Phototelegraphy Transmission. **1.30,** Programme for Children. **2.0,** Herr B. K. Graef, Talk: Elocution. **2.30,** Weather Report and Exchange Quotations **2.40,** Talk for Women by Helene Braun. **3.0,** Educational Talk by Prof. F. Lampe. **3.30,** Programme relayed from **Hamburg.** **4.30,** Prof. Lassar, Talk: The English Official. **5.0,** Felix Wisniewski, Talk: The Theory of Arbitration in Social Law-making. **5.30,** Elementary Spanish Lesson. **5.55,** Prof. Minde-Pouet, Talk: The Lessing Exhibition in the National Library. **6.20,** Herr Mendrzyk, Talk: The Forgotten Hinterland of Pomerania. **7.0,** "Agricultural" Concert. **8.0,** Orchestral Concert: Overture to The Marriage of Figaro (Mozart); Nocturne (Mozart); March in C Major (Mozart); Symphonic Poem, Die Moldau (Smetana); Overture to Tannhäuser (Wagner), followed by Weather Report, News, Time Signal, Sports Notes and Dance Music from **Voxhaus.** **11.30** approx.), Close Down.

BERLIN (Voxhaus) (**475 metres**); 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Programme of Gramophone Records. **10.30 a.m.,** Exchange Quotations. **11.55 a.m.,** Time Signal. **12.30,** Weather Report and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations, Agricultural Report and Time Signal. **2.30,** Dr. Ado Baessler, Talk: North American Settlements. **3.0,** Mr. P. V. Metzelthin, Talk: The Business Woman in America. **3.30,** Franz Hessel reads from his own Works. **4.0,** Tea Concert from the Hotel Esplanade, followed by Programme Announcements. **5.30,** Talk on Medical Hygiene by Dr. Paul Frank. **6.0,** Prof. W. Golther, Talk: Goethe's Faust in Music. **6.25,** Dr. Johannes Günther, Talk: The Attitude of the Modern Man to Lessing. **7.0,** Evening Entertainment by Willi Weiss (Tenor), Linus Wilhelm (Double Bass) and the Berlin Lute and Mandoline Orchestra. **8.0,** Strindberg Programme in commemoration of his Eightieth Birthday followed by News Time, Sports Notes and Dance Music. **11.30** (approx.), Close Down.

BERN (**407 metres**); 1.5 kW.—**3.0,** Concert by the Kursaal Orchestra. **3.30,** Programme for Children. **4.0,** Concert by the Kursaal Orchestra. **6.25,** Time Signal and Weather Report. **6.30,** Talk relayed from **Basle** (1,034 metres). **7.0,** Talk on the Dialect of the Lake Biel district, by Herr P. Balmer. **7.30,** Songs and Scenes of the People of Lake Biel. **8.30,** Concert by the Kursaal Orchestra. **8.45,** News and Weather Report. **9.0,** Orchestral Concert. **9.35,** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**321 metres**); 4 kW.—**2.0,** Review of Books by Richard Steinmolt. **2.50** Film Review of the Week by Dr. Heinz Hamburger and Gad M. Lippmann. **3.30,** Orchestral Concert: Overture to Waldmeister (Joh. Strauss), Potpourri from The Czardas Princess (Kálmán); Waltz, Winterstürme (Fucik); Potpourri from La Belle Hélène (Offenbach); Waltz, Durch die weiten Felder (Lehar); Overture to A Night in Venice (Joh. Strauss). **5.0,** Herr Schulrat Hoffmann, Talk: The Scenery and History of the Central Barschtal. **5.25,** Shorthand Lesson. **5.55,** Programme relayed from **Königswusterhausen.** **6.25** Weather Report. **6.27,** Topical Talk. **6.50,** Talk on the following Transmission. **7.0,** "The Merry Wives of Windsor": Opera (Nicolai), relayed from the Stadtheater, **Bern,** followed by News and Dance Music from **Voxhaus.** **11.0** (approx.), Close Down.

BRÜNN (**432 metres**); 2.5 kW.—**3.30,** Programme for Children. **3.45,** Talk on the Origin and Evolution of the Polka. **4.15,** Talk: Life on an Ocean Liner. **4.30,** Talk on Music. **4.45,** Programme in German: News and Announcements, followed by Songs. **5.15,** Weekly Report, followed by Concert of Popular Music: Overture to Indra (Flotow); Popular Songs; Fantasia on The Lark (Lehár); Songs; Ballet from Lakmé (Delibes). **6.45,** Talk: Czech Literature. **7.0,** Programme from **Prague.** **8.15,** Programme of Scandinavian Music: Symphonic Poem, Korsholm (Järnefeldt); Selection (Grieg). **9.0,** Programme from **Prague.** **9.15,** Programme from **Prague.**

BRUSSELS (**512 metres**): 1.5 kW.—**5.0,** Dance Music from the St. Sauveur Palais de Danse. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Pianoforte Recital. **7.0,** Programme of Gramophone Records. **7.30,** "Radio-Chronique." **8.15,** Concert arranged by "La Meuse," "L'Antenne" and L'Hebdo T.S.F." **9.0,** Topical Talk. **9.10,** Concert (continued). **10.10,** News and Esperanto Notes. **10.15,** Orchestral Concert from the Palace Hotel Restaurant. **11.0** (approx.), Close Down.

BUDAPEST (**554 metres**); 20 kW.—**4.10,** Reading. **4.40,** Gramophone Selections. **6.0,** Lesson in Shorthand. **6.30,** Recital by Aranka Stransky. **7.0,** Concert of Light Music. **8.30,** Humorous Musical Entertainment. **9.30,** Time Signal and Weather Report, followed by Selections by Tzigane Orchestra.

CRACOW (**314 metres**); 1.5 kW.—**4.25,** Mr. Imich, Talk: The Necessity of analysing Food Products. **4.55,** Programme relayed from **Warsaw.** **5.50,** Miscellaneous Items. **6.10,** Mr. J. Regula, Talk: Foreign Politics of the Past Week. **6.58,** Time Signal from the Astronomical Observatory. **7.0,** Chimes from the Church of Notre Dame, and News. **7.30,** Programme from **Warsaw.** **9.0,** Programme from **Warsaw.** **9.30,** Relay of Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**411 metres**); 1.5 kW.—**1.30,** Weather Report and Concert of Gramophone Selections. **7.20,** News. **7.30** Entertainment by Val Vousden. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Concert: Overture by the Augmented Station Orchestra; Soprano Solos by Mme. Heffernan; Fantasia by the Station Orchestra; Pianoforte Solos by Marguerite King; Orchestral Selections, (a) Selection from Le Médecin malgré lui (Gounod), (b) Valse Caprice (Rubinstein), Marguerite King (Piano); The Station Orchestra. **9.30,** "Tea and Terror": Sketch by K. MacCormack's Company. **10.0,** Selections by the Augmented Station Orchestra. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**421 metres**): 4 kW.—**2.0,** Report on Snow Conditions. **2.5,** Programme for Children. **2.55,** Hints for the Housewife by Fini Pfannes. **3.35,** Orchestral Concert of New Dance Music: Fox-Trot, Ich kann dein grünes Seidenkleid nicht leiden (Egen); Tango, Leila (Dauber); Slow Fox-Trot, Er ist nur ein Barspieler (Monaco); Boston, Was weisst denn du wie ich verliebt bin (Jurmann); Fox-Trot, Ein bischen Liebe (Egen); Fox-Trot, Ausgerechnet Donnerstag (Jurmann); Tango, Schöne Frau, kannst du mir treu sein (Geiger); March, Das war in Bonn am Rhein (Stipschitz); Boston, Frühling ist es wieder (Engel-Berger); Fox-Trot, Schön ist der Mai in Vorderindien (Fall); Slow Fox-Trot, Ein Lied aus Hawai (Baldoni); Potpourri, Was Euch gefällt (Borchert). In the Interval—News and Announcements. **5.10,** Reading from the Works of Jean Paul, by O. W. Studtmann. **5.45,** Esperanto Lesson by W. Wischhoff. **6.15,** Herr Reigel, Talk: Free Thought. **6.45,** Karl Otto Windecker, Talk: The Bourneville Garden Factory in England. **7.15,** Variety Programme, followed by Dance Music from **Voxhaus.** **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**392 metres**); 4 kW.—**9.15 a.m.,** News. **10.0 a.m.,** Programme of Gramophone Records. **11.10 a.m.,** Weather Report. **11.15 a.m.,** Exchange Quotations. **11.30 a.m.,** Concert relayed from **Hanover** (298 metres); in the Interval at **11.55 a.m.,** Time Signal. **12.10,** News. **1.40,** Exchange Quotations. **2.30,** Review of Books. **3.0,** Illustrated Music Talk by Dr. Wilh. Heinitz. **3.30,** Programme of Italian Songs. **4.30,** Orchestral Concert. **5.30,** Alfred Diller, Talk: The Branches of Social Insurance. **6.0,** Talk: In the Footsteps of Goethe, relayed from **Hanover.** **7.25,** Weather Report. **7.30,** "Die Rabensteinerin"—Play in Four Acts (Ernst von Wildenbruch). **9.45,** Weather Report, News, Sports Notes, Snow Report and Programme Announcements. **10.5,** Johann Strauss Concert relayed from the Ostermann Restaurant. **10.50,** North Sea and Baltic Weather and Ice Report.

HILVERSUM (**1,071 metres**); 5 kW.—**9.40 a.m.,** Time Signal and Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Concert of Trio Music. **1.40,** Concert relayed from the Tuschinski Theatre, **Amsterdam.** **3.40,** Italian Lesson by Mr. Giovanni Rizzini. **4.40,** French Lesson by Mr. R. Lafont. **5.40,** Time Signal. **5.42,** Trio Concert. **6.55,** German Lesson by Mr. Edgar Grün. **7.25,** Police Announcements. **7.40,** Programme organised by the Workers' Radio Society—Concert and Talk. **11.10** (approx.), Close Down.

HUIZEN (**300 metres**); 4 kW.—Transmits on 1,852 metres from 6.40 p.m. **12.10,** Concert of Trio Music. **2.40,** Programme for Children. **5.10,** Gramophone Selections. **6.10,** Talk by M. K. W. Gerisch. **6.20,** Gramophone Selections. **6.30,** Catholic Bulletin. **6.40,** English Lesson. **7.10,** Lesson in Dress-making. **7.40,** Talk by M. L. J. M. Feber. **8.0,** Vocal and Instrumental Concert.

KALUNDBORG (**1,153 metres**); 7kW.—Programme also for **Copenhagen** (340 metres).—**6.30 a.m.,** Morning Gymnastics. **10.0 a.m.,** Weather Report. **12.15,** Educational Talk **2.0,** Programme for Children by Ingvald Lieberkind. **2.30,** Concert of Instrumental Selections. In the Interval—Recitations by Per Knutzen. **5.20,** Kommandant Floridon, Talk: The Savannas of Centra Africa. **5.50,** Weather Report. **6.0,** News and Exchange Quotations. **6.15,** Time Signal. **6.30,** Talk by S. Munk. **7.0,** Chimes from the Town Hall. **7.2,** Concert of Modern Operetta Music: March from Eva (Lehár) Waltz from Madame Pompadour (Fall); Selection (Kollo); Vilja's Air from The Merry Widow (Lehár); Waltz from A Waltz Dream (O. Straus); Selection from La Bayadère (Kálmán); Cavalier March and Waltz from Polenblut (Nedbal). **8.15,** Stig Bredstrup, Talk: Child Pictures from Dickens. **9.0,** (approx.), News. **9.15,** Concert of Light Music: Overture to The Postillon of Longjumeau (Adam); Gavotte tendre (Ganne); Selection from La Belle Hélène (Offenbach); Serenade for Strings (Chaminade); Fantasia on Danish Student Songs; Galopp, Prestissimo (Waldteufel). **10.0,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

KATTOWITZ (**416 metres**); 10 kW.—**3.0,** Concert of Gramophone Selections. **4.0,** Music Lesson by Prof. F. Sachse. **4.25** Children's Letter Box. **4.55,** Programme for Children. **5.50,** Announcements. **6.10,** Talk by Mr. K. Zienkiewicz. **6.45,** News and Time Signal. **7.0,** Talk by K. Rutkowski. **7.30,** Popular Concert. **9.0,** Weather Report and News. **9.30,** Dance Music.

Programmes from Abroad.—

LAHTI (1,504 metres) ; 35 kW.—4.35, Talk. 5.15, Orchestral Concert : Summer Night (Söderström) ; Elegy (Sohlström) ; Gavotte (Mehul-Burmester) ; Romance (Denza). 5.40, Musical Selections. 6.0, Talk. 6.20, Orchestral Selections : Songs of Persia (Kauppi) ; Juhannustulilla (Merikanto-Kauppi). 6.40, Song Selections. 7.0, Dramatic Programme. 7.40, Orchestral Selections, Finnish Songs and Dances. 7.45, News in Finnish and Swedish and Close Down.

LANGENBERG (462.2 metres) ; 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres), and **Münster** (265.5 metres).—12.5, Concert : Overture to Le Roi d'Yvetot (Adam) ; Waltz, Lebensmärchen (Fucik) ; Selection from Hans Heiling (Marschner) ; Selection from The Betrothed (Ponchielli) ; Baritone Solo ; Suite, Aus dem Nordlande (Frederiksen) ; Tango, Lieb' Ohne Treue (Polak) ; Boston, Lune de Miel (Waldteufel) ; Potpourri, Vom Rhein zur Donau (Rhode). 1.30, Household Hints. 2.40, Arthur Wurbs, Talk : The Bases of Wireless Technique. 3.0, Talk for Women by Adalberta Gerhards. 3.30, Dr. Jost, Talk : The Organisation and Legal Development of German Broadcasting. 3.55, Talk for Young People by Dr. Stählin. 4.20, English Lesson by Prof. F. Hase. 4.45, Chamber Music ; The Trout Quintet (Schubert). 5.30, Dr. Salmony, Talk : Chinese Plastic Art. 5.50, Economic Notes, Weather Report and Sports Notes. 6.15, Talk for Workers by Dr. Darius. 6.40, Prof. Hessen, Talk : What do we know of the Soul ? 7.0, Variety Programme. 9.0 (approx.), News, Commercial Announcements, followed by Orchestral Selections and Dance Music. 12.0 **Midnight** (approx.), Close Down.

LEIPZIG (382 metres) ; 4 kW.—2.0, Weather Report. 3.30, Orchestral Concert : Overture to Der False Stanislas (Verdi) ; Ballet Suite, Hiawatha (Coleridge-Taylor) ; Selections from The Girl of the Golden West (Puccini) ; Two Studies for Strings (Sinigaglia), (a) Rain Song, (b) Capriccio, Slavonic Dance (Felber) ; Selections from Hocheit tanzt Walzer (Ascher). 4.45, Wireless News and Talk. 5.20, Weather Report and Time Signal. 5.30, Programme relayed from **Königswusterhausen**. 6.0, Prof. Georg Witkovsky, Talk : Lessing as Art Critic. 6.30, " A Masked Ball " : Opera in Four Acts (Verdi), relayed from the Opera House, Chemnitz. 9.0 (approx.), Labour Market Report, News, Sunday Programme Announcements and Sports Notes. 9.30 Dance Music relayed from **Voxhaus**.

MADRID (Union Radio). Call EAJ7 (435 metres) ; 3 kW.—7.0, Chimes, Exchange Quotations and Dance Music. 8.0, Dr. Zito, Talk : Inventors and Inventions. 8.25, Time Signal and News. 10.0, Chimes, followed by Selection from " Curro Vargas " : Musical Play (Chap.). In the Interval at 12.0 **Midnight** (approx.), News. 12.30 a.m. (approx.) (Sunday), Close Down.

MILAN, Call 1MI (504 metres) ; 7 kW.—7.30, Time Signal, Wireless Talk and Announcements. 7.45, E. M. Ciampelli, Talk : The History and Æsthetics of Music. 8.0, Opera Relay from the Scala Theatre. In the Intervals, Reading by Angelo Sodini, News and Economic Notes.

MOTALA (1,365 metres) ; 40 kW.—Programme also for **Stockholm** (438 metres), **Böden** (1,200 metres), **Göteborg** (346.8 metres), **Malmö** (229 metres), **Ostersund** (720 metres), **Sundsvall** (545.5 metres).—4.0, Concert of Gramophone Selections. 4.30, Programme for Children. 5.0, Programme of Old Dance Music. 6.0, Selma Lagerlöf Reading, relayed from **Karlstad** (219 metres.) 6.45, Talk : Professions and Professionals. 7.0, Programme relayed from a Theatre. 8.0, Topical Talk. 8.15, News and Weather Report. 10.0, Dance Music. 11.0 (approx.), Close Down.

MUNICH (537 metres) ; 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres).—5.0, Trio Concert. 5.35, Labour Market Report. 6.0, The Letter Box. 6.30, Reading from Modern Norwegian Literature. 7.0, Concert of Light Music : Grillenbanner Marsch (Komzak) ; Overture to A Night in Venice (Joh. Strauss) ; Waltz, Wenn die Fusschen sich heben (Gilbert) ; Potpourri, Schlager auf Schlager (Lincke) ; Entr'acte from La Vie Parisienne (Offenbach) ; Waltz from The Count of Luxembourg (Lehár) ; Golden Foxtrot (Salabert) ; Potpourri, From Heidelberg to Barcelona (Borchert) ; March Folies Berg res (Lincke) ; 9.20, News. 9.45, Dance Music from the Galerie Arcadia. 11.30, Trio Concert : Overture to Poet and Peasant (Suppé) ; Selection from Carmen (Bizet) ; Violin Solo, Berceuse (Daubé) ; Selections (Reger), (a) Waldeinsamkeit, (b) Mit Rosen bestreut ; Tambourin chinois for Violin (Kreisler) ; Selections (Albéniz), (a) Rumores de Caleta, (b) Sevilla ; Nocturne from A Midsummer Night's Dream (Mendelssohn) Waltz from Der Rosenkavalier (R. Strauss) ; Wiegenlied (Brahms). 12.30 a.m. (Sunday), Close Down.

Saturday, January 19th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

NAPLES, Call 1NA (333 metres) ; 1.5 kW.—7.30, Wireless Talk. 7.40, Announcements, News and Harbour Notes. 8.0, Time Signal. 8.2, Instrumental Concert : Quintet Op. 16 (Beethoven) ; Quartet Op. 79 (Saint-Saëns). 9.0, " Il cane della Favola," Comedy in One Act (Saint-Saëns), followed by Review of the Week. 9.50, News. 9.55, Calendar and Programme Announcements. 10.0, Close Down.

OSLO (497 metres) ; 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—4.0, Orchestral Concert : The Black Domino (Auber) ; Rêve d'amour (Czibulka) ; Nocturne (Ambrosio) ; Humoresque (Tchaikovsky) ; Dreams of Yesterday (Humphries) ; Hindou Song (Rimsky-Korsakoff) ; Berceuse (Gretchaninoff) ; Mclagnine (Moszkovsky) ; Varlaengsler (Hilmboe) ; Mariska (Lehár) ; Intermezzo, Asta (Leopold). 5.0, Programme for Children by M. C. Bödtker. 6.15, Weather Report and News. 6.30, Prof. A. Fridrichssen Talk : Caesar and Christ. 7.0, Time Signal. 7.2, Revue relayed from " Le Chat Noir." In the Intervals—Weather Report, News and Topical Talk. 10.0, Dance Music from the Hotel Bristol. 11.0 (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres) ; 5 kW.—5.0, Pa deloup Concert. 7.10, Weather Report 7.50, " Le Journal Parlé."

PARIS (Petit Parisien) (336 metres) ; 0.5 kW.—8.45, Gramophone Selections, Talk, and News. 9.0, Concert : Overture to The Nuremberg Doll (Adam) Selection from La part du Diable (Auber). 9.25, News and Announcements. 9.30, Symphony Concert : First Movement of the Fourth Symphony (Glazounoff) ; Villanelle for Horn and Orchestra (Dukas). 10.0, News and Concert : Waltz Suite (Brahms) ; Aubade (Erlanger) ; Norwegian Dance (Grieg).

PARIS (Radio-Paris), Call CFR (1,769 metres) ; 15 kW.—12.30, Concert of Columbia Gramophone Records : Selections from Petrouchka (Stravinsky), by a Symphony Orchestra, conducted by the Composer ; Pianoforte Solo, Etude No. 23 (Chopin), by Francis Plante ; Pianoforte Solo, Première Ballade (Chopin), by Robert Casadesus ; Choral and Orchestral Selections from Boris Godounoff (Moussorgsky) ; Ready for the River, by the Trix Sisters ; Good Night, by Ted Lewis and his Band ; Minnetonka, by the Piccadilly Players ; Hello, Montreal, by Ted Lewis and his Orchestra ; Get out and get under the Moon, by Paul Whiteman and his Orchestra ; Tango, Retintin by Tipica Argentina Salvador Pizarro's Orchestra ; Tango, Desengaño, by Lucchesi's Orchestra ; In the Interval, News. 2.0, News, Exchange Quotations and Religious Information. 3.45, Dance Music by the Joss Ghislery Symphonians. In the Intervals, News. 6.30, Agricultural Report. 6.45, Musical Selections. 7.30, Pianoforte Lesson by M. Pierre Lucas. 8.0, Talk on The Success of the Stamp Anti-Tuberculosis Campaign, followed by News and Exchange Quotations. 8.15, Concert : Songs by Mme. Renée Danthesse ; Selections by Mario Cazes ; Dance Music by the Joss Ghislery Symphonians. In the Intervals, News.

POSEN (343 metres) ; 1.5 kW.—4.15, Talk on Scouts. 4.30, English Lesson by Dr. Arend. 4.55, Programme relayed from **Warsaw**. 5.50, Talk. 6.15, Musical Interlude. 6.45, Talk for Women by Mme. Swidzinska. 7.0, Miscellaneous Items. 7.30, Programme relayed from **Warsaw**. In the Intervals, Theatre and Cinema Notes and News. 9.0, Time Signal and News. 9.30, Cabaret Entertainment. 11.0, Concert arranged by La Maison Philips. 1.0 a.m. (Sunday), Close Down.

PRAGUE (343 metres) ; 5 kW.—3.30, Orchestral Concert : Quartet in D Major, Op. 165 (Schubert) ; Quartet in D Minor, Op. 34 (Dvorak). 4.30, Talk by Dr. Herben. 4.40, Dr. Cipera, Talk for Workers : How to Economise with Fuel in Industry and at Home. 4.30, Agricultural Programme. 5.0, German Transmission. 6.0, Popular Orchestral Concert. 6.45, Scientific Talk by Dr. Sommer-Batak. 7.0, Popular Programme. 8.16, " The Gloves " (Bilhauer and Hennequin). 9.0, Time Signal, News and Theatre Report. 9.25, Dance Music.

ROME, Call 1RO (444 metres) ; 3 kW.—4.30, Concert of Vocal and Instrumental Music. 5.30, Wireless Experiments. 5.40, Morse and Wireless Technique Lesson. 6.50, Talk, News, Exchange Quotations Sports Notes and Weather Report. 7.29, Time Signa and Topical Talk. 7.45, Band Concert : Military March, La Fedelissima (Cirenei) ; Suite all 'antica (Palombi) ; " Pace in Famiglia "—Sketch in One Act (Courteline) ; Selection from Iris (Mascagni) Topical Talk. Selections (Cirenei), (a) In riva al Tescio, (b) Danza ; Overture to Saul (Bazzini). 9.50, Topical Talk, News and Close Down.

SCHENECTADY, Call 2XAF (31.4 metres) ; 30 kW.—11.28, Weather Report. 11.30, White House Coffee Programme, from **New York**. 12.0 (**Midnight**), Phil Spitalny's Music from **New York**. 12.30 a.m. (Sunday), Musical Programme from **Rochester**. 1.30 a.m., Concert from the Studio. 2.0 a.m., Lew White Organ Recital from **New York**. 2.30 a.m., Programme by Mildred Hunt and the Marimba Orchestra, from **New York**. 3.0 a.m., Lueky Strike Programme from **New York** 4.0 a.m., Dance Music from the Hotel De Witt Clinton, **Albany** 5.0 a.m. (approx.), Close Down.

STAMBOUL (1,200 metres) ; 5 kW.—3.30, Concert 4.30, Exchange Rates and Grain Quotations. 5.15, Concert of Turkish Music. 7.30, Weather Report and Time Signal. 7.40, Orchestral Concert : Selection from A Life for the Czar (Glinka) ; Selection from La Juive (Halévy) ; Selections from the Ballets (Tchaikovsky), (a) Sleeping Beauty, (b) Le lac des Cygnes. 9.0, News and Close Down.

STUTTGART (374 metres) ; 4 kW.—2.0, Concert by Hermann Achenbach (Baritone) and the Station Orchestra. 3.35, Programme relayed from **Frankfurt**. 5.0, Time Signal and Weather Report 5.15, Dr. Rob. Braun, Talk : Freiherr von Reichenbach, The Inventor of the Od Doctrine, on the 60th Anniversary of his Death. 5.45, Dr. Wolff, Talk : Book-keeping. 6.15, Reading from the Works of Jack London, by Alfred Beierle. 7.0, Time Signal and Sports Notes. 7.15, Vocal and Instrumental Concert of Swabian Music : Serenade for String Trio (Halm) ; Recitations, (a) Epigrammes (Weckherlin and Haug), (b) Der ka te Michel (Schubart) ; Soprano Solo, Ballade (Zumsteeg) ; Recitation, Schulz und Pfarrer (Sebastian Sailer) ; Recitation, Aus den Kindheitserinnerungen (Just. Kerner) ; Pianoforte Solo from The Passion (Hermann Reutter) ; Soprano Solo, Lieder an einen Freund (Hugo Hermann) ; Recitations (Dr. Strauss), (a) Ermunterung, (b) Letzter Hauch, (c) Zu Cannstatt an der Brucken ; Soprano Solos, (a) Two Songs (Zoller), (b) Aus den Mörike-Liedern (Hugo Wolf) ; Recitation, Im Zeichen des Steinbocks (Kurz) ; Soprano Solo, Liebesleben (Knayer) ; Song, Unendlichkeit (Sculz) ; Recitations (Schussen), (a) Das war mein Gang, (b) Neujahr ; String Quartet (Bleyle) ; " Im Schwobaländle isch guat sein " : Humorous Dialogue by Erna Fassbinder, Ernst Stockinger and Folk Song Quartet, followed by Dance Music from the Pavillon Excelsior.

TOULOUSE (Radiophonie du Midi) (383 metres) ; 8 kW.—12.45, Concert. 8.0, News and Exchange Quotations. 8.30, Instrumental Concert : Pianoforte Solos, (a) Malaguena (Lecuona), (b) On Wings of Song (Liszt) ; Harp Solos, (a) Siciliana (Respighi), (b) L'Hirondelle (Renié) ; Piccolo Solos, (a) Piccolo Polka (Damaré), (b) Le Rossignol (Blémant) ; Oboe Solos, (a) Sous les Sapins (Blémant), (b) Mazurka, Une soirée près du lac (Leroux) ; Accordion Solos, (a) One-step, Une gosse rosse (Tagson), (b) Waltz, Je voudrais te fuir (Peyronnin) ; followed by Programme arranged by La Dépêche. In the Interval : Selections of Viennese Waltzes from (a) The Count of Luxembourg (Lehár), (b) Die Fledermaus (Strauss), (c) The Merry Widow (Lehár), (d) Bonbon de Vienne (Strauss). 11.0, North African News. 11.30 (approx.), Close Down.

VIENNA (520 metres) ; 15 kW.—4.45, Chamber Music : Pianoforte Solos, (a) Arabesque (Schumann), (b) Rondo in E Flat Major (Hummel), (c) La fille aux cheveux de lin (Debussy) ; 'Cello Sonata (Brüll) ; Sonata in C Major for Two Pianos (Bach) ; Sonata in D Major for Two Pianos (Mozart). 6.0, Siegfried Loewy, Talk : The Centenary of the First Performance of Faust, January 19th, 1829. 6.30, Baritone Song Recital by Celestino Sarobe : Basque Songs (arr. Donosti), (a) Nik baditut, (b) Goiza, (c) Uneak, (d), Euskal Eria ; Air from The Barber of Seville (Rossini) ; Air from A Masked Ball (Verdi) ; Seguidilla murciana (de Falla) ; Jota (de Falla) ; Air from The King of Lahore (Massenet) ; Air from Hamlet (Thomas). 8.10, Time Signal and Weather Report. 8.15, " A Washerwomen's Ball " : Humorous Selections from a Popular Old Viennese Carnival Custom (Edmund Skurawy), followed by Phototelegraphy Transmission.

WARSAW (1,415 metres) ; 10 kW.—5.50, Miscellaneous Items. 6.10, " Radio-Chronique," by Dr. M. Stepowski. 6.35, News. 6.56, Time Signal. 7.30 Concert of Light Music. In the Interval : Theatre Notes. 9.0, Weather Report and News. 9.5, Police Announcements and Sports Notes. 9.30, Dance Music from the Oaza Restaurant. 10.30 (approx.), Close Down.

SUNDAY, JANUARY 20th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Programmes from Abroad.—

ALGIERS, Call PTT (353 metres); 1 kW.—12.30, Instrumental Concert by the Station Orchestra conducted by C. Cerlini (Flautist). Violin Solo: Sérénade à Kubelik (Drdla) rendered by M. A. Gonzalès.

BARCELONA (Radio Barcelona), Call EAJ1 (350 metres); 1.5 kW.—11.0 a.m., Cathedral Chimes Relay. 11.5 a.m., Spanish and European Weather Report and Forecast, followed by Aviation Notes and Route Conditions. 1.30, Musical Selections by the Iberia Trio. Gramophone Records in the intervals. 2.45 to 5.30, No Transmission. 5.30, Opening Signal followed by Part Relay of an Opera from the Gran Teatro del Liceo. Exchange Quotations and Market Prices in the interval. 8.0 to 8.20, Bulletin from the Catalonian Institute of Agriculture at San Isidro. 8.20, Concert Programme by the Station Orchestra: Aphrodite, Suite (H. Février-Mout n), (a) La Reine Bérénice, (b) La Kasbah, (c) Dans les jardins de la déesse, (d) Danse au clair de lune. 8.40, Sports Notes. 9.0 (approx.), Close Down.

BERGEN (366 metres); 1.5 kW.—9.30 a.m., Relay of Religious Service. 11.30 a.m., Weather Conditions and Forecast followed by News Bulletin. 7.0, Orchestral Selections. 7.50, Talk on a Topical Subject. 8.0, Talk by Martin Birkeland: "Christopher Brunn." 9.0, Weather Conditions and Forecast, Late News and Announcements and Time Signal. 9.15, Dance Music Programme. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,649 metres); 40 kW.—7.55 a.m., Relay of Chimes from the Garrison Church at Potsdam. 9.0 a.m., Recital of Sacred Music with Sermon relayed from **Voxhaus**, followed by Berlin Cathedral Chimes. 10.30 a.m., Relay of Orchestral Concert from **Voxhaus**. 12.45, Experimental Transmission of Pictures. 1.30 to 2.25, Three Talks for Farmers from **Voxhaus**. 3.0, Talk. 3.30, Musical Selections. 5.0, Talk. 6.0, Talk. 7.0, Musical or Dramatic Programme, followed by Late News Bulletin. 9.30 Programme of Dance Music. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475 metres); 4 kW.—7.55 a.m., Chimes Relay from the Garrison Church at Potsdam. 8.0 a.m., Morning Recital of Religious Music, Vocal and Instrumental Items and Address, followed by Chimes Relay from Berlin Cathedral. 10.30 a.m. (approx.), Concert of Popular Music. 1.0, Elementary Morse Lesson, by Hans W. Priwin. 1.30 to 2.25, Programme of Agricultural Talks. 1.30, Practical Hints for the Farmer. 1.45, A Weekly Review of the Market and Weather Conditions. 1.55, Lecture on an Agricultural Topic. 2.30, Programme of Fairy Tales for Children. 3.0, Talk. 3.30, Musical Selections. 6.0, Talk. 6.30, Talk. 7.0 (approx.), Musical or Dramatic Programme followed by Weather Report and Forecast, Late News Bulletin and Sports Results. 9.30, Dance Music Programme. 11.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—9.30 a.m. to 10.30 a.m., Sermon. 12.0 Noon, Time Signal and Weather Conditions and Forecast. 12.5, Concert Programme. 6.29, Time Signal and Weather Conditions and Forecast. 7.0, Lessing Programme. Dramatic Representation of a Scene from "Nathan the Wise" by artistes from the Berne Stadtheater. 8.45, Sports Results, Late News and Announcements and Meteorological Report. 9.0, Musical Programme. 9.40 (approx.), Close Down.

BÉZIERS (158 metres); 0.6 kW.—8.30, Sports Bulletin. 8.45, Concert of the Latest Pathé-art Gramophone Records arranged by the Maison Relin-Minoles at Béziers. 10.30 (approx.), Close Down.

BORDEAUX (Radio Sud-Ouest) (238 metres); 1 kW.—12.30, Selections from the Latest Gramophone Records. 1.45, Close Down.

BRESLAU (321 metres); 4 kW.—Programme relayed by **Gleiwitz** (326 metres).—8.15 a.m., Chimes Relay from Christ Church. 1.0, Hints for the Amateur Gardener. 1.35, Talk by Adolf Kramer for Chess Players. 2.0, Programme for Children. 2.30, Agricultural Talk. 4.10, Concert of Popular Music. 8.15, Concert with the collaboration of R. Benatzky and Josma Selim. 9.0, Weather Report and News and Announcements followed by Programme of Dance Music. 11.0 (approx.), Close Down.

BRÜNN (432 metres); 3 kW.—3.30, Musical Selections. 4.30, Programme for Workers relayed from **Prague**. 5.0, News Bulletin and Musical Programme for German Listeners. 9.0, Time Signal, Latest News and Announcements and Dance Music relayed from **Prague**. 10.30 (approx.), Close Down.

BRUSSELS (512 metres); 1.5 kW.—5.0, Musical Selections by the Orchestra of the Armenonville Tea Room, Brussels. 6.0, Children's Entertainment, organised by the Children's Theatre under the direction of M. Léon Leroy. 6.30, Concert of Chamber Music. 7.20, Radio-Chronique. 8.0, "Eva"—Operetta (L'hár) in Flemish received from the Folies Bergères Theatre at Brussels, followed by Late News and Announcements from the Evening Press. 11.0 (approx.), Close Down.

BUDAPEST (554 metres); 20 kW.—8.0 a.m., General News and Announcements and Hints for Women. 9.0 a.m., Relay of Divine Service and Address. 3.15, Wireless Educational Programme, including Talks and Musical Recitals.

COLOGNE (263.2 metres); 4 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Langenberg** (462.2 metres) and **Münster** (265.5 metres).—.45 a.m., Lesson in Self Defence by Dr. Ludwig Bach. 7.5 a.m., Shorthand Lesson by Hans Molitor. 7.25 a.m., Survey in Esperanto by Alfred Dormanns of the Programmes for the Week. 7.30 a.m., Lesson in Esperanto by Alfred Dormanns. 8.5 a.m., Festival of Sacred Music with Vocal and Instrumental Items and Address. 12.0 Noon, Concert of Orchestral Music. 1.30, Talk. 2.15, Talk by Marie-Theres van den Wyenberg on Books and Periodicals for Women. 5.0 Talk. 5.30 Talk. 7.0 Dramatic or Musical Programme, followed by Late News Bulletin, Sports Notes and Concert. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—8.30, Musical Programme of Vocal and Instrumental Selections, Pianoforte Solos by Frau Fleischmann. 11.0, National Anthem and Meteorological Report. 11.15 (approx.), Close Down.

CRACOW (314 metres); 1.5 kW.—9.15 a.m. to 10.45 a.m., Sacred Service relayed from a Cathedral. 10.56 a.m., Fanfare Relay from the Church of Notre Dame, followed by Time Signal and Weather Report and Forecast. 11.10 a.m., Orchestral Concert relayed from the Philharmonic Hall, **Warsaw**. 1.0 and 1.20, Talks for Farmers. 1.40, Agricultural Bulletin by Dr. St. Wasniewski. 2.0, Report of Weather Conditions. 2.15, Concert of Orchestral Music by the Philharmonic Orchestra, relayed from **Warsaw**. 6.0, Miscellaneous Items. 6.20. Talk. 6.56. Time Signal from the Observatory. 7.0, Fanfare relayed from the Church of Notre Dame, followed by Sports Bulletin. 7.30, "La Crèche de Noël à Cracovie," rendered by a Students' Choir, relayed from the Hall of the Cracow Industrial Museum. 9.0, Programme from **Warsaw**. 9.30, Relay of Concert from the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—8.30, Programme relayed from **Cork**. Soloist Concert: Sonata for Violin and Pianoforte rendered by Mr. W. E. Brady and Miss G. Sullivan. 11.0, National Anthem and Weather Report and Forecast. 11.15 (approx.), Close Down.

GENEVA (760 metres); 1.5 kW.—9.0 a.m., Divine Service with Sermon relayed from the Victoria Hall. 3.0, Relay of a Concert from the Plainpalais by the Suisse Romande Orchestra, conducted by M. Fernand Closset.

HAMBURG. Call KA (in Morse) (392 metres); 4 kW.—Programme relayed by **Bremen** (273 metres), **Hanover** (298 metres), and **Kiel** (250 metres).—7.25 a.m., Time Signal. 7.30 a.m., Weather Report and Forecast, followed by General News Bulletin. 7.50 a.m., Talk on Economic Problems of the Day. 8.0 a.m., Weekly Legal Talk. 8.15 a.m., Morning Festival. 10.0 a.m., Talk. 11.55 a.m., The Nauen International Time Signal. 12.5 (for **Hamburg** and **Kiel**), Sunday Concert. 12.5 (for **Bremen**), Sunday Concert by the Station Orchestra. 1.5 (for **Hanover**), Gramophone Selections. 1.0, Programme for Children. 10.50 (for **Hamburg**, **Bremen** and **Kiel**), Weather Report and Forecast for the North Sea and Baltic. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—12.10, Lunch-time Music by the Station Trio. 1.40, Musical Selections. 2.10, Concert relayed from the Concertgebouw, **Amsterdam**. 7.40, Time Signal. 7.42, General News and Announcements. 7.55, Concert Programme. 10.40 (approx.), Close Down.

HUIZEN (300 metres); 4 kW.—Transmits from 6.40 on 1,852 metres.—8.5 a.m., Divine Service. 9.10 a.m., Relay of Religious Service. 12.10, Selections by the Station Trio. 2.10, Concert Programme. 5.30, Relay of Divine Service (on 1,852 metres) and Address from an Evangelical Lutheran Church at **Amsterdam**. Sermon on the 30th Verse of 3rd Chapter of the Gospel according to St. John. Preacher: J. P. v. Heest. 7.10, Talk. 7.40 (approx.), Concert Programme. 10.25, Epilogue by the Choir under the direction of Mr. Jos. H. Pickkers. 10.40 (approx.), Close Down.

KALUNDBORG (1,153 metres); 7 kW.—Programme also for **Copenhagen** (340 metres).—9.0 a.m., Relay of Divine Service, with Sermon from a Church in **Copenhagen**. 10.30 a.m. to 10.40 a.m. (**Kalundborg** only), Weather Report and Forecast from the Copenhagen Meteorological Institute. 5.50 (**Kalundborg** only), Weather Report and Forecast from the Copenhagen Meteorological Institute. 6.0, Press News and Announcements. 6.15, Time Signal. 6.30, Talk. 7.0, Relay of Chimes from Copenhagen Town Hall. 7.5, Concert Programme. 9.0, Orchestral Concert by the Station Orchestra. Fantasia for Oboe and Orchestra (Vincent d'Indy) rendered by Henry Munck. 10.0, Dance Music Programme by the Palace Hotel Orchestra, conducted by Teddy Petersen. In the interval at 11.0, Chimes relayed from Copenhagen Town Hall. 11.30 (approx.), Close Down.

KATTOWITZ (416 metres); 10 kW.—9.15 a.m., Sacred Service Relay. 10.56 a.m., Time Signal. 11. a.m., Weather Conditions and Forecast. 11.15 a.m., Concert of Light Music by the Station Quartet. 1.0, Talk: "The Silesian Gardener." 1.20 and 1.40, Two Agricultural Talks. 2.0, Weather Report and Forecast. 2.15, Concert of Symphony Music by the **Warsaw** Philharmonic Orchestra, conducted by M. Glinsky and Mme. M. Marco (Violinist): Prelude to "Monna Lisa" (L. Rozycki). 6.0, Miscellaneous Information. 6.20, Programme of Humorous Items by Professor St. Ligon. 6.56, Time Signal. 7.30, Evening Concert relayed from **Warsaw**. 9.0, Weather Report and Forecast, Press News and Announcements and Sports Results. 9.30, Programme of Dance Music. 10.30 (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—2.30, Fairy Tales, Songs and Music for the Children. 3.0, Programme for Young People. 3.30, Talk on Hygiene by Doctor Jurgelionis. 4.0, Talk by J. Ardickas on Economics and the Life of the People. 4.55, Weather Report and Forecast and News and Announcements. 5.0, Talks in the Polish and the Lithuanian Languages.

KÖNIGSBERG (280 metres); 4 kW.—Programme relayed by **Danzig** (405 metres).—8.0 a.m. (Königsberg only), Sacred Recital with Vocal and Instrumental Items and Address. 10.0 a.m. (Königsberg only), Weather Conditions and Forecast. 10.5 a.m., Musical Programme. 11.55 a.m., The Nauen International Time Signal, followed by Meteorological Report. 1.0, Chess Talk by P. S. Leonhardt. 2.0, Spanish Lesson for Beginners by Kurt Metze. 7.0, Relay of "Gasparone": Operetta in Three Acts by F. Zell and Richard Genée, Music by C. Millöcker. Conducted by Carl Hrubetz and produced by Kurt Lesing, followed by News Bulletin and Sports Notes and Programme of Dance Music. 11.30 (approx.), Close Down.

LAHTI (1,504 metres); 35 kW.—Programme also for **Helsingfors** (374 metres).—8.0 a.m., Relay of Religious Service. 9.50 a.m., General News Bulletin. 10.5 a.m., Musical Selections. 10.59 a.m., Weather Report and Forecast and Time Signal. 3.0, Music by the Station Orchestra conducted by Erkki Linko. 3.50, Talk. 4.57, Time Signal and Weather Report and Forecast. 6.0, Musical Programme. 7.10, Concert Programme. 7.30, Concert by the Station Orchestra, Legend (Dvorák). 7.45, Late News Bulletin in the Finnish and Swedish Languages. 8.30 (approx.), Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 meteres), **Cologne** (263.2 metres) and **Münster** (265.5 metres).—6.45 a.m., Lesson in Self Defence by Dr. Ludwig Bach. 7.5 a.m., Lesson in Shorthand by Hans Molitor. 7.20 a.m., Review in Esperanto of Forthcoming Programmes by Alfred Dormanns. 7.30 a.m. to 7.55 a.m., Lesson in Esperanto by Alfred Dormanns. 8.0 a.m., Festival of Religious Music with Address in the interval. 12.0 Noon, Concert Programme. 1.30, Talk. 3.0, Talk or Reading. 3.30, Concert of Popular Music. 5.0, Talk. 7.0, "The Taming of the Shrew": Opéra-Comique in Four Acts by H. Götz, text following that by Shakespeare arranged by I. V. Widmann, followed by Late News and Announcements and Light and Dance Music. 11.0 (approx.), Close Down.

LEIPZIG (382 metres); 4 kW.—Programme relayed by **Dresden** (276 metres).—7.30 a.m., Recital of Organ Music. 8.0 a.m., Morning Musical Recital. 12.0 Noon Time Signal. 12.2, Talk. 12.30, Talk. 1.0, Foreign Press Review followed by Notes on Foreign Policy. 2.0 (approx.), Gramophone Selections. 3.0, Literary or Dramatic Programme. 4.0, Musical Programme. 5.30, Talk. 6.0, Talk. 8.0, Scenes from "King Lear"

Programmes from Abroad.—

Tragedy by William Shakespeare in a New Translation by Hans Rothe, followed by News and Announcements and Sports Results and Dance Music relayed from **Berlin**. 11.30 (approx.), Close Down.

LYONS (Radio Lyon) (291 metres); 1.5 kW.—7.30, The Radio Lyon "Journal Parlé" consisting of News and Announcements, Review of the Press and Theatre Programme Notices. 8.0, Concert of Popular Music rendered by Madame Ducharne (Pianist), M. Camand (Violinist) and M. Testanière (Cellist): Selections from "The Nuremberg Doll" (Adam). 10.0 (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (435 metres); 1.5 kW.—Programme relayed by **Salamanca** (EAJ22) (405 metres).—2.0, Relay of Chimes and Time Signal. 2.5, Musical Selections by the Station Orchestra with Interlude by Luis Medina, Good Friday Incantation from "Parsifal" (Wagner). 3.30 to 7.0, No Transmission. 7.0, Chimes. 7.5, Musical Programme. 8.0, Talk and Reading. Famous Journeys—Extracts from Interesting Stories of Great Voyages. 8.30 to 10.0, No Transmission. 10.0, Chimes and Time Signal. 10.5, Musical Programme. 12.0 Midnight, Relay of Chimes, followed by Dance Music Programme by the Palermo Orchestra relayed from the Alkazar. 12.30 a.m. (approx.) (Monday), Close Down.

MILAN, MI (504 metres); 7 kW.—9.0 a.m., Opening Signal and English Language Lesson. 9.30 to 10.30 a.m. (approx.), Vocal and Instrumental Concert of Religious Music. 11.30 a.m., Time Signal. 11.35 a.m., Selections by the Station Quartet. 3.5, Variety Concert: "La Dame blanche". Overture (Boieldieu), rendered by the Station Quintet. 4.15, Selections by the Tzigane Orchestra from the Fiaschetteria Toscana. 5.0 to 6.55, No Transmission. 6.55, Opening Signal. 7.0, Review of the Press. 7.15, Talk. 7.25, News from the World of Sport. 7.30, Time Signal. 7.35, Opera Relay. In the interval: Sports Notes and General News Bulletin. 10.30 (approx.), Close Down.

MOTALA (1,365 metres); 40 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Malmö** (229 metres), **Ostersund** (720 metres) and **Sundsvall** (545.5 metres).—10.0 a.m., Relay of Divine Service from a Church in **Stockholm**. 4.0, Programme for Children. 4.55, Chimes relayed from **Stockholm** Town Hall. 5.0, Divine Service Relay. 6.5 (approx.) Relay of Play "The Wild Duck" (Ibsen). 7.45, Programme of Choral Music. 8.15, News and Announcements and Weather Conditions and Forecast. 8.40, Concert Programme. 10.0 (approx.), Close Down.

MUNICH (537 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres) and **Nuremberg** (240 metres).—9.0 a.m., Catholic Morning Recital with Address. 10.0 a.m., Relay of Chimes from the Munich Town Hall. 10.10 a.m., Wireless Weather Chart for Bavaria. 1.5, Time Signal, Weather Report and Forecast and Review of Forthcoming Programmes. 8.35, Relay of Foreign Stations. 9.20, News and Announcements. 11.0 (approx.), Close Down.

NAPLES, Call 1NA (333 metres); 1.5 kW.—8.30 a.m., French Language Lesson under the direction of Professor Etienne Verdier. 9.0 a.m., Sacred Music Recital. 3.45, Programme for the Children. 4.0, Musical Programme. 4.30, Time Signal. 7.30, News and Announcements. 7.50, Report by the Naples Harbour Authorities. 8.0, Time Signal. 8.2, Musical Programme: Selections from Opera: Final Trio from Act V of "Faust" (Gounod), rendered by E. Blandi (Soprano), R. Rotondo (Tenor), and C. Albini (Bass), with accompaniment by the Station Orchestra. 9.0, Sports Review. 9.50, Calendar and Future Programme Announcements. 10.0 (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres); 5 kW.—7.56 a.m., Time Signal on 32.5 metres. 9.28 a.m., Time Signal on 1,488 metres. 5.0, Pasdeloup Concert Relay. 7.10 to 7.20, Meteorological Report. 7.5 (approx.), "Le Journal Parlé par T.S.F.," consisting of Talks on Hygiene, Police History, Sports Bulletin and Racing Results from "Paris Sport." 7.56, Time Signal on 32.5 metres. 8.0, Musical or Dramatic Programme. 10.26, Time Signal on 1,488 metres.

PARIS (Petit Parisien) (336 metres); 0.5 kW.—8.45, New Gramophone Records. 8.50, Talk. 8.55, News and Announcements from the Press. 9.0, Orchestral Concert with the collaboration of artistes from the Opéra and Opéra-comique. Selections from "Griséldis"—Opera (Massenet). 9.25, News and Announcements. 9.30, Programme of Symphony Music under the direction of Professor Estyle of the Paris Conservatoire. 10.0, Late News and Announcements. 10.15, Selections of Orchestral Music. 11.0 (approx.), Close Down.

Sunday, January 20th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

PARIS (Radio Paris), Call CFR (1,769 metres); 15 kW.—8.0 a.m., General News and Announcements and Press Review. 8.30 a.m., Physical Culture Lesson by Doctor Diffre. 12.0 Noon, Sermon, followed by Festival of Instrumental and Choral Music. 12.30, General News and Announcements. 12.45, Popular Concert by the Albert Locatelli Orchestra, with interlude by Bilboquet: Selections from "La belle Hélène" (Jacques Offenbach). 4.30, Latest Gramophone Records arranged by "L'Industrie Musicale." News and Announcements in the interval. 6.30, Agricultural Bulletin. 6.45, Gramophone Selections. 7.30, General News and Announcements. 7.45, Radio Paris Guignol. 8.30, Café-Concert and Radio-Paris Music Hall. Station Orchestra, conducted by Maurice André. In the intervals: News and Announcements and Press Review, followed by Notices. 10.30 (approx.), Close Down.

POSEN (343 metres): 1.5 kW.—9.15 a.m. to 10.45 a.m., Divine Service relayed from Posen Cathedral. 11.0 a.m., Time Signal. 11.15 a.m. and 11.30 a.m., Two Talks for Peasants. 11.55 a.m., Programme for Peasant Women. 2.15, Symphony Concert relayed from **Warsaw**. 4.30, (approx.) Miscellaneous Items. 4.50, Programme for Children. 5.20, Vocal Recital by Wanda Roesslerowna (Mezzo-Soprano) with Professor François Lukasiewicz at the Piano: Aria from the Opera "The Evangelist" (Kienzl). 6.0, Bulletin of the Catholic Polish Youth Association. 6.20, Relay of Talk from **Warsaw**. 6.45, Talk by M. B. Busiakiewicz "Silva rerum." 7.5, Programme of Various Items. 9.0, Time Signal. 9.5, Sports Notes and Announcements. 9.20, Dancing Lesson by Mr. Starski. 9.40, Dance Music Programme from the Palais Royal Restaurant. 11.0 (approx.), Close Down.

PRAGUE (343 metres); 5 kW.—8.0 a.m., Concert of Religious Music. 9.0 a.m., Talk for Farmers. 12.0 Noon, Notes on Trade and Industry. 12.15, Sociological Talk. 3.30, Concert Programme. 4.30, Talk for Workers. 5.0, Programme of News and Musical Selections for German Listeners. 9.0, Time Signal and Late News Bulletin followed by Dance Music. 10.30 (approx.), Close Down.

RABAT, Call PTT (414 metres); 2 kW.—12.30 to 2.0, Music Selections by the Station Orchestra. 4.0 to 5.0, Selections of Military Music. 8.15, "Le Journal Parlé," News Bulletin. 8.30, Concert by the Station Orchestra. At 9.30, in the intervals, Sports Talk and Results by M. Barrier. 10.30, Selections of Jazz Music from the "Chaumière de Rabat." 11.0 (approx.), Close Down.

ROME, Call 1RO (444 metres); 3 kW.—8.30 a.m., Opening Signal, followed by Lesson in the German Language. 9.0 a.m., Recital of Religious Music. Vocal and Instrumental Selections. 9.45 a.m. to 12.0 Noon, No Transmission. 12.0 Noon, Opening Signal. 12.5 to 1.0, Selections by the Station Trio. 1.0 to 4.0, No Transmission. 4.0, Opening Signal. 4.5 to 5.30, Concert of Light Music. 6.50, News Bulletin and Review of the Press. 7.10, (approx.) Talk for Agriculturists. 7.15, Sports Notes and General Announcements. 7.29, Time Signal. 7.31, Talk on Topics of the Day. 7.45, "The Daughter of the Regiment"—Lyrical Comedy in Three Acts by Gaetano Donizetti, rendered by the Station Choir and Orchestra with Soloists. In the interval: Short Story Reading. 9.50, Latest News from the Press. 10.0 (approx.), Close Down.

SCHENECTADY, Call 2XAF (19.56 metres); 30 kW.—4.0, Divine Service Relay. 6.30, Peerless Reproducers, Programme from **New York**. 9.0, Address for Men by Doctor Parkes Cadman, relayed from **New York**. 10.30, Violin Recital by Arcade Birkenholz, relayed from **New York**. 11.0, Stetson Parade: The American Legion Band from **Boston, Mass.** 11.30, The Acousticon Programme, relayed from **New York**. 12.0 Midnight, The Old Company's Programme relayed from **New York**. 12.30 a.m. (Monday), Relay of Programme from the Capitol Theatre, **New York**. 2.0 a.m., Talk on "Our Government," by the Editor of the "United States Daily," relayed from **Washington, D.C.** 2.15 a.m., Atwater Kent Programme from **New York**. 3.15 a.m., Correct Time. 3.17 a.m., Programme by the National Light Opera Company, relayed from **New York**. 4.15 a.m., Experimental Television Transmission. 4.30 a.m. (approx.), Close Down.

STAMBOUL (1,200 metres) 5 kW.—3.30, Concert Programme. 4.30, Stock Exchange Quotations and Grain Market Prices. 5.15, Selections of Turkish Music. 7.30, Weather Report and Forecast and Time Signal. 7.40, Concert of Orchestral Music. 9.0, Late News and Announcements. 9.30 (approx.), Close Down.

STUTTGART (374 metres); 4 kW.—Programme relayed by **Freiburg** (574 metres).—11.0 a.m., Relay of Orchestral Concert followed by Latest Gramophone Selections. 1.0, Entertainment for Children. 2.0, Talk or Reading. 2.30, Musical Programme. 7.15 (approx.), Concert, Opera or Play followed by Late News and Announcements and Sports News. 10.30 (approx.), Close Down.

TALLINN (408 metres); 2.2 kW.—5.0, Concert of Popular Music. 5.30, Talk. 6.0, Concert of Orchestral and Soloist Music. 9.0 (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (383 metres); 8 kW.—12.15, Agricultural Programme. 12.45, Concert. 1.0, Time Signal followed by Concert (continued). 1.45, News Bulletin from Le Télégramme, L'Express and Le Midi Socialiste. 8.0, Exchange Quotations and Grain Prices from Paris supplied by L'Agence Fournier. 8.15 (approx.), News of the Day from "La Depêche and Le Petit Parisien. 8.30, Concert of Orchestral Music. 9.10, Concert of Instrumental Music arranged by "L'Association des Commerçants Radio-Electriciens du Midi": Saxophone Solo, Pavane pour une Infante défunte (Maurice Ravel). Time Signal in the interval at 9.0. 10.15, News from North Africa and Late News Bulletin. 10.30 (approx.), Close Down.

VIENNA (520 metres); 15 kW.—Programme relayed by **Graz** (354 metres), **Innsbruck** (283 metres), **Klagenfurt** (219 metres) and **Linz** (250 metres).—10.0 a.m., Concert of Symphony Music by the Vienna Symphony Orchestra and Soloists. 3.0, Concert of Orchestral Music. 6.30, "Nathan the Wise": a Dramatic Programme in Five Acts by G. E. Lessing (born January 22nd, 1729), produced by Doctor Hans Nüchtern, followed by Programme of Light Music and Experimental Transmission of Pictures. 10.30 (approx.), Close Down.

VILNA (427 metres); 1.5 kW.—9.15 a.m. to 10.45 a.m., Divine Service relayed from a Cathedral. 10.56 a.m., to 4.30, Programme relayed from **Warsaw**. 10.56 a.m., Time Signal and Relay of Fanfare from the Church of Notre Dame at **Cracow**. 11.5 a.m., Aviation Route Notes and Weather Conditions and Report. 11.10 a.m. Concert of Symphony Music by the Warsaw Philharmonic Orchestra. 1.0 to 2.0, Three Agricultural Talks. 2.15, Symphony Concert by the **Warsaw** Philharmonic Orchestra. 4.30 (approx.), Talk in Lithuanian. 5.0, Gramophone Records. 5.20, Children's Corner. 5.45, Musical Selections on the Zither by Professor Witold Jodko. 6.0 (approx.), Humorous Programme. 6.30, Zither Music by Professor Witold Jodko. 6.50 (approx.), Time Signal. 7.0 to 10.30, Programme relayed from **Warsaw**. 7.0, "Intellectual Amusements" by M. C. Jablonowski. 7.30, Violin Recital. Sonatina in C. Major (Franz Schubert) rendered by S. Frenkel (Violinist) and Professor L. Urstein (Pianist). 9.0 Aviation Notes and Weather Conditions and Forecast. 9.5, News supplied by the Polish Telegraph Agency. 9.20, Police Notes and Sports Results. 9.30, Programme of Dance Music relayed from the "Oaza" Restaurant, **Warsaw**. 10.30 (approx.), Close Down.

WARSAW (1,415 metres); 10 kW.—9.15 a.m. to 10.45 a.m., Divine Service Relay from a Cathedral. 10.56 a.m., Time Signal. 11.0 a.m., Fanfare relayed from the Church of Notre Dame, **Cracow**. 11.5 a.m., Report on Aviation Routes and Meteorological Report. 11.10 a.m., Morning Symphony Concert organised by the Department for Education and Culture of the Magistracy of **Warsaw**. 1.0 to 2.0, Three Agricultural Talks. 2.0, Weather Conditions and Forecast. 2.15, Symphony Concert relayed from the Warsaw Philharmonic Hall. 4.30, Talk. 4.55, Talk. 5.20, Popular Concert. 6.0, Various Items. 6.20, Talk. 6.45, News Bulletin. 6.56, Time Signal. 7.0, Talk by C. Jablonowsky on Intellectual Amusements. 7.30, Violin Recital by Mr. S Frenkel with Professor L. Urstein at the piano: Nocturne and Tarantella (K. Syzmanowski). 9.0 Report on Aviation Routes and Weather Conditions and Forecast. 9.5, News Bulletin from the Polish Telegraph Agency. 9.20, Police Announcements and Sports Notes. 9.30, Programme of Dance Music relayed from the "Oaza" Restaurant. 10.30 (approx.), Close Down.

ZÜRICH (489 metres); 1 kW.—10.0 a.m., Musical Selections. 3.0, Music by the Castellano Orchestra relayed from the Carlton Elite Hotel. 6.30, Time Signal. 6.32, Protestant Address. 7.0, Request Concert—Artistes: Julius Bächi ('Cellist), Raffaele Terniniello (Clarinettist), Otto Strauss (Pianist); Songs by Torelli, rendered by Frau C. Müller-Schapier with Flora Pestalozzi-Hofer at the piano. 9.0, Late News and Announcements supplied by the Neue Züricher Zeitung. 9.30 (approx.), Close Down.

SCREEN GRID VOLTS

Hints on Regulating and Measuring Voltage.

By "RADIOPHARE."

IT is now generally appreciated that it is practically impossible to design an H.T. eliminator to give an exact predetermined output voltage, or series of voltages, for the reason that certain assumptions—often based on what must be largely guesswork—have to be made with regard to the output load. For instance, individual valves of the same type seldom have identical characteristics, and even the maximum permissible grid bias (which, of course, influences anode current) will depend to a certain extent on output circuit impedance. Fortunately, as far as ordinary valves are concerned, all this is of little importance, as their requirements as to the value of anode pressure are by no means exacting.

An exception is found in the screened grid amplifying valve; here the voltage impressed on the outer grid must be adjusted with a fair degree of accuracy, and from the fact that current consumption is low, close regulation becomes a matter of some difficulty; where the voltage of the source is considerably in excess of requirements it will generally be convenient to adopt the "potentiometer" method of supply, as described at length in a recent article[1] in this journal.

by using it, there is a much greater chance of obtaining an applied voltage approximating sufficiently closely to that desired.

Many readers will share with the writer a desire to know, rather than to guess at, the conditions under which the valves are operating. Such knowledge, while perhaps not essential when the set is working well, is particularly useful when things are not going as they should, and not the least important feature of the potentiometer method is that it enables us to make an accurate measurement of screen grid voltage without any apparatus other than a reasonably good voltmeter—an instrument that nowadays forms part of the equipment of everyone who takes his hobby seriously.

Measuring Working Voltage.

A suggested method of making provision for taking actual voltage readings is shown in Fig. 1 (a), from which it will be seen that the resistance of the voltmeter itself forms one of the potentiometer arms; its value is easily ascertained by multiplying its rated figure of "ohms per volt" by the voltage at full scale deflection. The value of the other resistor in series with the H.T.

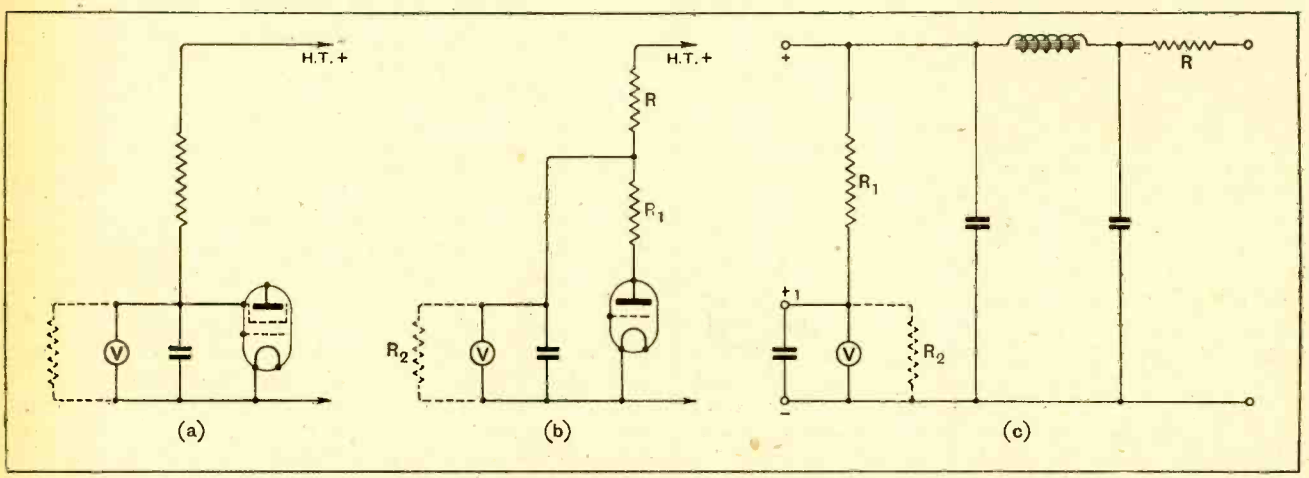


Fig. 1.—Method of measuring voltage applied to screen grid (a) and anode bend detector (b). A simple eliminator circuit, including provision for measurement of screen grid voltage, is shown in diagram (c).

This system has the advantage, as compared with the use of a simple series resistance, of offsetting to a great extent the influence of such factors as variation in valve characteristics and consequently the current consumed; supply is then estimated in accordance with instructions given in the article to which reference has already been made. If a correct reading is indicated, the meter is removed and is replaced by a fixed resistor having the same value as the instrument; this part of the operation need present no difficulty, as resistances in a wide range of values, guaranteed accurate within limits close

[1] "Dropping Volts," by W. I. G. Page, *The Wireless World*, November 28th, 1928.

Screen Grid Volts.—

enough for our purpose, are now obtainable commercially.

If it is found that the voltage is not sufficiently near to that specified, it may be adjusted by altering the value of the series resistor (a variable component may, of course, be used with advantage), or, in certain cases, it may be possible slightly to vary the total output of the eliminator without introducing any detrimental change in voltage supply to the remaining valves.

In cases where a very high eliminator voltage is developed it may at times be found that the resistance of the two arms of the potentiometer in series (which will be determined by that of the arm formed by the meter) will be insufficient, and will allow an excessive flow of current. This is especially likely to happen when the meter is of comparatively low resistance. Fortunately, there is an easy way of increasing potentiometer resistance: if a resistor of a value equal to that of the instrument is connected in series with it, the actual voltage existing can be ascertained by doubling the figure indicated. At the same time, the total resistance of the potentiometer will be increased and current flow will be reduced.

As stated in the article, "Dropping Volts," it is even more important to fit a potentiometer feed to an anode bend rectifier valve when there is a considerable excess voltage to be absorbed; although this is rather getting away from the screened grid valve, a diagram is given (Fig. 1 (b)), showing how a voltage measurement may be made when a valve is carrying out this function. Referring to the diagram, R and R_2 are the potentiometer resistances, the latter being that which replaces the voltmeter when a reading is not actually being taken; R_1 is the coupling resistance.

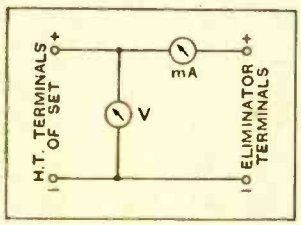


Fig. 2.—Measuring voltage output of an eliminator.

In certain receivers intended to give moderate volume and having circuit arrangements which are not prone to interaction it is possible to feed all the anodes from a common terminal delivering a voltage of from 120 to perhaps as much as 150. As far as the H.F. side of such a set is concerned, it will be unnecessary to use decoupling resistances of more than a few hundred ohms, in which the voltage drop will be so small that it may be ignored. If there is but a single L.F. amplifier, interstage coupling is not likely to give trouble unless the detector is preceded by a tuned anode H.F. stage, and very simple smoothing and voltage-reducing devices will often be adequate for the eliminator. However, if a screened grid valve (or valves) is used in the H.F. amplifier, some provision must be made for reducing screen grid voltage, and it is sometimes convenient to include this device in the eliminator. The circuit of this unit may be on the lines of that given in Fig. 1 (c), in which R is the voltage-reducing resistance for the main anode supply (marked +), and R_1, R_2, the potentiometer resistances for feeding the valve screen (or screens) through terminal $+_1$. As before, the resistance shown in dotted lines (R_2) replaces the meter when it is removed after taking a reading.

It is not always easy to measure the actual main voltage output of an eliminator unless one has access to special apparatus, but it is necessary to have this knowledge in order to calculate with some accuracy the value of absorbing resistances, however they may be connected or for whatever purpose they may be used. Probably the simplest way is to connect a voltmeter and milliammeter in the manner shown in Fig. 2; this will give the desired results provided the voltmeter consumes less current than the valves. The method of procedure is to insert the milliammeter in the common supply lead, and to note its reading, it being assumed that the valves are operating under normal conditions as to grid bias, filament brilliancy, etc. The voltmeter should now be connected in the position shown, when it will be noticed that an increased current is registered by the milliammeter; now dim the output valve filament by turning its rheostat till current is brought back to its former value. The voltmeter will now indicate the true voltage which will exist when original conditions are restored by removing the meters and turning the filament rheostat to its former setting.

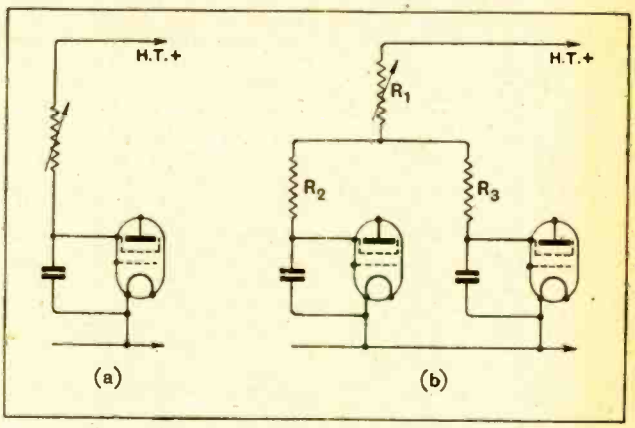


Fig. 3.—Regulating screen grid voltage by an adjustable series resistance.

Use of Series Resistances.

It must not be assumed that the simpler series resistance method of screen grid voltage reduction has no field of usefulness; it can be quite satisfactory, particularly if use is made of a good resistance element with continuous or semi-continuous adjustment. This method, which is particularly applicable when the voltage to be absorbed is comparatively low, is shown in Fig. 3; diagrams (a) and (b) give, respectively, the connections for supplying one and two valves. In the second, R_1 is the regulating resistance, and R_2, R_3, are simply isolating resistances of a few hundred ohms. In using this method, measurement of applied voltage is not possible, or rather, if we try to do it, we come back to the arrangement of Fig. 1 (a). The best procedure is to choose a variable resistor with a maximum value higher by a fair margin than is likely to be required, and then merely to set its control to the point found to give best results.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

More Television Tests?—Political Broadcasting.—A Programme of Talk.

The "D-G" Returns.

Sir John Reith, who has been taking a short recuperative holiday in Switzerland, returned to Savoy Hill last week.

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So Talks *are* Popular!

Savoy Hill can be forgiven a chuckle over the ironical results of a London newspaper competition in which readers have been asked how they would fill five minutes at the microphone. Nearly all the competitors are anxious to give a *talk!*

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Ambitious Talks Department.

Not even the Germans, who are prolific enough as broadcast talkers, could fail to be impressed by the sheer voluminousness of the B.B.C.'s Talks and Lectures syllabus covering the next three months. The compilation of the time-table must have been a big task in itself, while the number of subjects dealt with reveals a nice appreciation of the exact strength of a camel's back. There is this to be said: in the last two years each talks syllabus has been an improvement on its predecessor, and nowadays there must be few listeners who can conscientiously grumble at everything which the talks people lay before them.

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Talks for the Troops.

The War Office recently sent a circular to the Army Commands in Britain extolling the value of broadcast education. In consequence Savoy Hill has already received a visit from a representative of the Northern Command (York), seeking full details of the educational programme and time-tables. Enquiries have also been received from the Army authorities at Exeter, so it looks as if the canteens will soon ring with the refrain, "Stobart knows the stuff to give 'em." Let us hope so, anyway.

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Henry Arthur Jones.

The death of Henry Arthur Jones has removed another of the older school of dramatists whose work, like Jerome K. Jerome's, has proved readily adaptable to the microphone. When "The Liars" was broadcast a year ago its author took a tremendous interest in the production, paying a personal visit to the studio during rehearsals.

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Television.

Notwithstanding another of those guarded statements for which the B.B.C. shows such a masterly aptitude, I should not be surprised if relations between the Corporation and the Baird Company were strengthened in the near future.

The B.B.C. repeats its announcement of October last to the effect that an experimental transmission through a B.B.C. station cannot be undertaken at present, but adds that any further claim of improvement by the Baird Company would be examined with a view to determining whether the earlier decision should be modified.

The B.B.C. would hardly do otherwise in the circumstances; meanwhile it should be noted that the decision referred to relates to "an experimental transmission through a B.B.C. station." Other tests can be applied.

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Politicians in the Studio.

January 22nd is the date mentioned in connection with the proposed microphone debate on De-rating. I understand that the Conservative and Labour Parties have both assented to the B.B.C. suggestion that the proceedings should comprise a Government speech of twenty minutes, followed by Labour and Liberal speeches each of the same duration, and concluding with a Government reply lasting not more than ten minutes. It is considered probable that Liberal head quarters will agree to the plan.

What the listener thinks about it is another matter. The B.B.C. is assuming that silence means consent.

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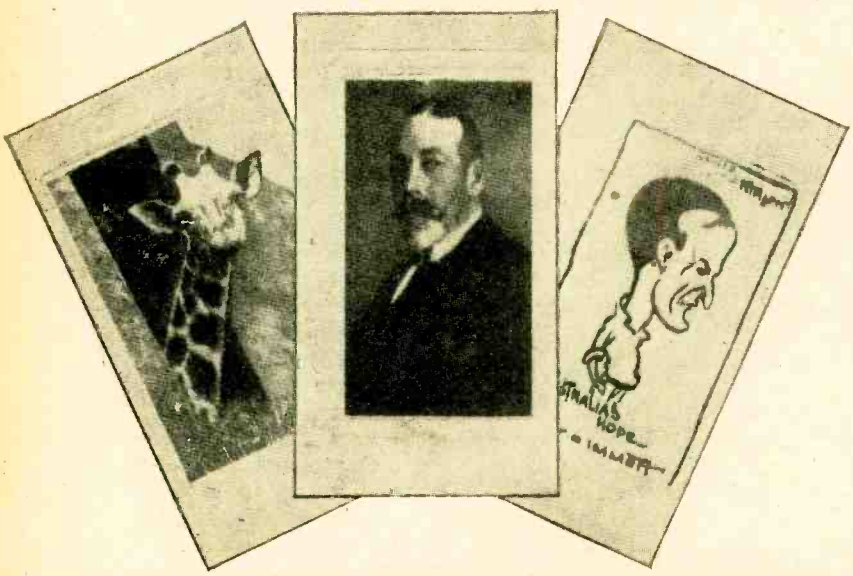
Smart Work.

I hear from Johannesburg that "J.B." is broadcasting the daily bulletins from Buckingham Palace with such promptitude that Jo'burg listeners hear the news almost as soon as listeners in Britain. "J.B." picks up the bulletin in Morse from Rugby, which sends out the message almost at the same time that it is being read in the London studio.



RESULTS WITH A HOME CONSTRUCTOR'S SET.—A selection of pictures received on a *Wireless World* instrument at a demonstration given at the exhibition of the Southend Radio Society on January 5th. The pictures have not been "re-touched" in any way.

NAUEN TO BUENOS AIRES

A Description of the Short-wave Beam Transmitting Stations.

THE telephony service on short waves between Nauen and Buenos Aires was opened on December 10th last. Each transmitter has a power of 20 kilowatts, while the wavelengths are 14.83 and 15.34 metres.

With regard to the design of the transmitting aerials, some interesting details were made public by several workers of the Telefunken Company at the meeting of German scientific workers at Hamburg last year. Both stations are constructed as beam transmitters, flat aerials being used. These, as is shown schematically in Fig. 1, consist of two parallel planes each containing sixteen horizontal aerial wires which oscillate exactly in phase. In this way an exceptionally sharply defined beam of transmitted waves is obtained. The complete aerial arrangement is hung from two masts 236ft. in height.

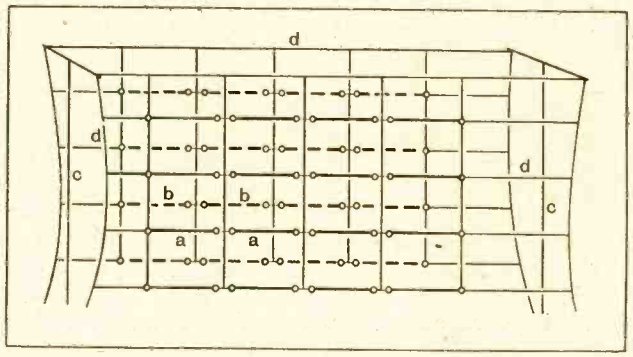


Fig. 1.—A sharply defined beam is obtained by employing flat aerials with two parallel planes each containing sixteen horizontal wires which oscillate exactly in phase. Aerial wires are shown at a. b represents reflector wires; c masts and d supporting ropes.

Investigations have shown that the use of a horizontal aerial leads to the emission of about three to four times more energy than can be obtained with vertical wires, though the reason for this is not yet known. The arrangement of two aerial systems in two different planes results in the elimination of "back-radiation." An aerial system in only one plane would, of course, be highly directional, but when receiving over long distances the signals coming from the two opposite directions interfere with one another. This, while particularly disturbing in the reception of high-speed telegraphy, is a nuisance also in telephony. But if the same number of wires is erected behind the first flat aerial system at a distance of a quarter of a wavelength, then, without the need for supplying any energy to this second aerial or connecting it in any way with the first, the backward radiation is reduced to about one-tenth of its original value. By suitable connection between the two planes the backward radiation can be reduced to 1/200th or less, so that it need no longer be considered.

Concentric Copper Feeders.

As the transmitting aerial in Nauen had to be placed outside the rest of the large aerial installation, it became necessary to use long leads from the transmitter itself to the aerials. The arrangement of these leads offered at first certain difficulties, for neither radiation from them nor appreciable energy losses could be permitted. The Telefunken Company therefore made extensive researches with various methods of transferring such short-wave energy. Leads consisting of concentric copper tubes proved themselves to be the best in this investigation. A lead of this kind may consist, for example, of an outer copper tube of 10 cms. (4in.) diameter, containing a concentric copper tube of 3.5 cms. (1⅜in.) diameter. The losses in a lead such as this, while carrying the

Nauen to Buenos Aires.—

short waves for which it is to be used, may amount to some 3 per cent. at 100 metres, and 23 per cent. at 1,000 metres, and they are thus considerably more satisfactory than leads or parallel wires. With concentric leads no radiation takes place. Fig. 2 shows two methods, which have proved satisfactory, for connecting the end of a lead of this type to a single aerial; in addition, various other circuits of similar kind have been examined.

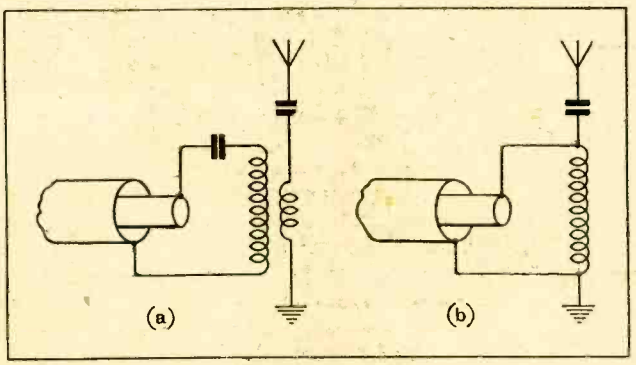


Fig. 2.—Radiation from the aerial feeder is avoided by using two concentric tubular conductors. Satisfactory methods of aerial coupling are shown in (a) and (b).

Special care must be taken over the energy distribution in the flat aerial, to ensure that the separate wires oscillate exactly in phase. Four successive aerial wires in a vertical line are connected to a current-lead similar to a pair of Lecher wires, as is shown diagrammatically in Fig. 3. The figure shows at the same time that the halves of the aerial wires directed to the left are connected alternately to the right and left lead-wires. The reason for this can be seen at once from the curve showing the distribution of voltage on the Lecher wire. If all the wires of one side of the aerial system were to be connected to a single lead-wire, any two neighbouring aerial wires would oscillate in opposite phase, and the radiation from each would annul that from the other. Near the earth the separate systems of Lecher wires are brought together and coupled to the main power lead.

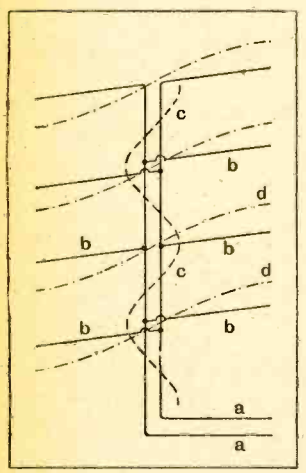


Fig. 3. — To prevent two portions of the aerial from tending to oscillate in opposite phase, the aerial leads are connected alternately left and right. Lecher wires are shown at a; b represents aerial wires; c, current distribution on the Lecher wires; d, voltage distribution on the aerial wires.

The coupling between two aerial wires, one belonging to each surface, is shown in principle in Fig. 4. The coil L_1, in the case of the transmitter, brings energy to the aerial system; in the case of the receiver it carries energy from the aerial to the receiving apparatus. Aerial and reflector can be connected either to condenser C_1 or to C_2. Tuning is then carried out by adjusting until the signals from a distant transmitter are no longer heard, and then the connections to the condensers are interchanged. One may then be sure that the adjustments are at their best for reception.

In the discussion following the various lectures, the opinion was expressed by Prof. Esau that a hollow mirror, especially if made with a continuous metal surface, should give a better directional effect than a flat aerial. The engineers of the Telefunken Company, however, did not agree with this, and said that it was not easy to make sufficiently large hollow mirrors for wave-lengths of the order of 15 metres, and that with present-day flat aerials the directional effect is so sharp that no improvement in this direction was in any way necessary.

H.F. Amplification of a Million on Short Waves.

In conclusion, it should be mentioned that Dr. W. Runge has developed in the Telefunken laboratories a receiver for telephony and high-speed telegraphy on short waves. This receiver provides, in four neutralised stages, a high-frequency amplification of about 500 times at wave-lengths down to 10 metres. It is followed by an intermediate-frequency amplifier giving an amplification of some twenty thousand times, so that altogether a high-frequency amplification of about a million times is in use. Such high amplification has been shown to be necessary so as to attain the desired certainty of working in the face of disturbances of all kinds.

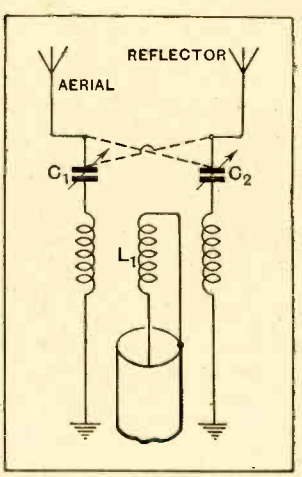


Fig. 4.—Tuning the aerial and reflector. The coil L_1 brings energy to the aerial system. The connections to C_1 and C_2 can be reversed.

Catalogues Received.

Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2. Complete price list of Philips radio products, including loud speakers, battery chargers, eliminators, and the Philips all-mains receiver.

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Crystalate Manufacturing Co., Ltd., Tonbridge, Kent. Illustrated catalogue of "Crystalate" mouldings.

The M-L Magneto Syndicate, Ltd., Victoria Works, Coventry. Illustrated leaflet (Radio Dept.), dealing with anode converts for high and low tension, hand-driven generators for transmitting sets, rotary transformers and motor generator sets.

William Geipel, Ltd., 156-170, Bermondsey Street, London, S.E.1. Illustrated leaflet describing the "Rapper" tool for drilling holes in brick, stone, cement, etc.

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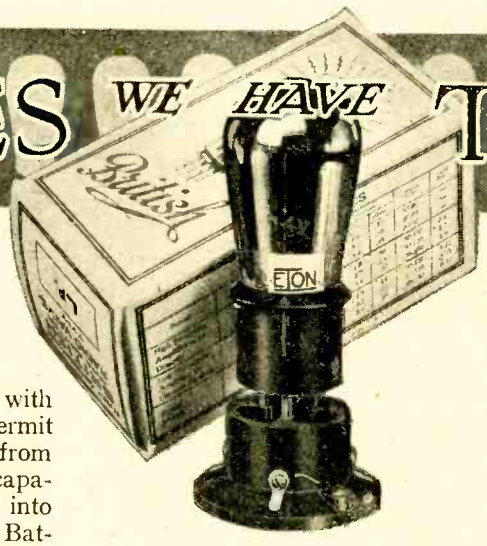
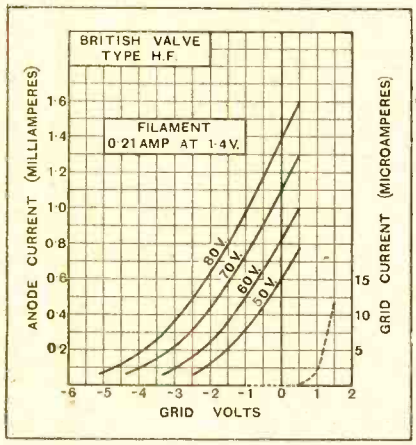
S. W. Lewis and Co., Ltd., 39, Victoria Street, London, S.W.1. Catalogue of N.S.F. components and other accessories handled by this firm.

VALVES WE HAVE TESTED



Eton "British Valves."

A RANGE of valves fitted with special filaments that permit of their being operated from one wet Leclanché type large-capacity cell has recently been put into production by the Eton Glass Battery Co., 46, St. Mary's Road, Leyton, London, E.10, under the name of "British valve." The filament takes 0.21 ampere at 1.4 volts, but the valve functions reasonably well at a voltage as low as 1.2, at which pressure the current is 0.18 ampere. A valve for practically every position is made, the range consisting of H.F., R.C., L.F., and output types.



Average values under amplifying conditions. A.C. resistance, 40,000 ohms; amplification factor, 15; mutual conductance, 0.38 mA/volt.

Owing to the heavy "gettering," it is difficult to examine closely the electrodes, but in one of the specimens sent in for test there was a small area of clear glass through which a glimpse of the internal assembly could be had. It appears that the electrodes are mounted vertically, the filament differing from that usually fitted to modern valves, in that a single strip is used in place of a round-section wire. The grid and plate are each mounted on a single support gripped in the "pinch."

The untarnished surface of the "getter" indicates that a high order of vacuum was achieved before the "getter" was flashed. On test the valves proved to be dead hard, not the slightest trace of reversed grid current could be detected.

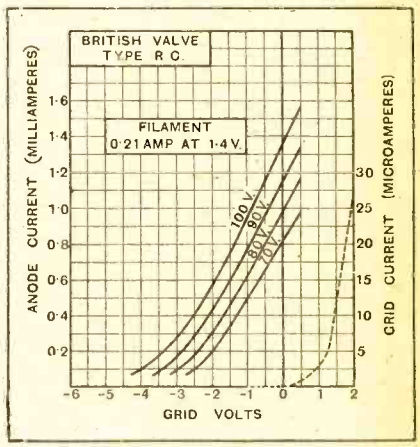
H.F. Valve.

This proved to have a rather higher A.C. resistance under normal amplifying conditions than is usual with valves of this type, but, used in conjunction with a suitable transformer, good results may be expected. With 80 volts on the plate and a grid bias of minus 1.5 volts, the average A.C. resistance was found to be 40,000 ohms, and the amplification factor 15, giving a mutual conductance of 0.38 mA per volt. This valve should make a good grid detector, and when used for this purpose the grid circuit should be returned to the positive leg of the filament. Grid current commenced to flow with about 0.2 of a volt positive grid bias.

R.C. Valve.

The principal function of the R.C. valve is as an amplifier followed by resistance-capacity coupling to the following stage. Under average amplifying conditions the characteristics were found to be A.C. resistance 60,000 ohms, amplification factor 24, resulting in a mutual conductance of 0.4 mA. per volt. These results were obtained with 100 H.T. and −1.5 volts grid bias. Reference to the characteristic curves will show that, as grid current commences at zero grid volts, a negative bias of this order will be required. Moreover, this just brings the working point at about the centre of the straight portion of the curve.

A point of special interest regarding this valve is the sharp bend at the foot of the curve following the comparatively long, straight portion. The inference that can be drawn from this characteristic is that the valve should make an exceptionally good anode-bend detector. A

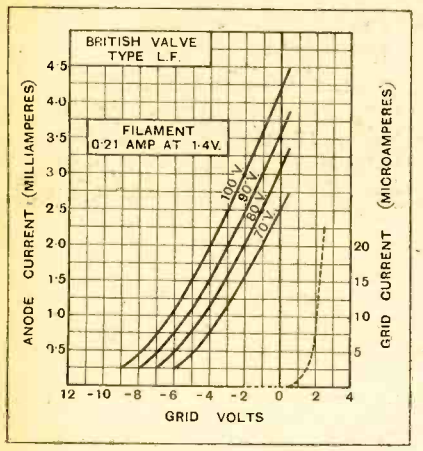


Average values under amplifying conditions. A.C. resistance, 60,000 ohms; amplification factor, 24; mutual conductance, 0.4 mA/volt.

negative grid bias of between 2.5 and 3.5 volts will be required, however. In view of this we would expect that the values of H.T. and grid bias will be fairly critical for best rectifying conditions, and it would be highly desirable to fit a potentiometer across the filament leads and employ two or three dry cells, according to the H.T. used. This will enable very fine adjustment of the grid bias to be made.

Valves We Have Tested.—

Needless to say, the A.C. resistance will increase considerably when the valve is employed for this purpose, and consequently the anode resistance should not be less than a quarter of a megohm.



Average values under amplifying conditions. A.C. resistance, 22,000 ohms; amplification factor, 11; mutual conductance, 0.5 mA/volt.

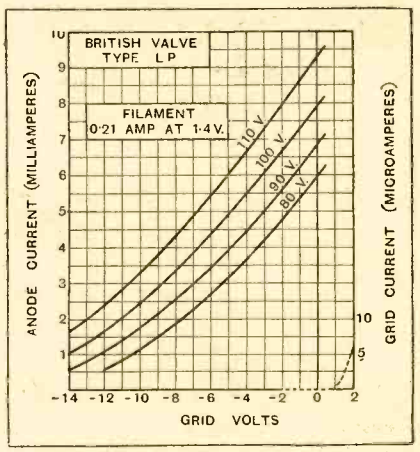
L.F. Valve.

The L.F. valve exhibits characteristics not generally associated with valves of this type. A.C. resistance, for example, under normal working conditions was found to be 22,000 ohms, and the amplification factor 11, giving a mutual conductance of 0.5 mA. per volt. In spite of this, however, quite good results can be expected from the valve, provided the impedance in the external anode circuit is made sufficiently high. If followed by a transformer one should be chosen having a large primary inductance. The anode current under normal amplifying conditions, i.e., 100 volts H.T. and −4.5 volts grid bias, will be in the order of 2 mA., and, as the majority of L.F. transformers with large primaries will pass this quantity without causing saturation of the magnetic circuit, there should not be any difficulty in obtaining a suitable component. Incidentally, this valve could be employed as an H.F. amplifier in a neutralised circuit, and, although the anode current required is greater than that generally taken by H.F. valves, it is considerably less than is usual with L.F. amplifiers. Used for this purpose, the grid should be biased to about 4.5 volts negative with 100 volts H.T.

L.P. Valve.

The particular function of this valve is as an output valve, and with suitable values of H.T. and grid bias it will handle a grid swing of about 16 volts without overloading. With 110 volts H.T. and minus 7.5 volts grid bias, the A.C. resistance was found to be 8,900 ohms, the amplification factor 5.2, and the mutual conductance 0.6 mA. per volt. The anode current under these conditions will be in the order of 5 mA. only.

As the terminal voltage of the Sac Leclanché cells will be greater than



Average values under amplifying conditions. A.C. resistance, 8,900 ohms; amplification factor, 5.2; mutual conductance, 0.6 mA/volt.

1.4 at the commencement it is recommended that a filament rheostat of a few ohms be included in the L.T. circuit. The amount of resistance in use can be reduced as the voltage falls.

The price of the H.F., R.C. and L.F. valves is 8s. 6d. each, and that of the output, type L.P., valve 9s. 6d.

BOOKS RECEIVED.

Definitions and Formulæ for Students. (1) *Applied Mechanics*, by G. H. Lewitt, including motion, force and energy, strength of materials, structures, machines and hydraulics. Pp. 36. (2) *Practical Mathematics*, by Louis Toft, including algebra, trigonometry and mensuration, differential and integral calculus, graphs and some differential equations. Pp. 28. (3) *Heat Engines*, by Arnold Rimmer, including internal-combustion and steam engines, steam turbines, air compressors and refrigeration. Pp. 32. (4) *Electrical*, by Philip Kemp, including electrostatics, magnetism, electrolysis, lighting and power, A.C. and D.C. generators and motors, and transmission of power. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 6d. each.

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Wireless—the Modern Magic Carpet, by Ralph Stranger. A popular and non-technical outline of the elements of wireless, especially in relation to broadcasting. Pp. 312, with nearly 250 illustrations and diagrams. Published by S. W. Partridge, Ltd., London. Price 3s. 6d. net.

Everyman's Wireless, by Ernest H. Robinson. A simple description of the apparatus generally required by the average man for broadcast reception, with practical advice in the choice of sets and components. Pp. 248, with 21 diagrams and illustrations. Published by Cassell and Co., Ltd., London. Price 3s. 6d. net.

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Commercial and Government Radio Stations of the United States. 1928 Edition. Pp. 176, and *Amateur Radio Stations of the United States*, 1928 Edition. Pp. 329. Published by the U.S. Department of Commerce. Price 15 cents and 25 cents respectively, from the Superintendent of Documents, Government Printing Office, Washington, D.C.

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Board of Trade Report of the Departmental Committee on Examination of Masters and Mates, including, in Appendix A, the arguments for and against the training of deck officers in the Merchant Service in the duties of wireless operators. Pp. 59. Published by H.M. Stationery Office. Price 9d. net.

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Department of Commerce, Bureau of Standards, Washington, D.C. (1) Methods for the derivation and expansion of formulæ for the mutual inductance of coaxial circles and for the inductance of single-layer solenoids, by F. W. Grover (Research Paper No. 16). Pp. 25. Price 10 cents. (2) Mutual inductance of any two circles, by Chester Shaw (Research Paper No. 18). Pp. 12. Price 5 cents. (3) Receiving sets for aircraft beacon and telephony, by H. Pratt and H. Diamond (Research Paper No. 19). Pp. 21, with 21 diagrams and illustrations. Price 15 cents. (4) The international temperature scale, by G. K. Burgess (Research Paper No. 22). Pp. 6. Price 5 cents. (5) Design of tuned-reed course indicators for aircraft radio-beacon, by F. W. Dunmore (Research Paper No. 28). Pp. 19, with 21 diagrams and illustrations. Price 5 cents.

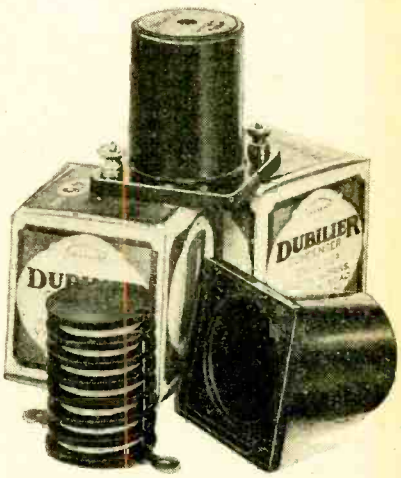
A Review of Manufacturers' Recent Products.

DUBILIER H.F. CHOKES.

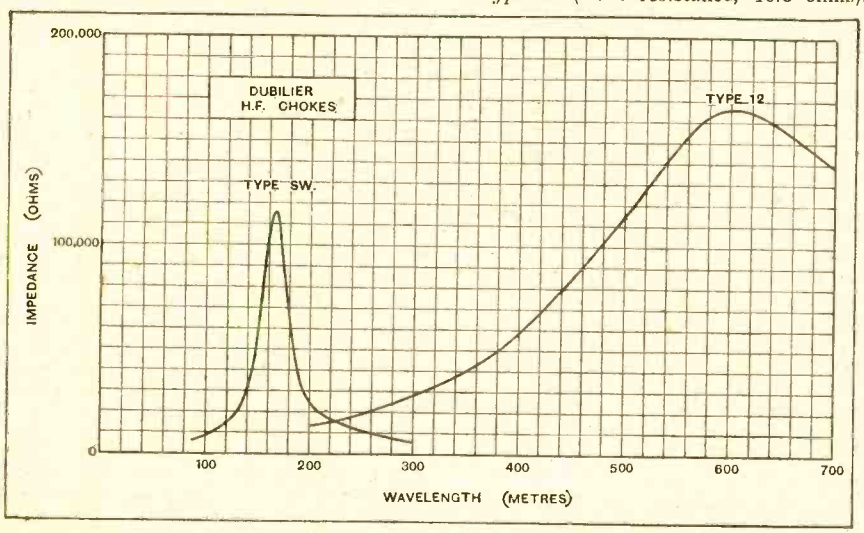
Although a single well-designed choke will perform satisfactorily on all wavelengths used for broadcasting, including short waves below 100 metres, there can be no doubt that an improvement can be achieved, when the wave band to be received is limited, by designing a choke specifically for the purpose, and neglecting the requirements of wavelengths outside the range of the receiver. For this reason, quite a number of firms market two types of H.F. choke, one for wavelengths between 200 and 2,000 metres, and another for short waves from 200 downwards. The Dubilier Condenser Co. (1925), Ltd., have carried this principle still farther and now supply no fewer than four distinct types for use in broadcast receivers. A standard former is used for all four chokes; this fits into a neat moulded case which excludes moisture and protects the windings from damage. There are seven slots in the former, though only three of these are utilised in the type AC choke. It was observed that the longitudinal slots used for transferring the wire from one section to the next were only $\frac{1}{16}$in. deep; as a consequence the inside end of the wire in each section touches all the turns of the winding on its way to the surface. In our opinion there is room for improvement here; not only is the insulation of the wire subjected to unnecessary strain, but the self-capacity of each section is increased. These objections would disappear if the lateral slots were increased in depth until they reached the core of the moulding.

Type S.W. (D.C. resistance, 3.6 ohms). This choke is intended for use exclusively on short waves, and the makers give the range as 22.5 to 100 metres. The winding is distributed over the seven slots of the former, and the number of turns in each slot is increased progressively, giving a conical formation of winding. The impedance measurements, which were only carried down to 90 metres, show that the choke resonates at 165 metres when the external circuit capacity is 8 micromicrofarads. The maximum impedance is 170,000 ohms, and this falls to 8,500 at 100 metres.

Type 12 (D.C. resistance, 10.5 ohms). The makers give the useful range of this choke as 100 to 2,000 metres, and it is intended as a general purpose or "universal" choke. The impedance measurements show, however, that the choke resonates at about 600 metres, and it cannot be used in the anode circuit of a valve with tuned grid circuit without risk of oscillation above that wavelength.



There are four different types of Dubilier H.F. chokes, each designed for a specific purpose.



Impedance curves of Dubilier Type S.W. and Type 12 chokes; external capacity 8 micro-mfd.

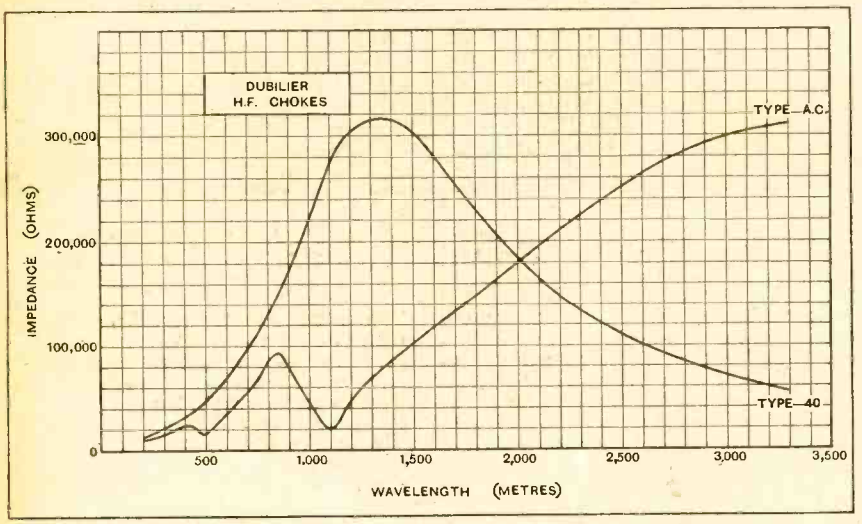
In our opinion the use of the choke should be restricted to the medium broadcast band (200-500 metres) when excellent results should be obtained.

Type 40 (D.C. resistance, 136 ohms). The inductance of this choke is much higher than that of the Type 12. With a circuit capacity of 8 micromicrofarads it is probable that the peak would be raised well above 1,600 metres. This choke approximates much more nearly to the requirements of a "universal" choke than the Type 12, and gives the following impedance values:—

Wavelength (metres).	Impedance (ohms).
200	13,000
500	47,200
1,350 (resonance) ...	316,000

Unless the circuit capacity is ot the order of 20 micromicrofarads or more it is likely to provoke oscillation on the 5XX wavelength, but will be quite stable on the medium broadcast band.

Type A.C. (D.C. resistance, 800 ohms). This is a special choke intended for use as an aperiodic anode inductance for coupling H.F. valves. Its total im-



Impedance curves of Dubilier Type 40 and Type A.C. chokes ; external capacity 8 micro-mfd.

pedance is higher than the preceding types, and the major resonance is well above 3,000 metres. The curve shows two minor resonances at approximately 400 and 850 metres. Following these resonance peaks the curve has a negative slope, and conditions are favourable for self-oscillation between 400 and 500 and between 850 and 1,100 metres. Only three slots of the former are used for the winding in this choke. One slot is filled with wire, the other is half-full, and the third contains comparatively few turns. It is evident that each section is resonating with its own self-capacity, and that, due to the dissimilarity in the size of the sections, the coupling is not sufficiently tight to pull the sections into one effective circuit.

However, if the circuit capacity is high enough to raise the bottom resonance clear of 500 metres there is no reason why the choke should not be used in an amplifier designed for 200-500 metres and the Daventry 5XX wavelength only.

The dimensions of all four types are 1⅞in. × 1⅞in. × 2in. in height, and the price is in each case 4s. 6d.

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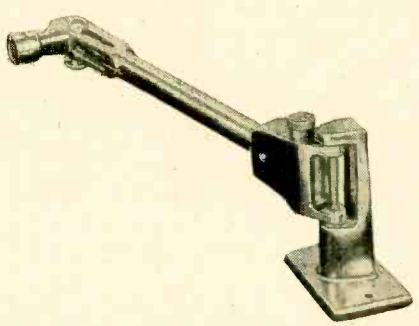
"KUSHA" PICK-UP ARM.

The pick-up arm has been designed specially for use in cases where electrical reproduction of gramophone records is preferred to the usual method. It is not essential to construct a separate amplifier for this purpose, as if the broadcast receiver incorporates a first-class low-frequency amplifier, it is a simple matter to adapt this for the purpose. One of the principal features of this device is the method of counterbalancing the weight of the pick-up. This is taken by a compression spring, which can be adjusted to give any desired pressure on the record, the outstanding advantage being the partial removal of friction, thereby enabling a medium-powered motor to do the work otherwise possible only with a more powerful mechanism.

The device exhibits excellent workmanship, the various parts consisting of duralumin castings finished with a high polish. The weight compensation enables a longer arm to be fitted than is usual, and provision is made for adjustment of the length within small limits, this being achieved by fitting the pick-up carrier on a carriage sliding in grooves. The maxi-



"Kusha" pick-up arm in which the weight of the pick-up is partially counter-balanced by an adjustable spring.

mum adjustment allowed is 1 inch, the length being variable between 7¼ and 8¼in.

The makers are R. H. Glasscoe, 3 and 4, Water Lane, London, E.C.3, and the price is 12s.

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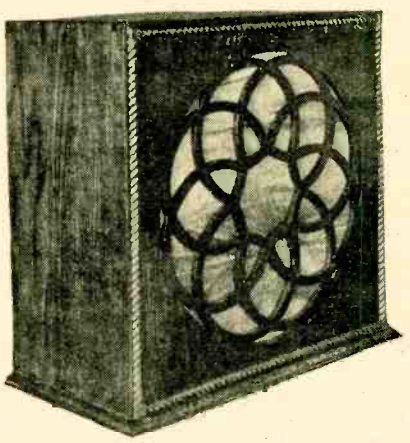
NEOPHONE LOUD SPEAKERS.

In all cone-type loud speakers the shape, substance and construction of the diaphragm contribute in no small way to the successful operation of the device. The paper cone commonly used possesses many defects, and although in numerous cases these have been partially overcome, they occasionally come to the fore under certain atmospheric conditions. Bearing this in mind, the Neophone Radio Manufacturing Co. turned their attention to developing a cone which was impervious to moisture, did not alter its shape under varying atmospheric conditions, and, most important of all, possessed that rigidity and lightness which is the recognised attribute of all high quality cones.

The outcome of many months of research is the production of a seamless vulcanised fabric cone diaphragm which is guaranteed to maintain its shape and stiffness under the most adverse conditions. The Neophone loud speaker under review incorporates a 12in. diameter cone-shaped diaphragm of this special formation, the driving mechanism functioning on the balanced armature principle. The periphery of the cone is virtually free, but, although not actually connected to,



Neophone loud speaker incorporating a vulcanised cone diaphragm.

it is positioned by a circular wooden rim screwed to a small baffle board 13in. square. The cone is furnished with a swaged edge, which takes the form of a double roll; the object of this is to impart a certain degree of stiffening without introducing excessive damping.

Actual tests showed that the reproduction compared favourably with that obtained from the best loud speakers in the same class. A critical ear would probably find cause to comment on an apparent over-emphasis of the middle register due to a slight falling off in amplification at either end of the audible scale. With the exception of the most expensive types, many loud speakers exhibit this defect, and as even to-day quite a few receivers are far from perfect, the slight reduction in amplification at both ends of the audio scale cannot be regarded as a serious defect.

The loud speaker is housed in a well-finished cabinet which can be supplied in either oak or mahogany. The oak model is £3 17s. 6d., and in a mahogany cabinet £4 4s. The address of the makers is: 9-10, Little St. Andrew Street, St. Martin's Lane, London, W.C.2.

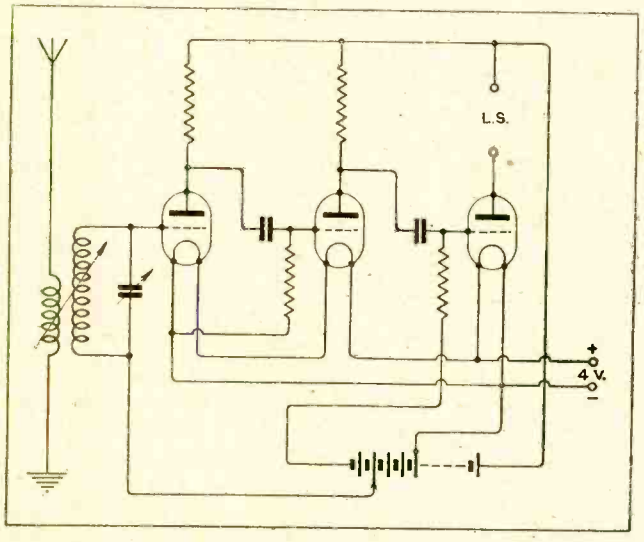
Broadcast Receivers

LOEWE TYPE O.E. 333
WITH MULTI-ELECTRODE VALVE

A Low-priced Local Station Receiver of Novel Design and Construction.

THE Loewe multi-electrode valve receivers are by no means new. They have been on the market in Germany now for some years, and their popularity in that country is firmly established. The development and progress of the multiple valve has been recorded from time to time in this journal and also in *Experimental Wireless*, and our technical readers are already well-informed of the general principles involved. The establishment in this country of a specially equipped factory for the production of Loewe Radio receivers has again directed attention to this unique system of broadcast reception, and is arousing considerable interest among the listening public on account of its reasonable price, and in technical circles on account of the novel construction of the multiple valve.

Loewe multiple valves are made in two types, the 2HF, employing four electrode valves for H.F. amplification, and the 3NF (nieder frequency), or low-frequency amplifier. The later type forms the nucleus of the receiver under review, and comprises two high-magnification valves followed by a "power" output valve. Resistance coupling is employed, and all three valves, together with their associated resistances and condensers, are enclosed in a single bulb, which is exhausted to the proper degree of hardness required for the proper functioning of the valves.



Equivalent circuit of the Loewe Type O.E. 333 receiver; the three valves together with their coupling resistances and condensers are assembled in vacuo as a single unit.

Improved Reproduction of High Notes.

Considerable ingenuity has been displayed in the arrangement of the elements, with the result that wiring is short and stray capacities are reduced to a minimum; this results in a great improvement of the reproduction of high notes, as the subsequent tests revealed. The well-known Loewe vacuum condensers and sputtered metal resistances are employed, and special precautions have been taken to preserve insulation resistance. The bulb is "gettered" but mica baffles are employed to confine the magnesium to the top of the bulb. A note is included to the effect that valves may require "ageing" for twenty minutes or so before their normal performance is attained. This suggests residual gas, which automatically clears itself after the valve has been running for a short period with normal H.T. and L.T. volts—quite a normal state of affairs and one which is common in ordinary commercial three-electrode valves. Actually the individual valve tested was perfectly hard and gave its maximum performance from the moment of switching on. It is a matter of no little difficulty to produce a hard vacuum with so much absorbent material in the bulb, and the makers are to be congratulated on having overcome the numerous problems presented by this form of construction.

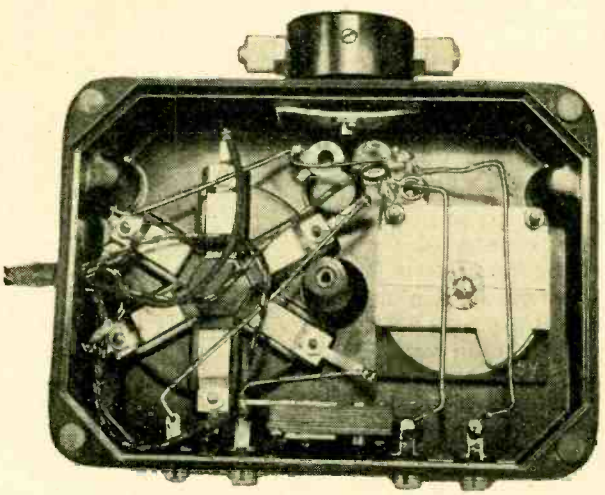
With so many of the essential parts of the receiver already incorporated in the valve, it is not surprising that the base is unusually neat and compact. It con-

Broadcast Receivers.—

sists of a one-piece moulding, and carries, in addition to the six-contact valve holder, an on-and-off switch, a mica dielectric tuning condenser, and sockets of the aerial and tuned grid coils. The aerial coil socket is mounted on a swivel bearing and carries terminals for the aerial and earth connections; there is no electrical connection between the aerial circuit and the remainder of the set, and the energy picked up by the aerial is transferred solely through the magnetic coupling between the two coils. On the opposite side of the base to the coil holders are to be found two pairs of sockets.

Remarkable Selectivity.

One pair is marked for the loud speaker leads, and the others are joined across grid and filament of the first valve, and may be used either for a frame aerial or for gramophone pick-up. When using either of these accessories the grid coil must, of course, be removed. The tuning condenser is of the rotary vane type, is neatly constructed, and free in action, while the filament switch is of the quick-break type. The valve holder is moulded integral with the base, and hard-rolled phosphor-bronze springs ensure firm contact with the valve pins. A multiple strand cable carries the H.T. and L.T. supply and the external grid bias potential.



View of underside of moulded base showing mica dielectric tuning condenser and valve contact springs.

In the circuit diagram the connections of the complete receiver have been redrawn in accordance with the usual convention. It will be observed that the filaments of the first two valves are connected in series, the fall of potential across each filament being two volts. This enables a negative bias of 2 volts for the second valve to be picked up from the filament circuit and also effects a legitimate economy in filament consumption, since the first two valves are used for *voltage* amplification the power involved being negligible. The last valve, on the other hand, is called upon to deliver power to the loud speaker, and the filament is designed to work on the full 4 volts supplied by the L.T. battery. The total filament current taken by the set was found to be 0.36 amp., the maker's rating being 0.34 amp.

The first valve functions as an anode bend detector with a grid bias of $1\frac{1}{2}$ volts. There is no loading of the tuned circuit, and the selectivity of the set is quite remarkable, having regard to the fact that no reaction is used. In London, at $1\frac{3}{4}$ miles from 2LO, on a large outdoor aerial, 5GB could be received without interference from the local station. The latter station is somewhat faint at this distance, but can be brought up to good strength by tuning the aerial circuit with a variable condenser across the aerial and earth terminals. Similar results were also obtained by choosing an aerial of such a size that it resonated, with the natural capacity of the aerial, at a wavelength approximating to that of 5GB.

The variable coupling between the aerial and grid coils can be used to improve selectivity, and also provides an excellent volume control which has the advantage of being sound in theory as well as effective in practice.

In the instruction leaflet a 90-volt high-tension battery with tappings at 6 and $7\frac{1}{2}$ volts is recommended. The connecting leads are so arranged that with such a battery grid bias as well as H.T. current can be obtained. The H.T. – terminal is connected to a $+7\frac{1}{2}$ on the battery, and all tappings below this are then negative with respect to H.T. – (and L.T. –). By inserting the detector lead in the 6-volt socket a bias of $-1\frac{1}{2}$ volts is obtained, and with the remaining grid bias wander plug in the negative socket of the battery, the output valve receives $-7\frac{1}{2}$ volts. Although this method makes for neatness, inasmuch as the use of a separate grid battery is avoided, it should be borne in mind that the H.T. voltage available is reduced by an amount equal to the grid bias. In the case of the 90-volt battery, the H.T. available is only $82\frac{1}{2}$ volts. Under these conditions we found that, although the reproduction was sweet and pure, the volume was hardly adequate for a small room, even when using an unusually sensitive loud speaker. Any attempt to increase volume resulted in overloading of the last valve with deplorable consequences as regards quality. In view of the fact that 90 volts is quoted as the normal H.T. on the valve carton, as well as in the instructions, it was thought at first that this must be the limiting value for which the valve was designed, but enquiry at the works elicited the information that the H.T. can be safely pushed up to 150 volts provided the grid bias is correspondingly increased. Accordingly the H.T. was increased gradually to 120 volts with a bias of $10\frac{1}{2}$ volts with very gratifying results. Under these conditions the volume was equal to that of the average three-valve receiver of conventional type, and the quality of reproduction was distinctly good. In spite of the employment of two stages of resistance coupling with high values of anode resistance, we could detect no serious deficiency in the reproduction, and even the high notes were particularly well produced.

Of the sensitivity of the multiple valve there can be no question, for without reaction both the Daventry 5XX and 5GB can be well received in London. The makers stated that the overall amplification is of the order of 3,000, and as the receiver is intended as a local station set, the factor of safety is more than adequate.

Broadcast Receivers.—

When using a 90-volt battery the total consumption of H.T. current is about 5 mA., which is well within the powers of the "standard" small capacity cells, but if a 120-volt battery is used, and this is strongly recommended, one of "intermediate" or "double" capacity is advisable. The current will be about 8 mA., which might come just within the powers of a small cell, but the larger type is preferable on account of its lower internal resistance. As the H.T. voltage is increased the margin of safety in the matter of back coupling through the battery resistance is narrowed. A test showed that 250 ohms was necessary to provoke oscillation at 120 volts, and while this value of resistance might be attained in a small capacity battery, it is unlikely that the internal resistance of the larger type would be sufficient to cause self-oscillation until the voltage had fallen below a useful marking value. Further, the increase in battery resistance is offset by the reduction in anode voltage as the battery runs down, and it is extremely unlikely that trouble will be met through self-oscillation.

The price of the receiver, including royalty, complete with multiple valve, but exclusive of coils, batteries, and loud speaker, is £4 10s. (In the Buyers' Guide, which appeared in the November 14th issue, the price was given, due to an oversight, as £4.) The registered offices of the Loewe Radio Co., Ltd., are at 364, Clements Inn, London, W.C.2, and the works address is 4, Fountayne Road, Tottenham, London, N.15.

LETTERS TO THE EDITOR.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

TELEVISION.

Sir,—When Mr. Moseley and his friends can produce television images comparable in size, quality and cost with the pictures given by the Fultograph there will be time to grouse about "unfair discrimination."

G. M. PART.

Woking, Surrey.

Sir,—In a letter in *The Wireless World*, dated December 19th, Mr. Moseley talks of possible "prejudice" in the B.B.C. dismissal of Television, and states that the B.B.C. "have not said *why* they rejected television."

[Since Mr. Moseley is connected with the "Television Press," it is possible that he himself may be unconsciously prejudiced in favour of television!]

If the B.B.C. were to reply to this question they would, one may suppose, have two answers at least. First, "in its present state of development television is of the greatest scientific interest, but has no entertainment value whatever"; and secondly, "development in the direction in which it is most needed could be made as well, or better, over a short 'land-line' between two adjacent rooms than by 'wireless.'" They might also add that with the side-band width permissible under the Geneva scheme, which allots stations frequencies differing by only 10 kilocycles, it would be physically impossible for a single broadcasting station to transmit a television picture of adequate size and definition, apart altogether from any mechanical difficulties which may yet have to be overcome. (The writer's reason for this statement will be given later.)

Still picture broadcasting is in rather a different position. A system has been in use for many years on land-lines (the exact date I cannot remember, but the *Daily Mail* worked a service on a private line between their London and Manchester offices before the War). With the perfection of improved methods of synchronisation and a reasonably cheap receiving device (all developed without any strictly "wireless" work at all by means of land-lines) there was no particular difficulty in adapting the land-line transmitter to modulate a wireless wave. The B.B.C. are, I suggest, justified in trying it, to see if there will be a sufficient demand created. As one of your other correspondents points out, we can get pictures much better and cheaper for 1d. a dozen in the evening paper; and it seems more than probable that after giving the scheme a fair run for, say, six months or so, the B.B.C. will drop it, which they will be able to do without incurring any very great expense for "scrapped" plant.

But while it is easy to produce a single picture in, say, four or five minutes, it is a very different matter to produce a picture 15 times a second, as is necessary to produce the effect of a moving picture. In either case the picture is divided into a number of bands or strips, which vary in depth of colour from white to black, according to the particular part of the picture to be reproduced. In the still picture these bands can be about $\frac{1}{50}$th inch apart, giving decent definition. If we assume that the dark and light parts of the band or strip may in the extreme case require to be as finely separated into dots as 50 per inch, we have $50 \times 50 = 2{,}500$ variations of intensity required per square inch of picture transmitted, and for television we require this 15 times a second, giving $15 \times 2{,}500 = 37{,}500$ variations per second. Now for a picture only one square inch in area we shall want a side-band width of 37,500 cycles, or 37½ kilocycles each side of the nominal "frequency" of the station. With the Geneva plan it can't be done. We should therefore be limited to a picture about ¼ square inch (say ½ inch × ½ inch) if we want as good definition as this.

Perhaps the definition would do rather less than this if we had a bigger picture. Suppose we consider a sort of cinema show on a picture 4ft. × 4ft., then all we can do is to have the "strips" about 2 inches wide! The definition will be unspeakably hopeless. On these lines the writer has worked out what would be the side-band width required to produce a picture 1 foot square, with definition equal to that of the illustrations in *The Wireless World*. It is over 5,000 kilocycles! Our transmitter would require as much space in the ether as several hundred broadcasting stations.

This, however, is "all theory," what is it like in practice? The writer was lucky enough to be able to see a demonstration during the time the Wireless Show was on. From a scientific point of view it was extraordinarily interesting, as a form of entertainment it was not. The picture appeared to be divided into some 15 or 20 vertical strips only; the "flicker," far worse than with the earliest cinematographs of 25 or 30 years ago, rather covered up this defect, but it was still very noticeable. After only some ten minutes' demonstration the writer was distinctly conscious of eye-strain (it is possible that, say, an hour of steady "looking in" would produce this effect in the exaggerated form met with in early cinematographs, in fact, as the flicker is so much worse, the resultant headache, etc., may be expected to be more acute). The want of definition, as may be expected from the small number of strips into which the picture is divided, was very obvious.

The report on the demonstration in *The Wireless World* was really very kind-hearted, as might be expected, perhaps, from a paper devoted to wireless and kindred subjects.

In order to have entertainment value it seems that television must work *at least several hundred times* as fast as at present, perhaps if only one hundred times as fast it might be used on

land-line to reproduce the head of the person spoker to on the telephone with sufficiently good definition to enable the man at the other end to be recognised. In the writer's opinion, for reasons stated above, it appears unlikely that it will be satisfactorily transmitted broadcast (possibly "wired wireless" might be a solution).

In any case, the direction in which a very great deal of progress seems called for before television is more than a scientific toy, is a very great speeding up and increase in the number of elements of pictures that can be transmitted per second. It is not known how fast the existing light-sensitive cells, etc., will work, but it may be necessary to find some entirely new method of dealing with this, and with "scanning" the picture (cathode rays have been suggested). But the experimental work still to be done before television is of "entertainment value" would appear to be an extension of Baird's own work for many years past, for which a "wireless" transmission is quite unnecessary. C. R. COSENS.

Cambridge.

DIODE DANGERS.

Sir,—We have read with interest the article by Mr. H. F. Smith in your December 12th issue entitled "The Distortionless Diode," and, in view of the apparent interest which is being taken by amateurs in this type of circuit, we feel that a word should be put in concerning the type of valve to be used with this method of detection.

As a certain number of experimenters may be adopting this form of circuit, we feel that it is important to point out that the valve used for this purpose is operated under extremely severe conditions.

A positive voltage of 10½ volts, or even more in some cases, on the grid of a valve would often result in the production of a very large electron emission, and may in many cases have the effect of running the valve under practically total emission conditions.

We should like, therefore, to stress the advisability of using a valve designed normally to operate under severe conditions unless the grid polarising voltage is maintained at a comparatively low value.

With small valves of types designed for broadcast receiving purposes, where only up to about 5 or 6 milliamperes maximum of anode current is drawn from the filament in normal practice, an attempt to increase this to 20 or 30 milliamperes, continuous drain, as might very well be occasioned when using the same valve as a diode detector, must have a detrimental effect on the life of the filament.

Although it has been pointed out elsewhere that this type of circuit abolishes the H.T. battery for the detector valve, we think it should be made clear that the large grid current occasioned by applying a considerable positive voltage to the grid would in some cases rule out the use of dry batteries for this purpose, otherwise the impression might be obtained that the normal grid bias battery, reversed, could always be employed for the diode detector circuit. J. H. MARRIOTT.

London, W.C. The General Electric Co., Ltd.

OUTPUT OF POWER VALVES.

Sir,—The occasions on which the serious-minded listener is called upon to make a comparison between various types of three-electrode power valves is now so frequent that it occurs to the writer that a brief restatement of one of the recognised methods employed for this purpose might be of service to readers of *The Wireless World*.

The object of the method is to make an approximate estimation (for example, in watts) of the maximum undistorted A.C. output of the valve. This can be done most satisfactorily from a full set of plate current-plate voltage curves taken for the various values of grid bias. A useful approximation can, however, be arrived at from the static curves of the valve as published by the maker The method depends on the theory established by W. J. Brown (Proc. Phys. Soc., Vol. 36, 15/4/24, page 218) and others, that with a low value of distortion the best load for the valve is twice its anode resistance (impedance).

For these conditions it can be shown :—

$$\text{Output} = (I_{max} - I_{min})^2 \times \frac{Ra}{4}$$

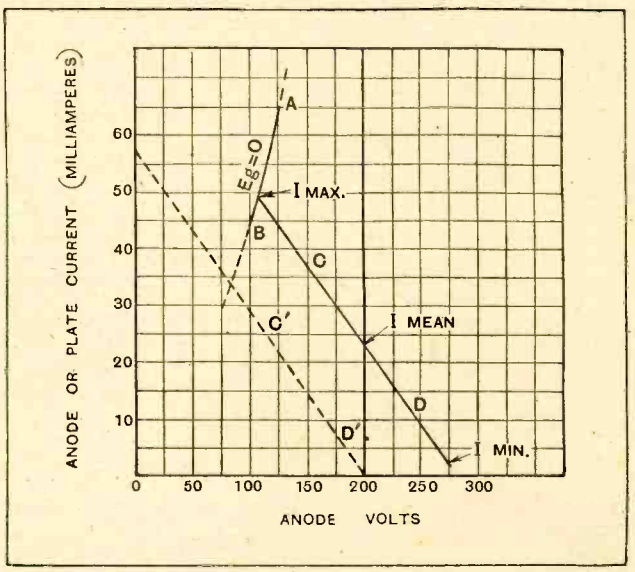
Where Ra is the anode A.C. resistance of the valve and $(I_{max} - I_{min})$ is a measure of the anode current swing when the valve is in service.

I_{max} and I_{min} may be estimated by setting down on a separate piece of squared paper (as in the figure) a skeleton anode current-anode voltage curve derived from the curves published. (It is convenient to do this since such a graph facilitates further investigation if this is required.)

In the figure, A and B are two points taken for $E_g = 0$ from published curves of a large-sized power valve at plate voltages of 150 and 100.

I_{max} is given by the point where the line CD, whose slope is $2R_a$ cuts the curve AB. The position of CD can be fixed because an anode current, or a grid bias, for $E_{a\,max}$ is always recommended by the manufacturer.

In this example the $E_{a\,max}$ was 200 v. and the bias advised is such that the plate current is 23 mA. (In practice it is



sometimes convenient to draw first any line C'D' of the required slope and move CD along parallel to C'D' until it cuts the vertical through $E_{a\,max}$ at the required point.)

The permissible value of I_{min} will be from 0.5 to 5 mA. for most power valves at present available. In any case this figure will be very small compared with I_{max}, and for a first approximation of the output will not greatly affect the result.

Thus, if we assume in the example of the figure that I_{min} is 1.5, we have

$$\text{Output} = (0.0495 - 0.0015)^2 \times \frac{1750}{4} \text{ 1 watt approx.}$$

It is thus an easy matter to obtain in this way from the makers' published curves a list showing approximately the relative outputs of all the three-electrode power valves available.

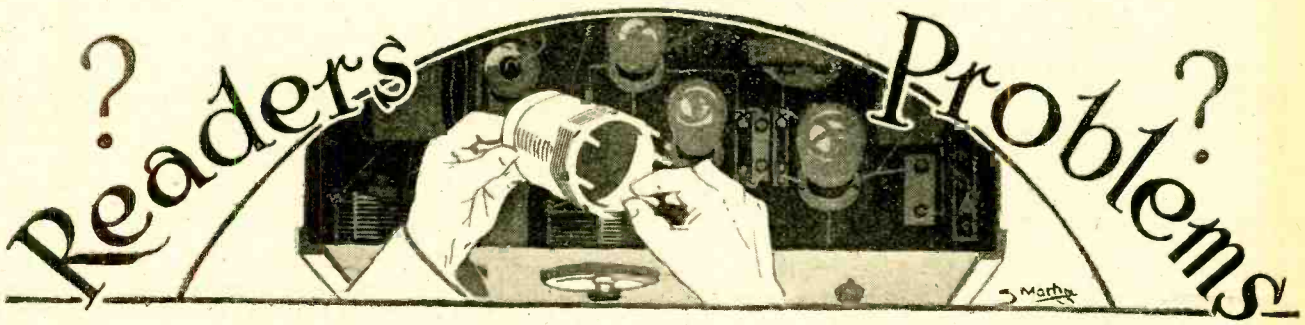
In fixing the grid bias for maximum output the manufacturer has to be certain that his recommended conditions do not permit excessive distortion when the full grid swing is used. The distortion to be considered is that due to the curvature of the anode current characteristic; it will be sufficient here to note that

$$\text{Distortion in } \% = \frac{\frac{1}{2}(I_{max} + I_{min} - I_{mean}}{I_{max} - I_{min}} \times 100$$

Approximately 5% is usually the maximum allowed.

The above remarks are, of course, no more than an outline of a subject which has already been dealt with in greater detail elsewhere, but it is hoped they are sufficient to help the uninitiated to make comparative estimates of the capabilities of any valves which may be of interest. L. A BARRY.

Rugby.



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Excessive Resistance.

My receiver is made up in two separate units; the first, a detector valve with capacity-controlled reaction, and the second a two-stage resistance-coupled amplifier. The detector unit, with phones connected to the output terminals, works quite satisfactorily, and reaction effects can be obtained, but when the amplifier is added, sensitivity is very poor, and variation of reaction capacity has little or no effect. Can you suggest what is wrong? B. R. N.

We expect that your failure to obtain reaction will be traced to the use of a coupling resistance (in the first stage) having an excessively high value. In all probability oscillations will be obtained if you shunt this resistor with a fairly large condenser (say 0.0003 mfd.), but this addition will produce a considerable attenuation of the upper audible frequencies, and on the whole we think you would be well advised to use a lower resistance; there is a distinct tendency nowadays to follow this plan.

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Double-tuned Couplings.

In reading one of my pre-broadcasting issues of "The Wireless World," I came across a circuit showing a loose-coupled H.F. transformer with tuned primary and secondary circuits; needless to say, this arrangement was applied to an ordinary three-electrode valve. I have tried it with a screened-grid valve, and as results are distinctly promising, both with regard to amplification and selectivity, I am thinking of incorporating it in an amplifying unit. Unfortunately, space is restricted, and to get the very loose coupling between primary and secondary which seems to be necessary, the two coils must be well spaced. Can you suggest a means whereby the advantages of this kind of transformer may be retained without making the amplifier unduly bulky? G. S. v. R.

We are afraid you will find it difficult to keep your H.F. unit within reasonable dimensions, but suggest that by dividing the primary coil in the manner shown in Fig. 1, you will partly overcome the difficulty. Referring to the diagram, you will observe that a screen (an addition to the amount of shielding normally required) is interposed between the primary loading coil L_1 and the coupling coil L_2. L_3 is,

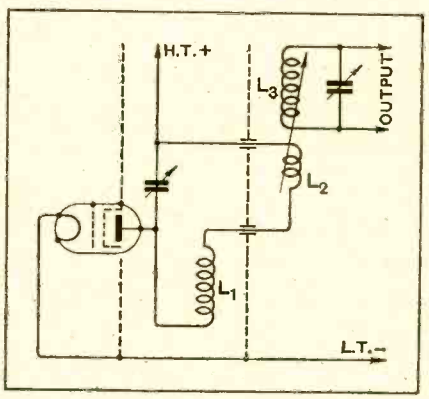

Fig. 1.—Loosely coupled H.F. transformer with tuned primary and secondary windings.

of course, the secondary inductance, and should be of high efficiency; it may be convenient to choose a compact and somewhat less efficient winding for L_1 in order to economise space. For reception on the normal broadcast waveband, L_2 should have about ten turns.

RULES.

(1.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(2.) Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(3.) Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

The South Kensington Receiver.

Will you please tell me if the South Kensington Museum receiver has been described in "The Wireless World," and if so, refer me to the back number in which it was described? J. F. B. W.

This demonstration receiver was described at considerable length in our issue of February 16th, 1927.

oooo

H.F. or L.F.?

I am undecided whether to make up a three-valve receiver with H.F.-det.-L.F., or with a reacting detector and two L.F. stages. Which do you advise? E. L. D.

So much depends on your requirements and local conditions that we fear it is quite impossible to give a definite and helpful answer to your question; indeed, the whole subject is still controversial, and pages could be written on the relative advantages of the alternative arrangements. Briefly, the set with H.F. amplification will score heavily in point of selectivity, and, if the circuit arrangement is suitably chosen, it will not suffer from L.F. instability even when used with an indifferent eliminator or high-resistance H.T. batteries. The detector-2 L.F. set, on the other hand, will give, up to a point, louder signals, and will be easier to operate.

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Grid Resistances.

In the receiver which I am about to construct, a resistance of the grid leak type, having a value of 100,000 ohms, is specified for insertion in series with the grid circuit of the first L.F. valve. Is there any objection to using a wire-wound resistor, which I already have? R. G. M.

This will be an H.F. stopper, and, for it to be completely effective, it is essential that its self-capacity should be as low as possible. Therefore we would strongly advise you not to use your wire-wound element, which almost certainly will have an appreciable self-capacity; most probably not enough to be harmful when it is fulfilling its normal function, but more than is permissible for the purpose to which it is to be put.

Mirrors and Portables.

Why is it that my transportable set will work anywhere in the house except on the sideboard in my dining room? In this position, signals are so weak that even the local station (about 20 miles away) is almost inaudible, and the reaction control becomes imperative. . . .

(In reply to a letter asking for further information)—

. . . There is no metal used in the construction of the sideboard, and the house is not steel-framed. I am sending you a photograph showing the set in the position in which it fails to work; perhaps this will give a clue. C. D. H.

Your photograph makes clear what seemed at first to be a puzzling problem. We see that the receiver is placed against a mirror which forms part of the sideboard. The glass will have a metallic coating, and this is undoubtedly absorbing energy from your frame aerial, which is probably built into the back of the case; consequently it is in close proximity to what is, in effect, a large sheet of metal.

o o o o

H.F. Stopping.

I attach two circuit diagrams showing the anode connections of the detector in my four-valve receiver; you will see that alternative positions for the H.F. choke are shown. Which is correct? C. C. L.

The diagrams mentioned are reproduced in Fig. 2. The function of an H.F. choke in a circuit of this kind is mainly to restrict the application of H.F. voltages to the grid of the succeeding L.F. amplifier, and the arrangement shown in diagram (a) does little to achieve this end. The second method of connection (b) is infinitely better; you will see that the intervalve condenser is connected to the junction between choke and coupling resistance.

Indoor Aerials.

Can you give me some advice on the erection of an inside aerial? In one of the rooms of my flat the set worked well when connected to a wire running along the picture-rail, but since moving it to another room, signal strength is so seriously reduced that it is quite inadequate. The earth connections are similar in both cases, being made to a radiator. This seems to prove definitely that the aerial is at fault. D. S. G.

We agree, and think you will find that in the new position the aerial will be found to be running parallel with and in close proximity to a steel girder, or possibly an electric light conduit embedded in the wall. Without a knowledge of your conditions we cannot give any definite advice, but suggest you should try another side of the same room; or, perhaps best of all, run the aerial wire diagonally across the room under the ceiling.

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Badly Reproduced Sibilants.

My set gives fair quality, but I am not at all satisfied with the reproduction of speech. In particular, "s" sounds do not come through at all well. Does this symptom convey to you any hints as to where I should look for the trouble? J. C. S.

Poor definition of the sibilants is generally a sign that the higher audible frequencies are not properly reproduced. As far as the set is concerned, attenuation of these upper frequencies may be due to excessively sharp tuning or to the use of anode resistances having an excessively high value; these are the two main causes, but there are others. Again, some loud speakers do not deal faithfully with "s" sounds, and before condemning the set, we advise you to make a comparative test on another loud speaker, if this can be arranged.

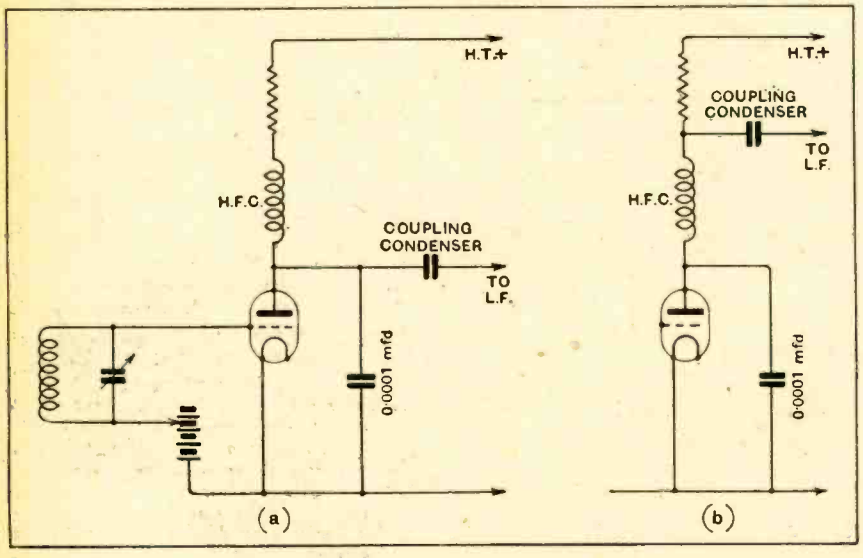

Fig. 2.—Incorrect (a) and correct (b) positions of an H.F. choke in the anode circuit of a detector valve.

Difficulties of Adding H.F.

My two-valve receiver ("Hartley" detector with one L.F. stage) gives good signals from the two nearest stations, but it is very seldom that I can receive Continental transmissions. However, the set is so satisfactory that I would prefer not to "scrap" it, and would like to add an H.F. amplifying valve. Have you described a suitable method of procedure in any back number? If so, will you please give me a reference to it? W. D. M.

This matter was treated briefly in *The Wireless World* for June 27th, 1928. We should warn you, however, that the addition of an H.F. stage to an existing detector-L.F. set is seldom an easy matter—if maximum efficiency is to be obtained—and your circuit arrangement happens to be particularly unsuitable for this modification.

o o o o

Detecting Distortion.

In the interests of good quality, is it really essential that a milliammeter connected in series with an output valve should show a perfectly steady reading when signals are being received? I find it almost impossible to prevent occasional slight variations, even though I satisfy myself with volume that cannot be called excessive. Although there are fluctuations, I notice that distortion does not become apparent unless they are of considerable magnitude. H. P. C.

In the ideal amplifier, a milliammeter connected in series with the output of the last valve would remain quite steady, but in practice this desirable state of affairs is, as you have found, extremely difficult to achieve, and providing the fluctuations are not continuous and heavy, we do not think you need be perturbed.

We notice that you live in a locality remote from a broadcasting station, and thus assume that your set will, of necessity be of a fairly sensitive kind; although you arrange to eliminate variations due to actual signals, even on deeply modulated passages, it is quite possible that atmospherics will cause occasional "kicks" of the meter needle.

o o o o

Short-wave H.F. Amplification.

Can you give me a hint to help me in my experimental work with a short-wave H.F. amplifier using a screened-grid valve? I have had some small measure of success, but am surprised to find that the valve goes into oscillation when the grid and plate circuits come into tune over a good part of the tuning range. This happens in spite of the fact that all the usual precautions have been observed; screening is complete, and all the circuits are decoupled. E. D. L.

It is rather difficult to help you in a highly specialised matter of this kind, but we suggest that the most suitable line of attack would be to add a neutralising system. There is no real reason why this should not be used with a screened-grid H.F. valve.

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CONTENTS OF THIS ISSUE.

A TRUCE.

A LULL in the storm of opposition against the publishing activities of the B.B.C. has intervened as the result of a provisional agreement between the Corporation and those representing the interests of the Press, under which a committee is to be formed to keep in touch with the publishing projects of the B.B.C. and be given the opportunity of discussing with the B.B.C. any new publishing proposals, and also of making representations regarding existing publications of the Corporation.

This truce is, we consider, a fortunate development of the argument from the point of view of the B.B.C., for it has allowed the new publication *The Listener* to come into existence, and this, in itself, is evidence that the Press are prepared to adopt a tolerant view within certain prescribed limits. But it seems to us quite apparent that the duration of the truce is dependent entirely on whether the B.B.C. intends that this committee shall, or shall not, be an effective body. The B.B.C. has attempted to assist in the establishment of a better feeling by undertaking not to accept for *The Listener* more advertisements than are necessary, with its other revenue, to cover the total cost of production.

Whilst we welcome the establishment of a committee having what may be, perhaps, described as a "watching brief" for the Press, yet we cannot express ourselves as envious of the task which they have set themselves to perform. It will be their responsibility to see that the menace of *The Listener* as a publication in competition with privately owned journals is not increased. Without the strict supervision of this committee it would seem that the menace would be greater by reason of the fact that the B.B.C. undertakes that it shall not make a profit, since all surplus revenue from the publication, however great, could be put back into the production of the journal. Thus we might see the editorial expenditure soaring and the journal growing in bulk week by week in the effort to maintain the balance between revenue and expenditure. The time might come, too, when the B.B.C. might desire to give the journal away rather than receive payment for it. Such a policy would not necessarily tend to reduce the number of advertisement pages which the paper would carry, and would certainly not make it a less formidable rival of those journals with which its contents is expected to compete.

Last week we pointed out that, in our opinion, the case of *The Listener* was only a single instance of the incursion by the B.B.C. into active competition with private enterprise. At present the effect which B.B.C. enterprise may have upon the interests of the teaching profession is being discussed, and it is suggested that not even the Board of Education would take it upon itself to indulge in so much interference with the machinery of education as is foreshadowed in B.B.C. policy.

Perhaps the recent outbreak may serve to revive the efforts of the entertainment industry to safeguard themselves against encroachment which they have every reason to fear. In the plans for the new Broadcasting House we observe that a super studio, with accommodation for 1,000 members of the public, is promised. Whether the B.B.C. derives box-office receipts from such an audience or not, in either case it would seem to us that this is equivalent to the establishment of a B.B.C. theatre or concert hall in direct competition with those privately owned.

The radio industry, too, can scarcely feel safe against the possibility of awakening one day to find that the B.B.C. has decided that the manufacture and sale of broadcast receivers is not one of the activities (if indeed there are any) denied to them under their Charter.

ONE METER MANY PURPOSES

The Principles Underlying the Design of Shunts and Series Resistances.

By A. L. M. SOWERBY, M.Sc.

PROBABLY every wireless enthusiast would like to be able to measure the various voltages and currents that are of importance in his receiver, and to make those other measurements that continually seem to be necessary in the making up, and especially in the designing, of a receiver, such, for example, as checking the characteristics of valves, and finding what variations from the makers' figures of those alleged constants, amplification factor and A.C. resistance, occur in practical working. To do all this, however, a very extensive range of meters is necessary, covering all ranges of current from the one or two milliamps in the plate circuit of a valve up to the quarter ampere or so consumed by valve filaments. In voltage measurements a similar range is wanted, beginning with an accurate reading of the voltage of a single accumulator cell, and rising to the determination of the high-tension voltage, or perhaps 200 volts, applied to the plates of the output valve of the set.

It is the purpose of this article to show how a single meter, with the addition of some carefully adjusted home-made accessories, can be made to fulfil all these functions at will, and so to take the place of the six or eight separate meters that would otherwise be necessary to cover all the various ranges required. In comparison with the possessor of the full range, the owner of a single meter that has been made adaptable to all these various tasks suffers practically nothing in loss of accuracy, provided he has carried out the making of the accessories with sufficient care, and that he is not looking for apparatus of the highest laboratory standard. The only advantage that remains to the owner of a number of instruments is the ability to use several meters at once in different parts of the same circuit, a possibility that is obviously denied to the owner of a single multi-range meter. Those who have studied the catalogues of the makers of electrical measuring instruments will realise that the extra expenditure necessary to obtain this convenience is by no means inconsiderable.

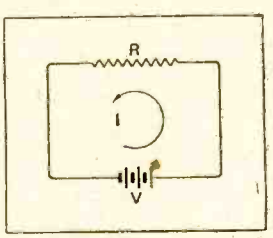

Fig. 1.—The current flowing in a circuit such as this is given by:— current in amperes = E.M.F. in volts / resistance in ohms or $I = \frac{V}{R}$.

Relationship between Volts, Ohms and Amperes.

Before discussing the method to be used for converting a single-range meter into one that can cope with any measurement for which it is wanted, it is necessary to digress for a short while into a consideration of Ohm's Law, which expresses the relationship that exists between voltage, current, and resistance in a direct-current circuit, for we shall have occasion to use this law at every step of the proceedings.

Those who are completely unacquainted with Ohm's Law are referred to an article entitled "Volts, Ohms, and Amperes," which appeared in this journal recently (March 28th, 1928, p. 341), which gives a fuller and more elementary exposition of this law and its applications than can possibly be attempted here. We will confine ourselves to a mere statement of the law and a very brief outline of its possibilities in practical measurement.

If a steady potential difference V is applied to the ends of a resistance R, as suggested in Fig. 1, a current will obviously flow through the resistance. The magnitude of the current will be greater the greater the potential difference V, and will be smaller for large values of the resistance R than for small. Provided we stick rigidly to ohms, amperes, and volts as our units, and do not permit ourselves to stray into using megohms or milliamps, the relation-

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ship between V, R and the current I will be given, whatever actual numerical values of these may be, by the equation $I = \frac{V}{R}$. Expressed in words, the current in amperes is equal to the potential difference V in volts, divided by the resistance R in ohms.

It matters not one whit whether R is a simple resistance, as shown in Fig. 1, or whether it is a composite thing made up of several resistances in series, or half a dozen in parallel, or even of a combination of resistances, some in series and some in parallel; provided the effective resistance of the combination is known, its value may be used for R in the equation of Ohm's Law. Such cases are indicated in Figs. 2a and 2b.

Since the equation $I = \frac{V}{R}$ is a relationship between three things, we can always find any one of the three provided the other two are known. To do this it will be convenient to rewrite the equation in two new ways,

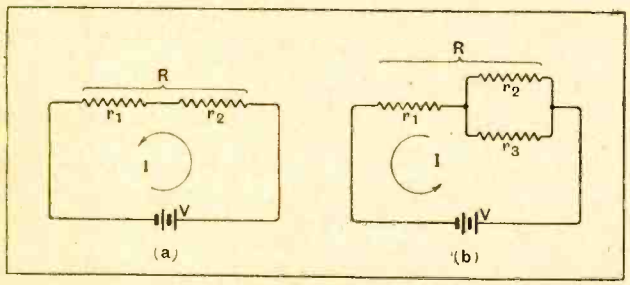

Fig. 2.—The same law as in Fig. 1 holds so long as it is understood that R means the total effective resistance of all the constituent resistances r_1, r_2 and r_3.

so that each of the other two quantities is expressed directly in terms of the others. The three forms, which will be wanted for reference, are therefore given in the following table:—

(1) To find current I, knowing V and R, $I = \frac{V}{R}$.

(2) To find voltage V, knowing I and R, $V = IR$.

(3) To find resistance R, knowing V and I, $R = \frac{V}{I}$.

Converting Milliammeter to Voltmeter.

With these three equations as moral support, let us now look again at the problem of making one meter read a number of different voltage ranges, postponing for the moment the question of arranging the instrument to read currents other than those for which it is primarily designed.

For the sake of taking a concrete instance, we will assume that the meter which we wish to use reads currents up to 5 milliamps, and that it has an internal resistance of 50 ohms. The voltage across the meter when its maximum current is flowing can be obtained from equation 2; R in this case is 50 ohms, and I is 5 milliamps, or 0.005 amp., so that $V = IR = 50 \times 0.005 = 0.25$ volt. The meter, then, can be used as it stands in the capacity of voltmeter, reading "5" for 0.25 volt, and so on, *pro rata* all down the scale, each twentieth of a volt producing a deflection of 1 milliamp. The point is that the meter cannot be used to measure voltages greater than $\frac{1}{4}$ volt, for if a greater voltage is applied it will be overloaded.

Since a single accumulator cell has a voltage of about 2, and we practically never wish to measure voltages lower than this, the meter, without additions, is to all intents and purposes useless as a voltmeter. If we put a resistance R_1 in series with the meter, as in Fig. 3, we can arrange that the bulk of the voltage to be measured is dropped across R_1, and not more than the allowable $\frac{1}{4}$ volt is dropped across the meter, under which conditions the current flowing through the two in series will not exceed 5 milliamps. The value of the total resistance, *including that of the meter*, necessary to provide a current of 5 milliamps on 2 volts can be obtained from equation 3: $R = \frac{V}{I} = \frac{2}{0.005} = 400$ ohms. Since the resistance of the meter is 50 ohms, this leaves 350 ohms for R_1, and if we make a composite instrument consisting of R_1 and the meter in series, we shall always get a deflection of $2\frac{1}{2}$ milliamps for every volt applied. Thus, by the addition of a series resistance, our milliammeter can be made quite readily into a voltmeter.

Extending Voltage Range.

A voltmeter made up according to this prescription will be very valuable for reading the voltage of single accumulator cells, but will be of no use whatever for reading the voltage of an H.T. battery, for if we connect it across, say, 50 volts, the current that will flow (equation 1) will be 125 milliamps, and the result will be a damaged meter. But just as the insertion of a series resistance raised the range from $\frac{1}{4}$ volt to 2 volts, so the increase of this resistance to 25 times its former value will result in increasing the maximum voltage that can be read approximately 25 times, and the meter will then give a reading of 5 milliamps for 50 volts, or 1 milliamp for every 10 volts applied.

We now have a second voltmeter, reading up to 50 volts, as well as our first, which read up to 2 volts, and it is clear that by having a sufficient number of suitable resistances, and making them interchangeable so that we can put any one at will in the position of R_1, in Fig. 3, we can use the one meter to cover any voltage range we please.

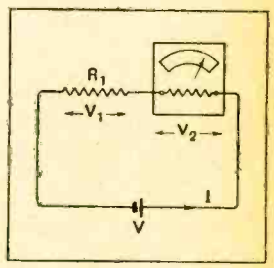

Fig. 3.—The series resistance R_1 drops a known part V_1 of the total voltage V; the remainder V_2 is insufficient to drive through the meter a current large enough to damage it.

In the case of a moving-coil voltmeter, sold as a separate instrument, this series resistance is already in place, and, although it enables the meter to be used for reading voltages, it unfits it completely for reading currents, since the insertion of so high a resistance into the circuit in which is flowing the current to be measured will usually alter seriously the value of the current. If, therefore, we are going to use the instrument for both purposes, we must buy, not a voltmeter, but a milliammeter, and supply our own external series

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resistance, fitting it in such a way that it is readily removable when the meter is to be used for measuring currents again.

For extending the range of currents that can be read by means of the meter, the process is a little different. We have seen that the maximum voltage that can be permitted to exist across the terminals of the meter is 0.25 volt, since a higher voltage than this leads to overloading the meter. The value 0.25 was obtained, it will be remembered, by multiplying the current flowing, I, by the resistance of the meter, R. If we want to measure current up to 50 milliamps we must, therefore, arrange that with this current flowing the voltage drop across the meter-terminals, as given by the product IR, still does not rise above 0.25 volt. Since we have decided that we want to increase the current ten times, we have no resource but to decrease R, the resistance of the meter, ten times, for this is the only possible way of keeping the product IR unchanged.

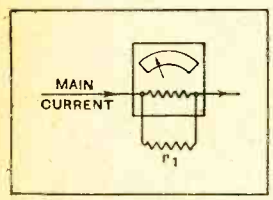

Fig. 4.—By connecting a shunt r_1 in parallel with the meter, the resistance of the two together is decreased. The shunted meter may then be interposed in the path of a heavy current without developing voltage enough to drive a dangerously large current through it.

This reduction of the resistance of the meter is accomplished, not by disembowelling the meter and rewinding the coil, but by the much simpler process of connecting in parallel with it a subsidiary resistance, known as a "shunt," in the manner shown in Fig. 4. To reduce the total resistance of meter and shunt in parallel to exactly one-tenth of that of the meter alone, and so to multiply the maximum current that can be read ten times, the shunt itself must have a resistance of one-ninth of that of the meter. In general, if we wish to multiply the current n times, the shunt must have a resistance of $\frac{1}{n-1}$ times that ot the meter, and the combination of meter and shunt will then have a joint resistance of $\frac{1}{n}$ of that of the meter alone. This fact should be noted, as we shall have occasion to make use of it several times in the practical application of these general remarks.

Shunts for Extending Current Ranges.

Another way of looking at the effect of a shunt multiplying the range ten times is to consider that it has to carry exactly nine-tenths of the current, leaving only one-tenth to pass through the meter; on this basis the reason why the shunt must have a resistance one-ninth that of the meter is perhaps clearer.

Just as a number of different voltage-ranges can be covered by using a number of different interchangeable series resistances, it is possible to arrange for as many different current-ranges as may be desired by employing different shunts, those for the higher current-ranges having the lower resistances. But although we can thus shunt away unwanted current from the meter, and so measure currents greater than can be dealt with by the unaided instrument, there is no way of making the meter more sensitive than it is by nature. The meter must, therefore, be chosen in the first place to indicate satisfactorily the smallest current that we are likely to want to read.

Standard Resistance Required.

It is by now becoming evident that we are to be let in for a series of accurate measurements of resistance, and for this the meter alone will not suffice. We have said that to have complete command of any circuit we must know two out of the three quantities; the meter itself puts us in a position to measure current, so that it remains to us to acquire either a standard of voltage or a standard of resistance. Theoretically, it is not of the slightest consequence which of these we elect to add to our equipment, but in practice a standard of voltage has to take the form of a "standard cell" giving a known voltage. This is rather an expensive item and, in addition, is only indirectly of use in that the voltage that it gives varies from the standard value as soon as more than a very small current is taken from it. We choose, therefore, a standard of resistance instead, for as soon as we have added this to our current-measuring meter we can measure voltages for ourselves. Moreover, standards of resistance of accuracy amply high enough for our present purpose are not expensive, and may be used with reasonably large currents without varying appreciably from their nominal value.

Since the first task that we shall have to undertake with the aid of this resistance is the measurement of voltage, and since, further, the source of voltage that we shall use will be the accumulator cell, the value of this resistance must be so chosen that, when put in series with the meter and a 2-volt accumulator, the current taken is just about the maximum current that the meter will read. Equation 3 helps us here; the value of resistance must be *not less than* $\frac{2}{I}$ where I is the largest current that the meter reads. If this is 10 milliamps (or 0.010 amp.) the resistance must not be less than $\frac{2}{0.010} = 200$ ohms; if it is 5 milliamps, not less than 400 ohms, and so on for other values. Suitable resistances can be obtained from Messrs. Pye, Granta Works, Cambridge; their "Educational Quality" is amply accurate enough for our purposes, and costs about seven or eight shillings. Messrs. F. E. Becker and Co., 17, Hatton Wall, E.C.1, make similar resistances, or they can be obtained from any dealer in scientific apparatus. An accuracy of not worse than about 0.5 per cent. will be good enough, and though a higher accuracy than this can be obtained, it is not worth paying for, since it will make no difference to our final results, for the method we are going to employ is only accurate to about 1 per cent.

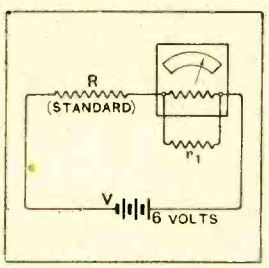

Fig. 5.—The circuit employed for adjusting the shunts precisely the required value for higher current ranges.

It is also absolutely essential to find out from the makers of the meter to which the shunts are to be fitted the exact value of its resistance, for the system of shunt-

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making that we shall use cannot be applied unless the resistance of the meter is known.

The equipment that is required, then, is a milliammeter which covers the lowest current-range that is likely to be wanted, together with an accurate fixed resistance of such a value as to convert the milliammeter into a voltmeter reading up to 2 volts or a little more, and a knowledge of the internal resistance of the meter itself. With these and a few accumulator cells of fair size (the ordinary L.T. battery, augmented if necessary by borrowing one or two extra cells) we can make up accurately as many shunts and series resistances as may be wanted.

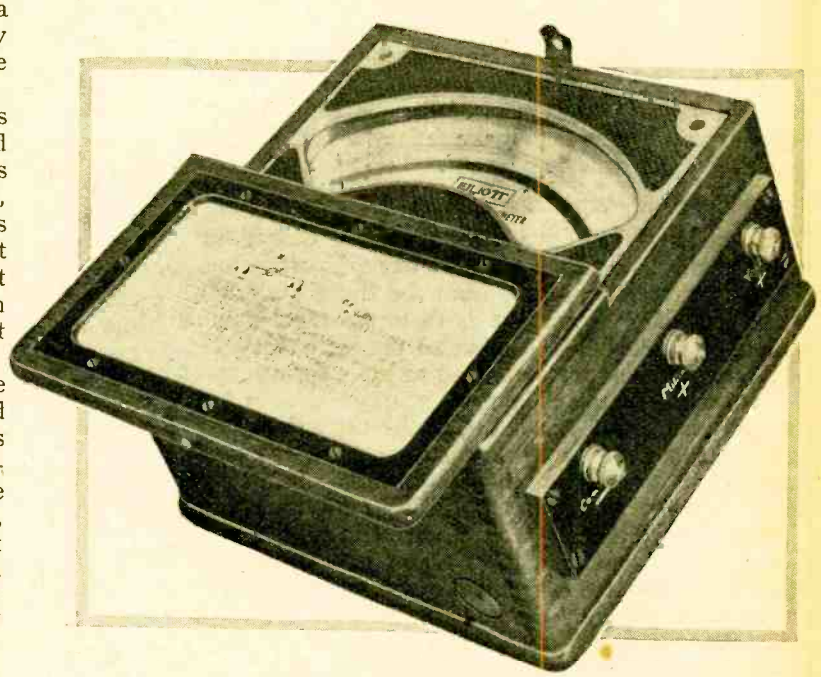
The mode of procedure is, in outline, as follows: First, the standard resistance and the meter are connected in series across one cell of the accumulator, as in Fig. 3, and the current indicated by the meter is noted. The total resistance R in circuit is the resistance of the standard *plus* that of the meter, and so is known. From equation 2, multiplying this by the current flowing gives the voltage of the cell.

Owing to the fact that the total resistance of the circuit is not a convenient round number, the combination as it stands is hardly suitable for permanent use as a voltmeter, for the current will not be a whole number of milliamps for each volt applied, but some inconvenient fraction. The first step is, therefore, to make a new series resistance so that the volts being measured fit conveniently on to the scale division of the meter. Two milliamps per volt will be convenient for the first of the ranges, as this, with a 5-milliamp meter, will give a voltage range up to $2\frac{1}{2}$ volts, which is exactly right for examining a single accumulator cell. We then work out from equation 3 the value of resistance necessary for this, and from the wire table at the end of this article we choose a suitable gauge of resistance wire, and measure off a length which gives a slightly higher resistance than we expect to require.

The standard resistance is then removed and replaced by this new one, and the accumulator of accurately known voltage is again connected. Since the resistance is too high the meter will give a reading that is too low. The resistance is therefore lowered, by cutting off short lengths, until the meter reads the voltage correctly; that is to say, in the case taken, until the reading on the scale is precisely double the voltage found for the accumulator. Whenever we connect this resistance in series with the meter, we therefore have an accurate voltmeter reading 0-$2\frac{1}{2}$ volts.

Thus equipped we can proceed to the making of a new series resistance for a higher voltage range—say, 0-50 volts. For this we take with the newly constructed voltmeter the exact voltage of 20 cells in succession (H.T. accumulators) and adding all these voltages together we have an exact figure for the total voltage of these 20 cells. We must now work out the series resistance necessary to give 4 milliamps current on 40 volts (it comes out at 10,000 ohms) and wind, from fine resistance wire, a resistance of a little more than this value. This is connected in series with the meter and the 20 cells whose voltage is known, and the resistance is adjusted as before until the scale reading is exactly one-tenth of the voltage of these cells. The 5-milliamp meter, in conjunction with this latest resistance, has now become a voltmeter reading 0-50 volts.

And so the process continues for as many ranges as may be wanted, the series resistance required becoming higher for the higher ranges. Later on a method will be suggested by which the winding and adjusting of these high resistances can be avoided, commercially obtainable components being used instead.



A moving-coil meter of the type which is easily convertible by means of external resistances for reading voltage or current.

Higher Current Ranges.

The making of the shunts necessary for the higher current ranges is carried out in a very similar manner, but in this case we have to bear in mind throughout the whole process the resistance of the meter itself. If, for example, we wish to make a shunt to enable the meter to measure currents up to 20 milliamps, we proceed in this way:—

Since 20 milliamps is four times 5 milliamps, the multiplying power of the shunt is 4, and its resistance must therefore be $\frac{1}{4-1} = \frac{1}{3}$ of that of the meter. If this is 50 ohms, the shunt must therefore have 16.67 ohms resistance. Using the wire tables, a piece of resistance wire is measured off to give a resistance of about 18 to 20 ohms, thus allowing a margin for adjustment.

Next, the voltage of each of three accumulator cells

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is measured with the 0-2½ voltmeter already prepared; the cells are then connected in series, giving a total voltage equal to the sum of the three separate voltages. The shunt is connected in parallel with the meter, and the standard resistance and cells in series, as shown in Fig. 5, and the current flowing is calculated thus:—

The total resistance of the circuit is that of the standard resistance (400 ohms in our example) *plus* that of the shunted meter. When the shunt has been correctly adjusted, the resistance of the shunted meter will be exactly one-fourth of that of the meter alone; that is, one-fourth of fifty, or 12½ ohms. This gives a total resistance of 412½ ohms, and, knowing the exact voltage of the three cells, and using equation 1, we can find the precise value of the current flowing—it will be about 15 milliamps. We have to make the meter read exactly one-fourth of the calculated value; i.e., some 3¾ mA.

Sufficiently High Standard of Accuracy.

Since the shunt has initially too high a resistance the meter will read, not some 3¾ mA., but a higher value. By cutting successive scraps from the shunt the reading can gradually be brought down to the exact figure required, and when this is achieved the meter may be used, by multiplying the scale reading by 4, for measuring currents up to 20 milliamps.

It is to be noticed that although the current flowing is not quite the same as the calculated value as long as the shunt is wrong, it moves towards and finally attains that value as the process of adjusting the shunt is carried out, so that no error is introduced by assuming from the beginning that the shunt is correctly adjusted, and basing the calculation of the current flowing on that supposition.

Two alternatives are open to us in making the next shunt; either we can retain the 400-ohm resistance, and increase the voltage applied in order to obtain larger currents, or we can use the shunt already made to standardise a new and smaller resistance. The former process generally means having recourse to the H.T. battery, and this, even if consisting of accumulator cells, will drop measurably in voltage so soon as a heavy current is drawn. Consequently the second method, by adopting which we can use again the much larger cells of the L.T. battery, is greatly to be preferred.

First a resistance is made that will pass 20 mA. on two volts; its exact value can be found from equation 3, and comes out at 100 ohms. A length of resistance wire having a little more than this resistance according to the wire table is taken, and connected in series with one cell and the meter, the latter being shunted for 20 mA. The current flowing is noted, and, if thought desirable, the voltage of the cell is taken again. The total resistance in circuit is then found from equation 3, and that of the shunted meter (12½ ohms in our example) is subtracted; this gives the exact resistance R_2 of the piece of wire.

Suppose the shunt is to make the meter read to 50 mA.; the resistance of the shunt will have to be $\frac{1}{10-1}$ = 1/9th that of the meter, or about 11 ohms. Using the wire table again, a piece of resistance wire of resistance some 12 to 14 ohms is taken and connected in parallel with the meter. When this has been correctly adjusted, the resistance of the shunted meter will be 1/10th that of the meter alone, or 5 ohms. This, in series with the newly standardised resistance R_2, gives a total resistance of $(R_2 + 5)$ ohms, and if this is connected to the three cells of known voltage the current resulting can be calculated from equation 1. Once again the shunt is adjusted in length until the correct reading, in this case one-tenth of the calculated current, is obtained on the meter, which then reads from 0 to 50 milliamps.

By extending this process, making new standard resistances as required, a whole series of shunts may be made to cover all the current-ranges that are likely to be required. The only flaw in the process that the writer has been able to detect, either in theory or through practical application of the method, is that the accumulator cells used have their voltage measured when only a very small current is being drawn from them, and are assumed to maintain this voltage unchanged when a larger current is taken. This leads to an error, but for comparatively small currents the error is small, being certainly less than two per cent. provided the accumulators are in good condition, and neither too freshly charged nor run right down.

TABLE OF RESISTANCE WIRES.

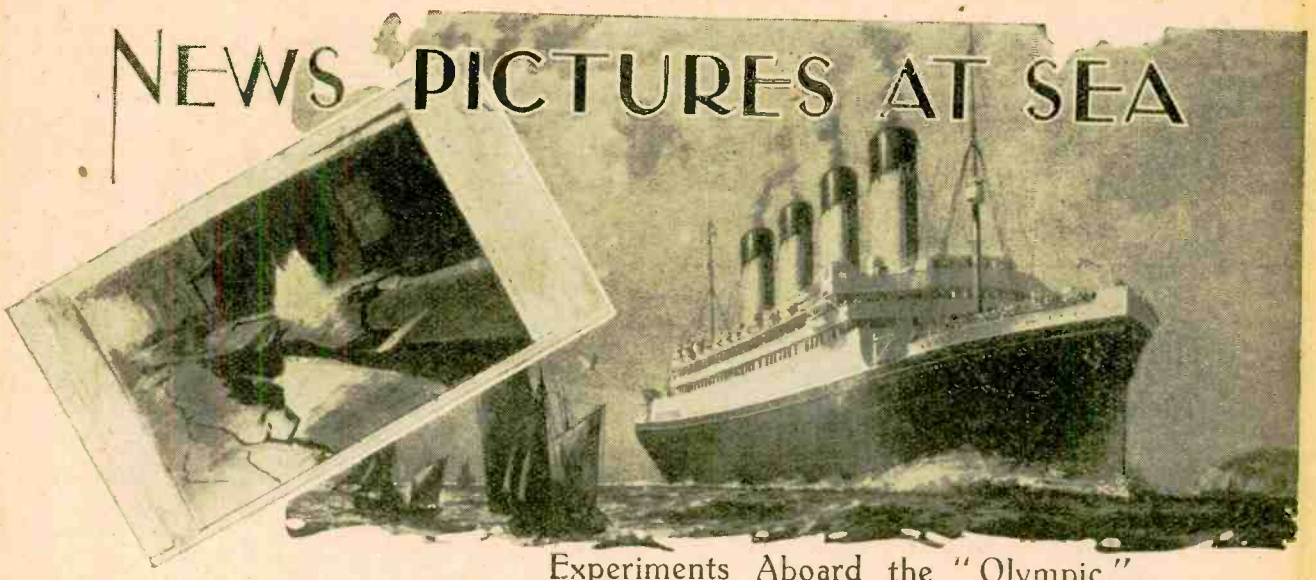
S.W.G.	Resistance in ohms per Yard. Eureka.	German Silver.
22	1.10	0.52
24	1.77	0.84
26	2.65	1.26
28	3.91	1.85
30	5.58	2.65
32	7.35	3.50
34	10.13	4.82
36	14.84	7.06
38	23.81	11.33
40	37.18	17.70
42	53 56	25.58
44	83.66	39.87
45	108.6	51.75
46	148.8	70.9
47	214.3	102.2

In making shunts for ranges over some 200 milliamps, it is desirable to arrange to read the voltages of the various cells while actually delivering a current approximately equal to that which will be required when finally adjusting the shunt. If, for example, three cells are to be used to give a current of 0.6 amp. through a resistance of 10 ohms, a resistance of between 3 and 3½ ohms should be connected across each cell separately while taking their voltages, and to ensure a steady value the current should be allowed to flow for some five minutes before reading the voltage. With this precaution, shunts up to 2 amps. may be made up with confidence.

If the meter used as a basis for all this work is of a sufficiently high standard of accuracy, it would even be advisable to proceed in this way when preparing shunts for lower ranges. It will, however, be appreciated that it is hardly worth while to take the extra trouble necessary to fit the shunts with an accuracy of 0.5 per cent. if the meter with which they are to be used is only guaranteed to read within a margin of error of one or two per cent.

(To be concluded.)

NEWS PICTURES AT SEA

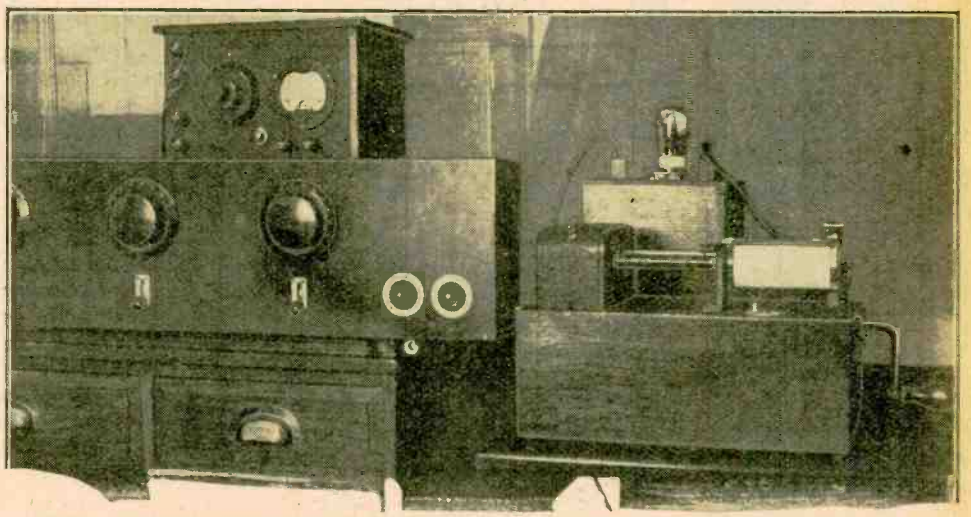


Experiments Aboard the "Olympic."

TO make the North Atlantic crossing may possibly suggest five days' isolation at sea with little or no information concerning current events. Now that but small interest is taken in morse reception it is overlooked that the high power stations regularly transmit lengthy news bulletins which are published in the daily newspapers produced aboard many of our larger liners.

The recent remarkable achievements in the transmission of pictures by wire and wireless and picture broadcasting point to the possibility of including topical illustrations in the pages of the ocean newspapers. Arrangements were therefore made early in last month by the *Daily Telegraph* to test the practicability of the scheme. The Fultograph apparatus, the excellent results of which made the whole idea possible, requires a modulated transmitter of sufficient power to bridge the three thousand odd miles of the North Atlantic. This presented little difficulty, and by Post Office co-operation the picture signals were applied to the Rugby telephone transmitter which is used for the transatlantic telephony service. Receiving equipment was installed aboard the White Star liner "Olympic," and consisted of an almost vertical aerial running down from one of her funnels, a four-valve receiver, and a standard Fultograph. In addition provision had to be made for the preparation of process printing blocks from the pictures as received.

Preliminary tests were carried out aboard the "Olympic" during the night of December 6-7th, and these, the first pictures transmitted from Rugby, were received from the onset with that same perfection of definition possessed by the many wireless transmitted pictures which have been reproduced in these pages. Sailing on the 12th, the first actual reception at sea was arranged during the early hours of the 13th, the "Olympic" by this time being about 400 miles out. Six pictures were received without a hitch, printing blocks were made, and a large number of illustrated news sheets printed off, creating much surprise among the passengers at breakfast. Equally successful results were obtained on the 14th, 15th, 16th and 17th, the range then having reached 2,225 miles. On the 18th, the last day of the outward trip, good reception was obtained at 2,800 miles, although the images bore the marks of static. To the reader possessing a picture receiver these experiments not only reveal the reliability of the system at extreme range, but also indicate channels for many possible developments.



Picture receiving equipment on the "Olympic." The wireless receiver is a Wireless World "Kilomag Four" adapted on one of its wave-ranges to suit the wavelength of Rugby. Using the Daventry range, 5XX was heard outside New York.

KIT CONSTRUCTORS' NOTES

The New Cossor Melody Maker.

How Best Results may be Obtained.

A WIRELESS Rip van Winkle, oblivious to developments in the amateur field since, say, 1922, would, on resuming his hobby to-day, probably be even more intrigued by the way in which the set builder's difficulties have been removed than by the technical progress made during the intervening years.

Kit construction is not new, but what changes it has undergone! Looking through an old copy of *The Wireless World*, dated a few months before the inception of broadcasting in this country, one sees a "bargain offer" of a set of parts for making a tuner—coil-holder, variable condenser, and box—for £5. Nowadays we expect to get all necessary components for a simple receiver for something less than that, and, thanks to increased demand and production, we are not disappointed.

The new Cossor Melody Maker is an outstanding example of what may be done, by careful attention to details, in producing a kit of parts that can be assembled and wired by the veriest novice. Everything, excepting batteries and loud speaker, is included, and there is no need for such work as drilling or sawing; the set can be built in a living room without any messy operations, as terminals are used throughout in place of soldered connections. Even the boring of holes for wood screws is avoided by supplying a plywood baseboard ready drilled to take the small bolts, by means of which the various components are secured in position.

Features of the Design.

Needless to say, the receiver can be wired without any knowledge of theoretical diagrams, but it will be interesting to consider the circuit, which is given in Fig. 1. The aerial is coupled to the grid circuit of the shielded H.F. amplifying valve by an auto-transformer arrangement, and is tapped to a point on the winding near its earthed end. Normally the valve is operated with a zero grid, but a small negative bias is applied when resistance is included by rotation of the volume-reducing rheostat.

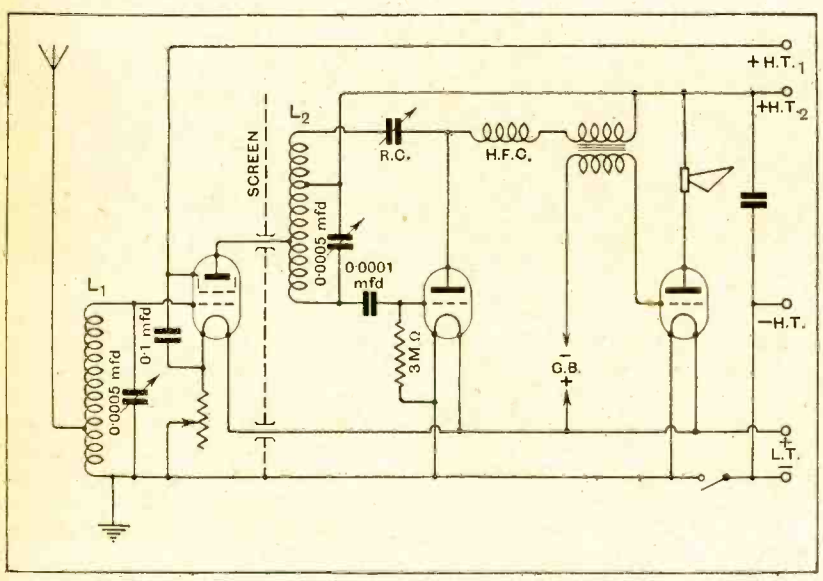


Fig. 1.—Theoretical circuit diagram, showing values of the various components.

The anode coil, which couples the H.F. amplifier to the detector, is almost equally simple, consisting as it does of a single-layer winding with two tappings; the first, at the centre point of the tuned section, is connected to plate of the H.F. valve. A second is joined to H.T. positive, and a few extra turns wound from this point as a continuation of the low-potential end of the coil, serve as a reaction winding. It will be observed that the grid condenser and leak have values respectively somewhat lower and higher than usual.

There is but one L.F. stage, transformer-coupled, which probably accounts for the fact that there is no appreciable tendency towards low-frequency instability. It should be possible to operate the set on dry-cell H.T. batteries of high internal

Kit Constructors' Notes.—

resistance without introducing howling; indeed, the effect of inserting artificial resistance in the common H.T. lead had no effect beyond reducing volume.

Although matters are so arranged that pitfalls for the novice are almost non-existent, one rather serious "snag" was encountered in testing the particular receiver under review: it was found that self-oscillation was produced as the two variable condensers were brought into tune, in spite of the fact that the reaction capacity was set at minimum. This effect was evident on both medium and long wavebands, and it could be checked only by dimming the H.F. valve filament to an extent which reduced amplification excessively.

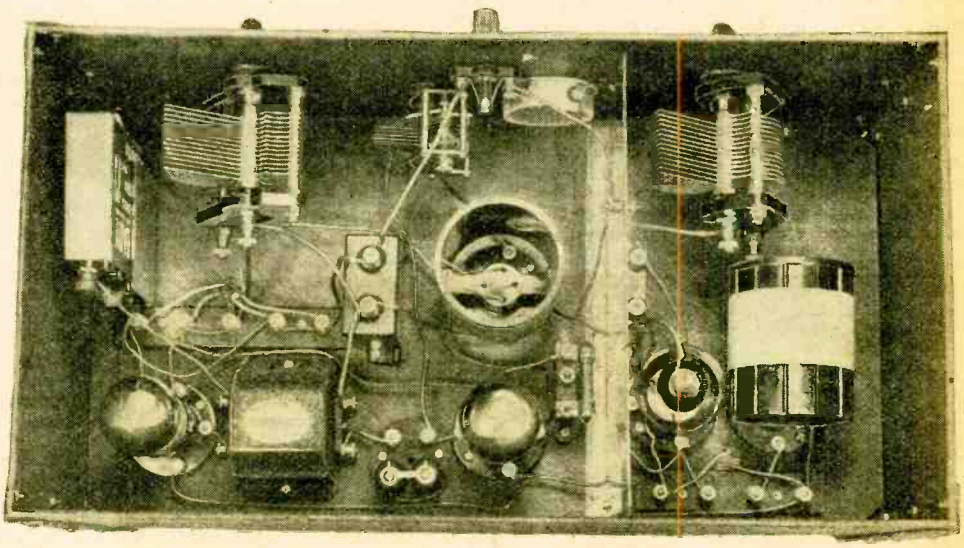
Ensuring Complete H.F. Stability.

A careful check of connections and measurement of the applied voltages failed to show anything abnormal, but brought to light the fact that the metal container was not earthed, although there was a connection between the vertical screen and the earth terminal. The addition of a wire connected between a screw securing one of the angle-pieces of the box and the common negative lead was found to effect a complete cure; precautions were taken to ensure a good electrical joint by scraping away the enamel from the metal walls under both head and nut of the bolt. Although this expedient can be recommended to any users of the set who may encounter the same trouble, it should be pointed out that, when the original design has been thus modified, care must be taken to avoid short-circuits between the terminals of phones or loud speaker and any exposed metal work.

The selectivity of any set with simple tuning controls and a single-stage H.F. amplifier is bound to be inadequate when it is used in the wipe-out area around a high-power broadcasting station, and, as was only to be expected, interference from 2LO was a difficult problem when the receiver was tested with an aerial of medium length at a distance of 1¾ miles from that station. With the medium waveband coils in position, signals spread over a large part of the tuning scale, but it was possible to receive 5GB without any background, and on the wavelength of this station there was no need to improve selectivity by reaction. Even when the long-wave coils were substituted, there was still interference, but it could be satisfactorily reduced either by using a shorter aerial or connecting the full-sized aerial to its terminal through a small fixed condenser of 0.0001 mfd. Under conditions less exacting than these, selectivity was found to be all that could be desired.

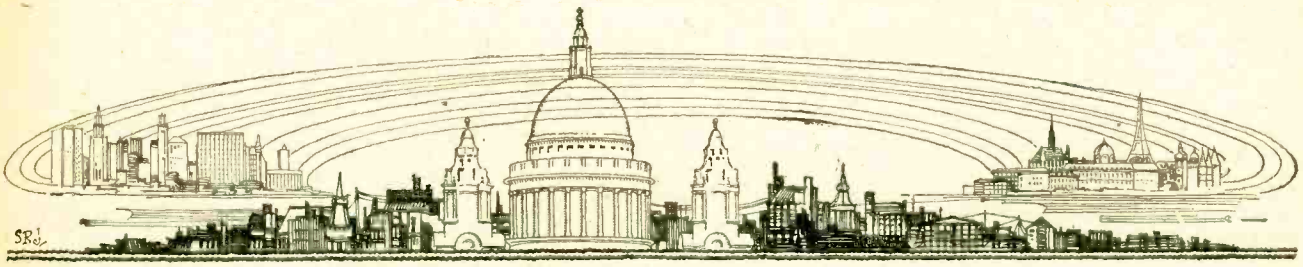
An excellent feature of the particular form of capacity reaction control is its small effect on tuning, and the operator can take advantage of this in searching for distant stations. At the time of writing, the state of ether congestion is most marked on the lower part of the broadcast band, and many stations receivable below about 300 metres are heterodyned. Attention was accordingly concentrated on reception of transmissions corresponding to dial readings of over 40 divisions. A convenient method of searching is as follows: Tune in a station at about this setting and adjust reaction for maximum response; then slowly work each dial together towards a higher reading, keeping them "in step" (as indicated, in the absence of actual signals, by a breathing sound in phones or loud speaker). Do not trouble unduly about critical adjustment of reaction until a transmission to which it is desired to listen is heard; by concentrating on the tuning dials proper, the advantages of two-handed control are retained, and a signal once tuned in can be brought up to maximum possible intensity by a slight right-handed rotation of the reaction control without fear of losing it.

Mention has already been made of the absence of any tendency towards L.F. instability; this largely accounts for the fact that the quality of reproduction is distinctly pleasing, inclining perhaps towards a slight emphasis to the higher musical frequencies. In view of the simplicity of the L.F. amplifying side of the receiver, it seems most unlikely that it will be responsible for trouble, and so comment is unnecessary.



Plan view of the receiver, with cover removed.

The fact that actual or incipient L.F. oscillation is not produced when the set is used with an H.T. battery with an (artificial) high resistance would suggest that little trouble should be encountered in using a simple eliminator for the supply of anode current. Provision for reasonably close adjustment of screen grid voltage must be included, and, to be on the safe side, it is as well to include a simple decoupling feed scheme to prevent feed-back to the detector grid.



CURRENT TOPICS

Events of the Week in Brief Review.

TWOPENCE-A-WORD WIRELESS.

A new Marconi night letter service between Great Britain and New York has been inaugurated at the reduced rate of 2d. per word.

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RUMANIA MAKES A START.

Rumania, after a long period of hesitation, has finally decided to adopt broadcasting, and it is hoped that a 12 kW. station now under construction at Otopeni, between Bucharest and Ploesci, will be working before the end of March. A provisional 400-watt transmitter is already in operation, and can be heard daily from 3 to 4 p.m. and from 7 to 10 p.m. G.M.T. on 401.6 metres. According to the *Plan de Bruxelles* the station should be working on 223.9 metres.

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SIAM SEEKS A STANDARD.

The wireless experimenter will not be tolerated in Siam, according to a fiat of the Prince of Kambaeng Bejra, Minister of Communications, who explains that all radio apparatus is banned for the present. Meanwhile the Government is carrying out tests to determine the most suitable kind of apparatus required, having regard to the climate and other natural phenomena. When a decision is arrived at regulations will be issued concerning the type of receiver which the public may use.

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IF IT HERTZ—KILL IT.

A puzzled young fellow named Merson,
An inquisitive, pert little person,
Said: "Look, Brother Bert,
Is it one Kilohert
Or does one say two Kilohertzen?"

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THE ONUS ON THE LISTENER.

Doubt, genuine or otherwise, is frequently expressed as to whether the unlicensed listener should await Post Office notification that a licence fee is due. There should, of course, be no doubt in the matter, a licence being a legal necessity *before* a set is installed.

A Northwich listener who was recently fined for working a set without a licence pleaded that he received no notice from the Post Office. It did not look, he said, as if he were trying to hide the fact that he owned a wireless set because he had two aerial poles in his back garden.

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THE OXIDE-COATED FILAMENT.

"The Development of the Oxide-Coated Filament" is the title of a paper to be read at a meeting of the Wireless Section of the Institution of Electrical Engineers on February 6th. The authors are Messrs. B. Hodgson, O.B.E., D.Sc., Ph.D., L. S. Harley, B.Sc.(Eng.), and O. S. Pratt, B.A.

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TALKING FILMS.

The directors of British Phototone, Ltd., and French Phototone, Ltd., announce that an agreement has been signed with Messrs. Klaugfilm, a subsidiary of the powerful electrical group, Messrs. A.E.G. and Messrs. Siemens-Halske A.G., who have been engaged in the development of talking and sound film devices for some years.

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THE WIRELESS CONSULTING ROOM.

A year's trial with the wireless medical service for mariners, instituted by the Belgian Government, has proved highly successful, according to a report presented at the Antwerp Military Hospital last week. The service permits captains of Belgian vessels to obtain medical advice from certain coast stations, special medicine chests being provided on each boat.

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U.S. COMMISSION ASKED TO GO.

Private broadcasting interests in America are urging the abolition of the Federal Radio Commission which is declared to have outlived its usefulness and which a San Francisco paper likens to the mule—"having neither pride of ancestry nor hope of posterity." Apparently the Commission refuses to acknowledge the compliment, resolving to defend its claims for prolongation at the next assembly of Congress.

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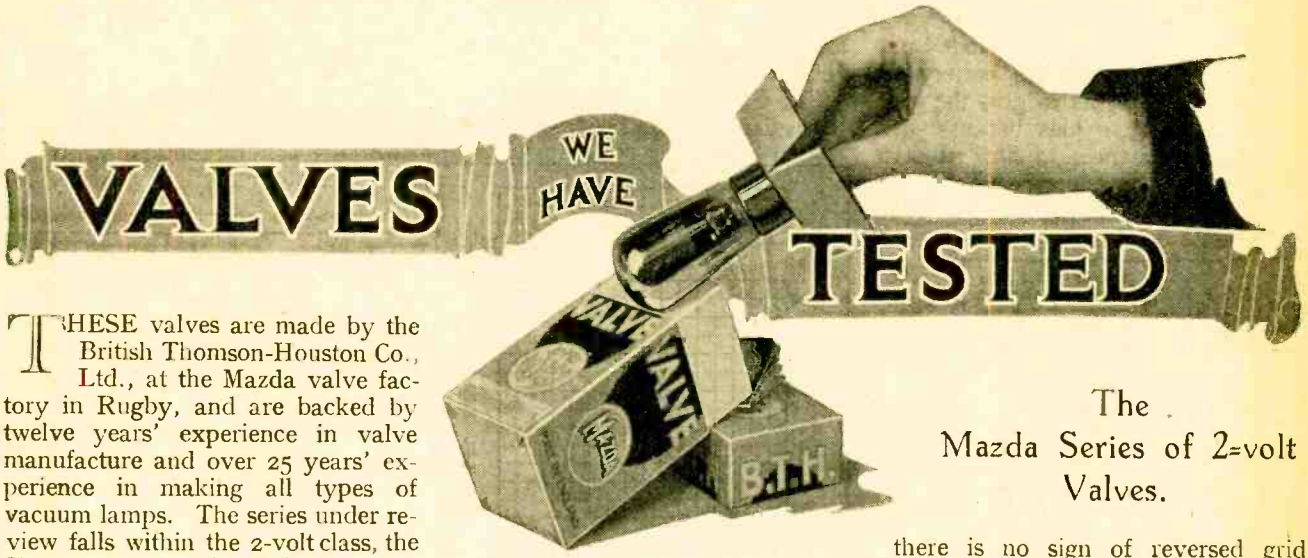
INDEX AND BINDING CASE.

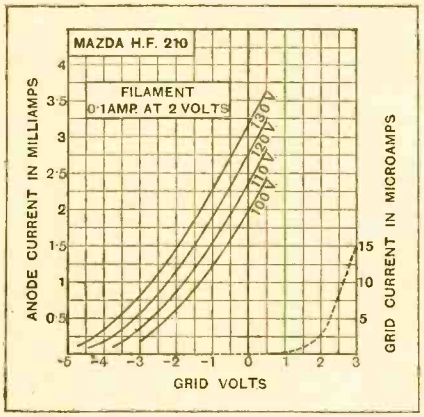
The index for Volume XXIII of *The Wireless World* is now ready, and copies are obtainable, price 3d. (post free 4d.), from the Publishers, Dorset House, Tudor Street, E.C.4. Binding cases for the volume can also be supplied, price 2s. 6d., or 2s. 10d. post free.

WATCHING A PICTURE GROW. Visitors to the recent exhibition of the Southend Radio Society witnessing a demonstration of *The Wireless World* home constructors' picture receiver. Some of the pictures reproduced on this occasion appeared in our last issue.



The Mazda Series of 2-volt Valves.

THESE valves are made by the British Thomson-Houston Co., Ltd., at the Mazda valve factory in Rugby, and are backed by twelve years' experience in valve manufacture and over 25 years' experience in making all types of vacuum lamps. The series under review falls within the 2-volt class, the filament consumption being 0.1 ampere for the H.F., R.C., and G.P. types, 0.15 ampere for the L.F. valve, and 0.27 ampere for the power-output valve. Similar construction is adopted for all types in this particular class, the filament being an inverted "V" with a spring support at the top to keep the filament taut and prevent it sagging on to the grid. The plate and grid electrodes are of



Average values under amplifying conditions. A.C. resistance 32,000 ohms, amplification factor 23, mutual conductance 0.72 mA/volt.

the familiar "flattened" type mounted vertically. These electrodes are anchored also to a glass support at the top, which is kept in position by a stout wire gripped in the "pinch" at the foot of the valve. This method of construction ensures a rigid assembly and is largely responsible for reducing to a minimum the rather unpleasant valve "pong" hitherto associated with high-amplification valves.

The H.F. 210 valve is primarily intended for use in neutralised high-frequency amplifiers, but under certain conditions it can be employed as a detector or first stage L.F. amplifier. Two specimens were tested, and in both cases the A.C. resistance was slightly lower than the makers' figures, the amplification factor being of the same order as stated, resulting in a better mutual conductance. Under average amplifying conditions, the A.C. resistance will be about 32,000 ohms, and the amplification factor 23, giving a mutual conductance of 0.72 milliamp. per volt; a good showing for a valve of this type. These results were obtained with 120 volts H.T. and −1.5 volts grid bias. If used as an anode bend detector, a negative bias of 3 to 4.5 volts, according to the H.T., should be applied, and this will lead to an increase in the A.C. resistance to between 50,000 and 60,000 ohms, and under these conditions the external anode impedance should not be less than 100,000 ohms. When employed for grid rectification, it would

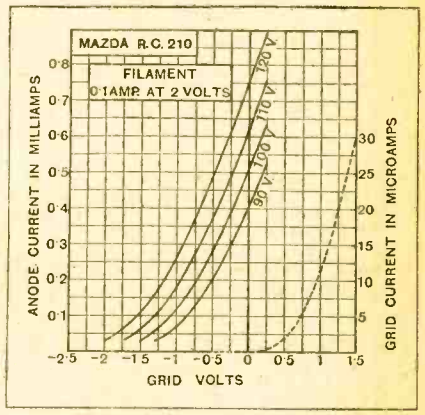
H.F. 210.

Characteristics at zero grid bias and 100 volts H.T.

H.F. 210.	Amplification Factor.	A.C. Resistance (ohms).	Mutual Conductance (mA./volt)
Makers' Rating ..	20	28,000	0.7
Specimen 1	20	25,000	0.8
Specimen 2	22	25,000	0.88

be wise to keep the H.T. well below 100 volts and return the grid-circuit to the positive end of the filament. Grid current commences to flow at 0.5 of a volt positive on the grid, and there is no sign of reversed grid current showing that the valve is dead hard.

The special function of the R.C. 210 valve is as an amplifier followed by resistance-capacity coupling, and the makers suggest that the anode resistance should have a value of 2 megohms. A high anode resistance demands a rather high battery voltage to compensate for the volts dropped by the resistance, and in



Average values under amplifying conditions. A.C. resistance 90,000 ohms, amplification factor 40, mutual conductance 0.4 mA/volt.

such cases where 120 volts only are available it would be admissible to employ an anode resistance of slightly lower value.

The two specimens tested showed better mutual conductances than the makers' rating In one case the A.C. resistance as well as the amplification factor were higher and in the other a lower A.C. resistance was accompanied with a slightly bigger amplification. When used as an amplifier

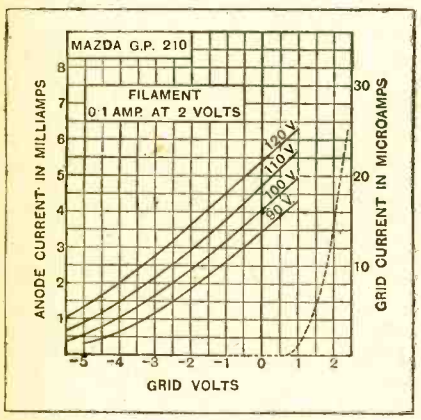
Valves We Have Tested.—

with 120 volts on the anode—not terminal voltage of the battery—it would be advisable to give the grid a small negative bias because grid current commences to flow at zero grid volts. As one cell will be too much, it is suggested that a potentiometer be connected across the filament and the positive of the grid cell connected to the slider, thereby enabling a fraction of a volt to be applied. About 0.5 of a volt negative will be correct under these conditions, but as this may vary slightly with different specimens, the potentiometer should be adjusted to give best results as judged by the ear. This valve could be used as an anode bend detector in a receiver for which a high-impedance valve is specified for this position, in which case the grid will require a negative bias of from −1 to −2 volts, according to the amount of H.T. used. To obtain satisfactory control of the bias, which may be fairly critical when dealing with small inputs, a potentiometer should be fitted as explained above.

R.C. 210.

Characteristics at zero grid bias and 100 volts H.T.

R.C. 210	Amplification Factor.	A.C. Resistance (ohms).	Mutual Conductance (mA/Volt).
Makers' Rating ..	40	86,000	0.47
Specimen 1	50	90,000	0.55
Specimen 2	44	83,000	0.53



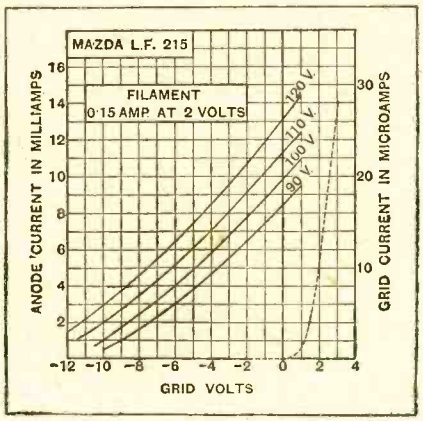
Average values under amplifying conditions. A.C. resistance 17,000 ohms, amplification factor 13, mutual conductance 0.77 mA/volt.

G.P. 210.

Characteristics at zero grid bias and 100 volts H.T.

G.P. 210.	Amplification Factor.	A.C. Resistance (ohms).	Mutual Conductance (mA/Volt).
Makers' Rating ..	13.0	14,000	0.93
Specimen 1	15.4	16,700	0.92
Specimen 2	14.0	15,400	0.91

The G.P. 210 valve occupies an intermediate position between the H.F.



Average values under amplifying conditions. A.C. resistances 8,460 ohms, amplification factor 7.7, mutual conductance 0.91 mA/volt.

type and the low-frequency amplifying valves, and is appropriately termed a general-purpose valve. It is difficult to assign to it any particular function as it is applicable to H.F., L.F., or detector usage, though as a detector it would probably give the best results when employed under leaky grid conditions.

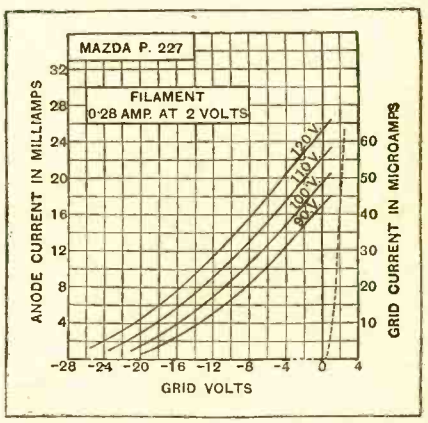
Although the A.C. resistance of the specimens tested were higher than the makers' rating, the amplification factors increased proportionately so that the mutual conductances were of the same order. Under normal working conditions, and when used as an amplifier, the average A.C. resistance was found to be about 17,000 ohms, and the amplification factor 13, giving a mutual conductance of 0.77 milliamp. per volt. In the specimen from which the characteristic curves were obtained, grid current commenced to flow at 0.7 of a volt positive grid bias, and as no sign of reverse grid current was to be found, it shows that the vacuum is of a very high order. For amplification purposes, the grid should be given about 3 volts negative bias.

Mazda P. 227 2-volt power valve.

L.F. 215.

Characteristics at zero grid bias and 100 volts H.T.

L.F. 215.	Amplification Factor.	A.C. Resistance (ohms).	Mutual conductance (mA/Volt).
Makers' Rating ..	7.0	7,000	1.0
Specimen 1	9.0	8,000	1.1
Specimen 2	7.4	7,140	1.0



Average values under amplifying conditions. A.C. resistance 4,000 ohms, amplification factor 4.15, mutual conductance 1.04 mA/volt.

P. 227.

Characteristics at zero grid bias and 100 volts H.T.

P. 227.	Amplification. Factor.	A.C. Resistance (ohms).	Mutual Conductance (mA/Volt).
Makers' Rating ..	4.0	2,900	1.4
Specimen 1	3.85	3,450	1.1
Specimen 2	4.2	3,600	1.2

The L.F. 215 valve is essentially a low-frequency amplifier, and is most usefully employed in the first stage following the detector. However, in certain cases, and especially where only two valves are used in the set, it can be employed to advantage in the output position.

Valves We Have Tested.—

Actual measurements made with the two samples available showed that their characteristics were very close to the makers' specification, and careful tests for reversed grid current failed to reveal any softening due to residual gases, indicating that the valves are dead hard. Grid current commences with 0.2 volt positive grid bias, so when biasing the valve for amplification purposes it would be well to arrange this so that the grid swing is wholly restricted to the negative side of the zero line. Under normal working conditions the average A.C. resistance was found to be about 8,460 ohms, and the amplification factor 7.7, giving a mutual conductance of 0.91 milliamp. per volt.

The particular function of the P.227 is as a power-output valve in receivers required to deliver a relatively large electrical input to the loud speaker. The maximum anode potential is restricted to 120 volts, but it will, nevertheless, successfully operate large cone-type loud speakers and sensitive moving-coil instruments at a reasonable volume which should be sufficient for average purposes, although in cases where a larger power output is desired it would probably be advisable to employ two such valves in parallel.

At zero grid bias and 100 volts H.T. the mutual conductance of the two specimens tested were of the same order as the makers' figures, but in both cases the A.C. resistance was found to be slightly high. One valve showed a higher amplification factor, the other being slightly lower. Grid current commenced at half a volt positive on the grid in both valves, there being no sign of reversed grid current. They are, therefore, satisfactorily evacuated. The A.C. resistance and amplification factor under normal operating conditions of the specimen from which the curves were obtained is about 4,000 ohms and 4.15 respectively, the mutual conductance being 1.0 milliamp. per volt.

USEFUL DATA CHARTS. (No. 20.)

Approximate H.F. Resistance of a Coil when Diameter of Wire is Optimum.

THE D.C. resistance of a coil wound with solid copper wire is given by

$$R_0 = \frac{N.D}{d^2} \times 2.67 \times 10^{-6}$$

Where R_0 = D.C. resistance in ohms.
N = total number of turns of wire.
D = mean diameter of coil in inches.
d = diameter of wire in inches.

If stranded wire without twist is used the formula becomes:—

$$R_0 = \frac{N.D}{n.d^2} \times 2.67 \times 10^{-6}$$

Where d is the diameter of a single strand and n is the number of strands: when the strands are twisted together, as in Litz wire, we must multiply this value of R_0 by 1.02 for 3-strand, 1.04 for 9-strand, and 1.06 for 27-strand wire, to allow for the increased amount of wire due to twist.[1]

Resistance to A.C. Currents.

When alternating current is used the resistance increases for two reasons; first, the magnetic field set up by the current forces the current away from the central part of the wire, so that this portion fails to do its share, and we get what is called the "skin" effect; secondly, in a coil the magnetic field due to neighbouring turns distorts the lines of current flow in each wire, and produces what is known as the "proximity" effect.

Hence we may write for the A.C. resistance:—

$R = R_0$ [skin factor + proximity factor].

Both these factors increase as the wire diameter is made larger, but at the same time R_0 decreases, so that a certain wire gauge can always be found which will make R minimum. When this best gauge is found the skin factor is approximately equal to the proximity factor, and accordingly

$R = R_0$ [twice skin factor]

approximately, when d is properly chosen.

The Abac.

Abac No. 20 is constructed on the preceding formula. It gives R_0, the skin factor, and R (which is twice the product of the first two quantities). For a solid wire coil we first multiply N by D, as shown in the inset, and on the return journey we divide by d^2, and so come to R_0, the D.C. resistance.

For calculations in the case of stranded wire coils three multiplying bars are marked off corresponding to 3-, 9-, and 27-strand Litz. The appropriate bar is to be applied by means of a pair of compasses to the d scale, so that the lower pointer rests on the actual value of d, and the upper one marks a new point on the d scale, which new point is to be used on the return journey from right to left.

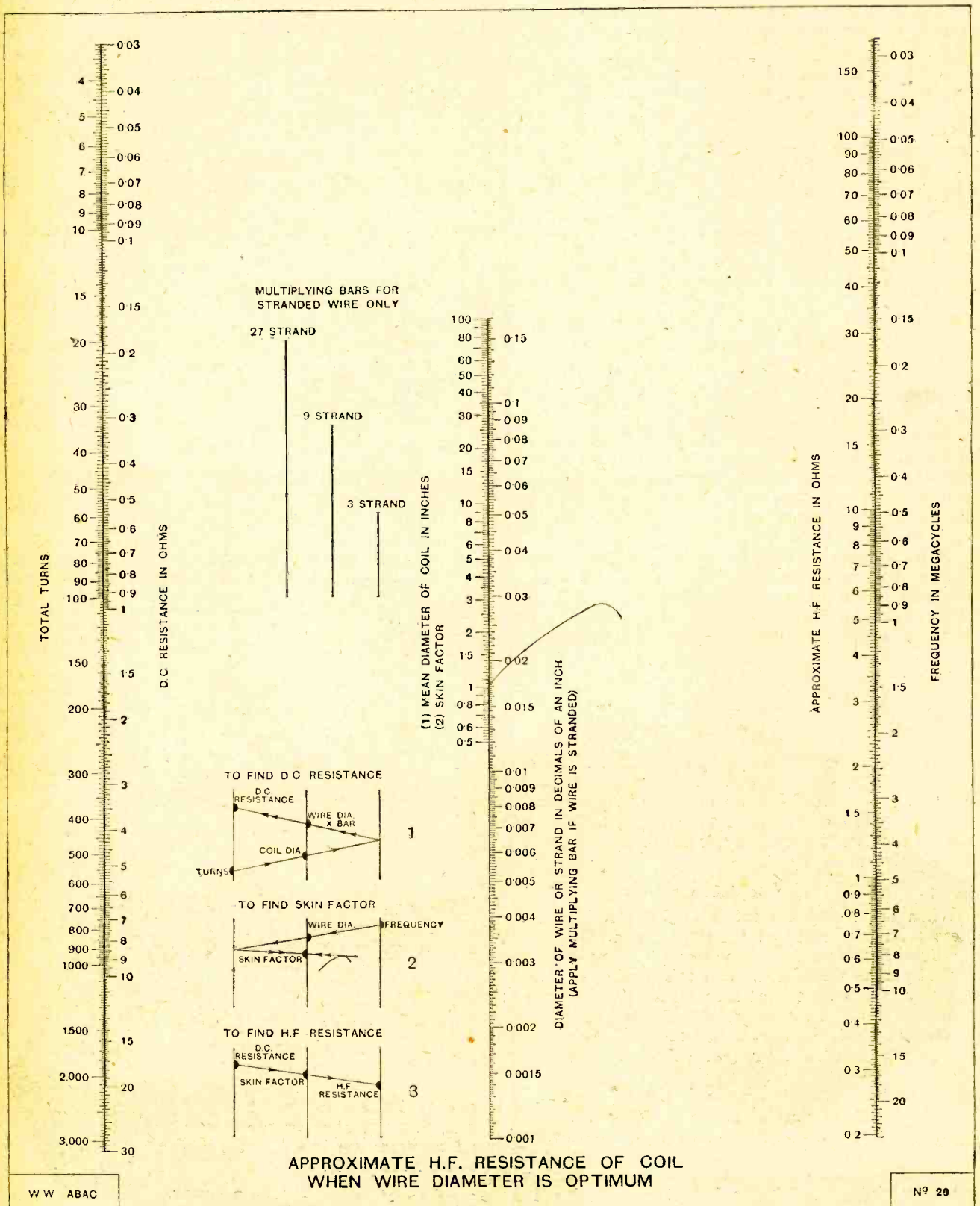
What this operation actually does is to replace the diameter of a strand by the diameter of the equivalent solid wire, which would have the same D.C. resistance: thus if three strands are used, each of diameter 0.01in., the application of the multiplying bar will give the value 0.0171in. The correction required by the twist in the wire is also included in this operation.

The more strands we use the smaller will be the diameter of each strand to give minimum A.C. resistance. Hence when d lies near the bottom of its scale a long multiplying bar is present to pull it up again, and so a large range of wires can be dealt with; it would be an extreme case in which the ruler would be found to run off the paper.

The Skin Factor.

The skin factor depends only on the product of the diameter of the wire or strand by the square root

[1] Data kindly supplied by the London Electric Wire Co. and Smiths Ltd.



APPROXIMATE H.F. RESISTANCE OF COIL WHEN WIRE DIAMETER IS OPTIMUM

W W ABAC

Nº 20

Useful Data Charts. No. 20.—

of the frequency. Accordingly we find it, as the inset shows, by performing this multiplication on going from right to left, and by drawing a tangent to the curve on the return journey. It is easily seen that the skin factor is greater at high frequencies, and that it also goes up as the diameter of the wire increases.

The last step is to multiply the D.C. resistance by twice the skin factor to obtain the A.C. resistance. This is done by joining the points already found for R_0 and the skin factor, and reading off the A.C. resistance on the right.

Examples.

A single-layer coil of solid wire of circular cross-section is required to have an inductance of 200 micro-henrys, and it is decided to make its diameter 4in. and its length 2in. We want to design it for 300 metres, and to find its resistance at that frequency.

From Abac 17 we find that 43.5 turns are required to give the desired inductance, and from Abac 19 the diameter of wire to give minimum resistance at 300 metres works out at 0.034in.

Hence we have N=43.5, D=4in., d=0.034in.; and, using these figures in the present abac, we find that the D.C. resistance is 0.402 ohms. The skin factor comes out at 3.55, and on multiplying twice this figure by the D.C. resistance we find the H.F. resistance to be 2.85 ohms.

Now, suppose we wish to use 27-strand Litz instead. From Abac 19 we find the best diameter of strand is 0.0042in. We have accordingly N=43.5, D=4in., d=0.0042in., n=27. On applying the multiplying bar to d=0.0042in., we find the new value d=0.0212in. Using this value in working through the abac, the D.C. resistance is found to be 1.06 ohms, which is two and a half times as great as for the solid wire; but we gain on the skin factor, which is now only 1.009, and the H.F. resistance is 2.14 ohms, so that we have improved matters by using stranded wire.

The reactance of either coil is found from Abac 6 to be 1,260 ohms, or it can be calculated directly [$2\pi f.L = 2\pi \times 10^6 \times 200 \times 10^{-6} = 1{,}260$], and the magnification factor at 300 metres is consequently $\frac{1{,}260}{2.85} = 442$ for the solid wire coil, and $\frac{1{,}260}{2.14} = 590$ for the 27-strand Litz.

As another example, take a coil of 20,000 micro-henrys and of solid wire, the mean diameter being 10in., the length and thickness also being 10in.; the coil is to work at 50,000 cycles. The number of turns required is 470, and the best wire gauge is 0.0336in. On working through the abac we shall find that the D.C. resistance is 11.1 ohms, the skin factor 1.08, and the H.F. resistance 24 ohms.

R. T. B.

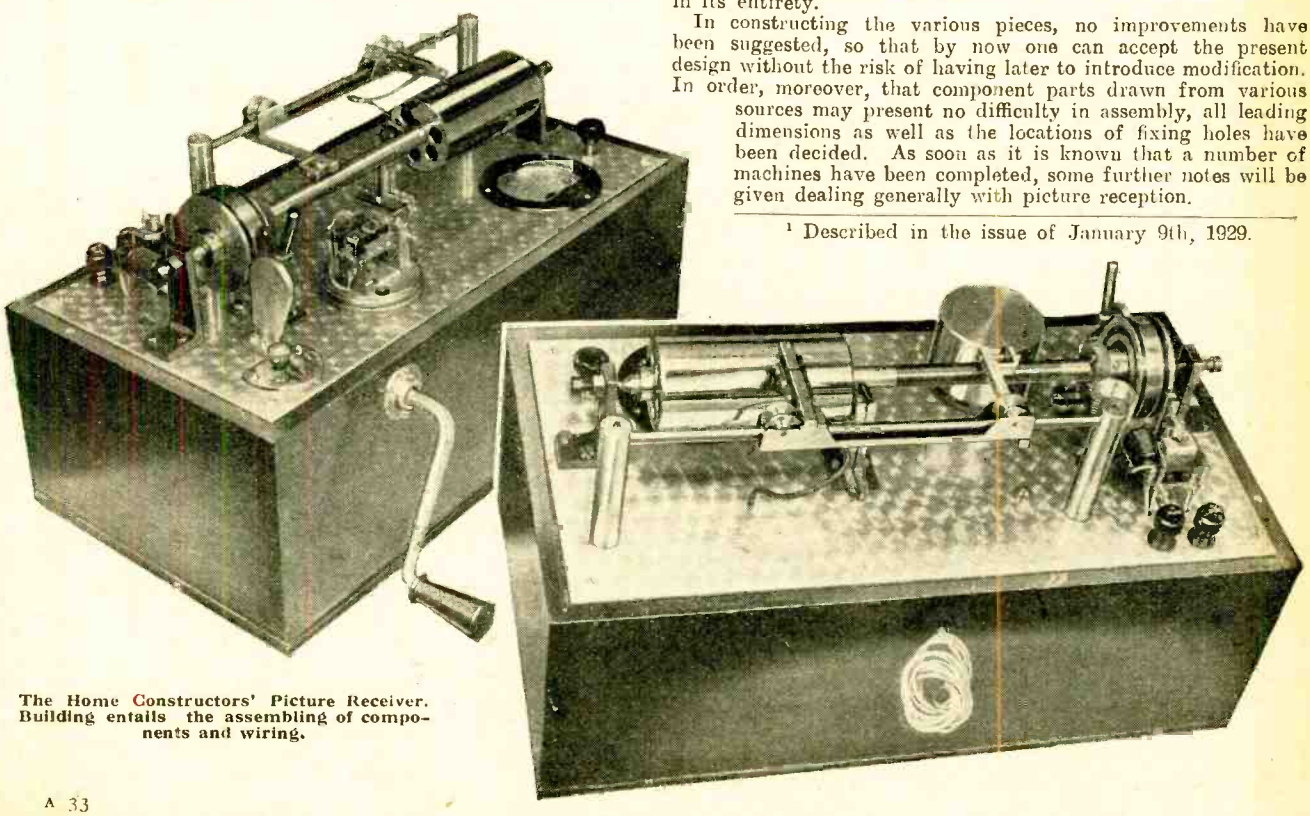
INTEREST IN PICTURE RECEPTION.

Components for Making the Home Constructors' Picture Receiver.[1]

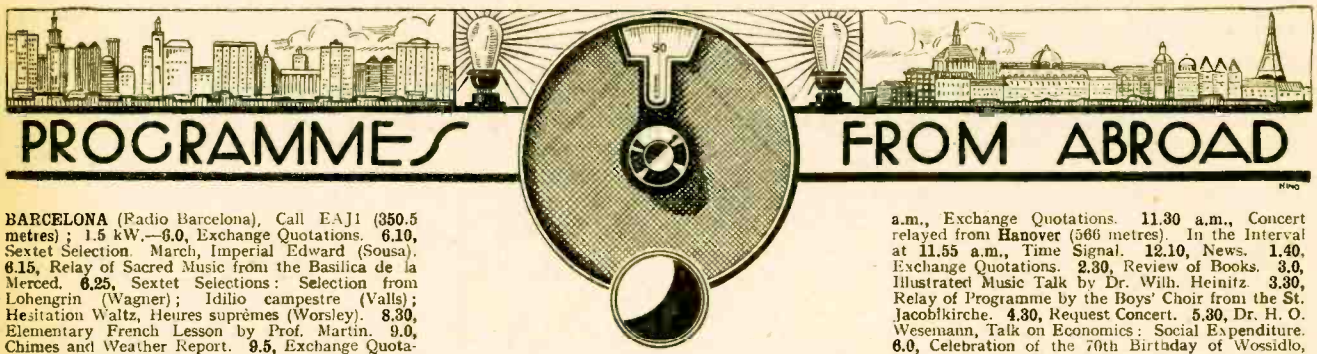
From correspondence it is obvious that picture reception is likely to prove popular. Questions are being asked concerning making, modifying, and working the apparatus, while no less than ten manufacturing concerns are definitely busy with the parts. Many requests have been made for precise details of the less important parts, so that it has become necessary, when furnishing these sketches, to standardise the present machine in its entirety.

In constructing the various pieces, no improvements have been suggested, so that by now one can accept the present design without the risk of having later to introduce modification. In order, moreover, that component parts drawn from various sources may present no difficulty in assembly, all leading dimensions as well as the locations of fixing holes have been decided. As soon as it is known that a number of machines have been completed, some further notes will be given dealing generally with picture reception.

[1] Described in the issue of January 9th, 1929.



The Home Constructors' Picture Receiver. Building entails the assembling of components and wiring.



PROGRAMMES FROM ABROAD

SATURDAY, JANUARY 26th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—**6.0,** Exchange Quotations. **6.10,** Sextet Selection. March, Imperial Edward (Sousa). **6.15,** Relay of Sacred Music from the Basilica de la Merced. **6.25,** Sextet Selections: Selection from Lohengrin (Wagner); Idilio campestre (Valls); Hesitation Waltz, Heures suprêmes (Worsley). **8.30,** Elementary French Lesson by Prof. Martin. **9.0,** Chimes and Weather Report. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Concert: March, Jollity (Ganglberger); Selection from Bohemios (Vives); Waltz, España (Waldteufel); Demande et réponse (Coleridge-Taylor); Ballet from La Gioconda (Ponchielli); Indian March, Taj Mahal (Hausen-Lotter). **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (366 metres); 1.5 kW.—**5.30,** Programme for Girls. **6.0,** Programme for Children. **7.0,** Orchestral Concert. **7.30,** Programme of Concertina Selections. **7.50,** Topical Talk. **8.0,** Mrs. von der Lippe Konow, Talk: George Eliot. **8.30,** Orchestral Concert. **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (1,250 metres); 40 kW.—**12.45,** Phototelegraphy Transmission. **1.30,** Programme for Children. **2.0,** Herr B. K. Graef, Talk: Elocution. **2.30,** Weather Report and Exchange Quotations. **2.40,** Talk for Women by Alice Fliegel-Bodenstedt. **3.0,** Educational Talk by Fritz Westermann. **3.30,** Programme relayed from **Hamburg.** **4.30,** Herr Hesslein, Talk: Public Opinion and Officialdom. **5.0,** Herr Monzel, Talk: The Influence of Co-education on the Youth of Big Cities. **5.30,** Elementary Spanish Lesson. **5.55,** Dr. Herse, Talk: Lessing in Wolfenbüttel. **6.20,** Talk. **7.0,** Agricultural Programme: March, Entry of the Gladiators (Fucik); Gavotte, Zircus Renz (Fliege); Waltz, Künstlerleben (Joh. Strauss); Talk on The Travelling Circus in the Country; Overture to Light Cavalry (Suppé); March, Der Jongleur (Rosey). **8.0,** Programme from **Voxhaus.**

BERLIN (Voxhaus) (475 metres); 4 kW.—**9.15 a.m.,** Opening Ceremony in connection with the Berlin "Green Week," relayed from the Kaiserdamm Exhibition Hall. Musical Selections. **9.30 a.m.,** Address of Welcome by Hans Jürgen von Hake, Director of the Exhibition, followed by Programme of Talks including Talk by Lord Mayor Böss. **2.30,** Mr. P. V. Metzenthin, Talk: Domestic Conditions in America. **3.0,** Prof. W. Andrae, Talk: The Tower of Babylon. **3.30,** Concert from the Clou Concert Hall, followed by Advertising Notes. **5.30,** Felix Stiemer, Talk: Friendship as Destiny—Frederick the Second and Voltaire. **6.0,** Dr. Richard Stein, Talk: Belgian and Dutch Music, with Illustrations. **6.30,** Prof. Hans Delbrück, Talk: The Relation of Various Forms of Government to War and Peace. **7.0,** Vocal and Orchestral Concert: Overture to La Belle Galathée (Suppé); Soprano Solos, (a) Song from Die Teresina (Straus), (b) Song from The Czarevitch (Lehár), Selection from Zigeunerprimas (Kálmán); Soprano Solos, (a) Song from Der Orlov (Granichstaedten), (b) Song from Der blonde Zigeuner (Knopf); Red Roses (Königsberger); Indian Temple Dance (Königsberger); March, Bis früh um fünf (Lincke). **8.0,** Dialogues from World Literature; Selections from Three Funeral Orations (Bernard von Fontenelle); An Address for Free masons (Lessing). Selections from Faust (Lessing), followed by Weather Report, News, Sports Notes and Dance Music. **11.30** (approx.), Close Down.

BERN (407 metres); 1.5 kW.—**3.0,** Concert by the Kursaal Orchestra. **3.30,** Programme for Children **4.0,** The Kursaal Orchestra. **6.29,** Time Signal and Weather Report. **6.30,** Dr. Hans Müller, Talk: The Peasant National Week in Schloss Hünigen. **7.0,** Popular Programme. **8.45,** News and Weather Report. **9.0,** The Kursaal Orchestra. **9.35,** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (321.2 metres); 4 kW.—**6.20,** Shorthand Lesson. **6.50,** Topical Debate between Four Young Men. **7.15,** Recital of Songs and Duets: Songs (Göhler), (a) Ich komme bald, ihr goldnen Kinder, (b) Serenade, (c) Das Scheiden, (d) Der schönste Platz, (e) Im Walde; Duet, So let us wander (Brahms); Soprano Songs (Reger), (a) Klein Marie, (b) Der König aus dem Morgenland, (c) In einem Rosengärtelein, (d) Kindes Gebet, (e) Mittag, (f) Folksong; Duets (Dvorak), (a) Bestimmung, (b) Der Abschied, (c) Das Seidenband (d) Der letzte Wunsch. **8.0,** Mafalda Salvatini Song Recital from the Concert Hall. **9.0,** News. **9.30,** Silesian Press Festival relayed from the Concert Hall, followed by Dance Music. **11.0** (approx.), Close Down.

BRÜNN (432 metres); 2.5 kW.—**4.45,** German Transmission. **5.15,** Topical Talk, by Dr. Jerabek. **6.0,** Talk on the following transmission. **6.15,** "The Lantern": Opera (Novak) from the National Theatre, **Brünn.** **9.0,** Programme from **Prague.** **9.25,** Tzigane Music relayed from **Bratislava** (278 metres).

BRUSSELS (396.3 metres): 1.5 kW.—**5.0,** Concert from the Armenonville Tea-rooms. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Pianoforte Selections. **7.0,** Gramophone Selections. **7.30,** "Radio-Chronique." **8.0,** Concert: Mass in F Minor No. 3 (Bruckner); Graner Festmesse (Liszt); In the Interval: Topical Talk, followed by News and Talk in Esperanto. **10.15,** Concert from the Palace Hotel Restaurant. **11.0** (approx.), Close Down.

BUDAPEST (555.5 metres); 20 kW.—**3.0,** Talk for Scouts. **4.0,** Literary Talk. **4.40,** Concert of Trio Music with Vocal Selections by Jolán Láng. **5.40,** Talk. **6.15,** "Ritter Johann": Operetta in Three Acts (Paukratius Kacsóh). **8.50.** Time Signal, News, Weather Report and Concert by the Tzigane Orchestra from the Café Spolarich.

CRACOW (314.1 metres); 1.5 kW.—**4.0,** Mme. Joter, Talk: Flemish, French and Italian Stories. **4.25,** Programme from **Warsaw.** **4.55,** Programme for Children. **5.50,** Miscellaneous Items. **6.10,** Review of the Foreign Politics of the Past Week by Mr. Jean Regula. **6.56,** Time Signal from the Astronomical Observatory. **7.0,** Chimes from the Church of Notre Dame and News. **7.30,** Programme from **Warsaw** **9.30,** Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—**1.30,** Weather Report and Concert of Gramophone Selections. **7.20,** News. **7.30,** Recital of Poems by May Pitchford. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Symphony Concert by the Station Symphony Orchestra and Miss Culwick's Choir. **10.30,** News, Weather Report and Close Down.

FRANKFURT (421 metres); 4 kW.—**3.35,** Orchestral Concert of Operetta Music: Wedding March from Didi (Oscar Straus); Waltz from The Czardas Princess (Kálmán); Song; Potpourri from Das Puppenmädel (Fall); Waltz from Rastelbinder (Lehár); Potpourri from The Star-gazer (Lehár); Song; Two Selections from Polenblut (Nedbal); In the Interval: News and Announcements. **5.10,** Reading from Doktor Katzenbergers Badereise (Jean Paul), by O. W. Studtmann. **5.30,** The Letter Box. **5.45,** Esperanto Lesson by Herr W. Wischhoff. **6.15.** Armin Gessner, Talk: The Insurance of Employees. **6.45,** Clemens Taesler, Talk: Lessing as a Pioneer of German Idealism. **7.15,** Variety Programme. **8.0,** Programme relayed from **Voxhaus.** **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (392 metres); 4 kW.—**9.15 a.m.,** News. **10.0 a.m.,** Programme of Gramophone Records. **11.10 a.m.,** Weather Report. **11.15 a.m.,** Exchange Quotations. **11.30 a.m.,** Concert relayed from **Hanover** (566 metres). In the Interval at **11.55 a.m.,** Time Signal. **12.10,** News. **1.40,** Exchange Quotations. **2.30,** Review of Books. **3.0,** Illustrated Music Talk by Dr. Wilh. Heinitz. **3.30,** Relay of Programme by the Boys' Choir from the St. Jacobikirche. **4.30,** Request Concert. **5.30,** Dr. H. O. Wesemann, Talk on Economics: Social Expenditure. **6.0,** Celebration of the 70th Birthday of Wossidlo, relayed from the Rostock University. **6.55,** Weather Report. **7.0,** Talk on Women's Fashions by Ida Mahl-Hoffmeister. **7.20,** Grieg-Svendsen Concert; Overture to Im Herbst (Grieg); Scandinavian Folksong for String Instruments (Svendsen); Vocal and Orchestral Selection from Björnson's Arnljot Gelline (Grieg); Two Norwegian Rhapsodies (Svendsen); Four Songs (Grieg); Norwegian Carnival (Svendsen); Sarabande (Grieg); Selection from Aus Holbergs Zeit (Grieg); Festival Polonaise (Svendsen); Peer Gynt Suite (Grieg). **8.50,** Humorous Programme. **9.30,** Weather Report, News, Sports Notes, Snow Report and Programme Announcements. **10.50,** North Sea and Baltic Weather and Ice Report.

HILVERSUM (1,071 metres); 5 kW.—**9.40 a.m.,** Time Signal and Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Musical Selections. **1.40,** Concert relayed from the Tuschinski Theatre, **Amsterdam,** under the direction of Mr. Max Tak, with Pierre Palla (Organ). **3.40,** Italian Lesson by Mr. Giovanni Rizzini. **4.40,** French Lesson by Mr. Raymond Lafont. **5.40,** Orchestral Concert of Marches: The Gladiators' Farewell (Blankenburg); Soldatenblut (Blon), Florentine March (Fucik); March of the Cadets (Sousa); El Capitan (Sousa); Barataria (Sullivan); Retour à la France (Mezzacapo); Le Régiment de Sambre et Meuse (Turlet); Hoch und Deutschmeister (Ertl); Old Comrades (Teike). **6.25,** German Lesson by Mr. Edgar Grün. **7.25,** Police Announcements. **7.40,** Programme arranged by the Workers' Radio Society—Concert and Talk. **11.10** (approx.), Close Down.

HUIZEN (336.3 metres); 4 kW.—Transmits on 1,852 metres from 5.40 p.m. **12.10.** Concert of Trio Music. **2.40,** Programme for Children. **5.10,** Gramophone Selections. In the Interval at **5.30,** Talk by Father Grul. **6.30,** Catholic Bulletin. **6.40,** English Lesson, **7.10,** Lesson in Dressmaking. **7.40,** Talk by Dr. J. Kranendonk. **8.20,** Concert by Street Musicians of Amsterdam.: Vocal, Accordion and Street Organ Selections. **9.20,** Songs to the Lute.

KALUNDBORG (1,153 metres); 7 kW.—Programme also for **Copenhagen** (339.8 metres).—**6.30 a.m.** Morning Gymnastics. **10.0 a.m.,** Weather Report. **10.15 a.m.,** Educational Talk. **2.0,** Programme for Children. **2.30,** Orchestral Concert. In the Interval: Reading by Carl Schionning. **5.20,** Car. C. Lassen, Talk: Mrs. Heiberg and her Circle. **5.50,** Weather Report. **6.0** News and Exchange Quotations. **6.15,** Time Signal. **6.30,** Prof. H. O. Larsen. Talk: Former Agricultural Crises. **7.0,** Chimes from the Town Hall. **7.2,** Concert of Old-time Music: Quintet Selections, (a) Minuet in E Major (Mozart), (b) Selection from No, (c) Selection from En Søndag paa Amager, (d) Jomfru vil de med i Skoven (Krageland), (e) Lette Bölge, naar du blaaner (Tholle); Four Recitations; Five Quintet Selections, (a) Tyrolese Waltz and Hopsa, (b) Cradle Song (Hartmann), (c) Waltz, Queen Louise (Lumbye), (d) Do you remember the Autumn? (Heise), (e) Fantasia on Danish Folk Songs and Dances (Larsen), followed by News. **8.30,** Emil Bonnelycke, Talk: Danish Poets. **9.0,** Concert of Light Music: Marche lorraine (Ganne); Overture to Les Saltimbanques (Ganne); Polka, Les vendredis (Borodine, Sokoloff and Liadoff); Selection from "L'Africaine": Opera (Meyerbeer); Entr'acte-Gavotte for String Instruments (Gillet); Waltz, Blue Lagoon (Strauss); Selection from The Czardas Princess (Kálmán); The Top (Gillet); March, Fairest of the fair (Sousa). **10.0,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

KATTOWITZ (416 metres); 10 kW.—**3.0,** Concert of Gramophone Selections. **4.0,** Music Lesson by Prof. F. Sachse. **4.25,** Children's Letter Box. **4.55,** Programme for Children. **6.10,** Talk by Prof. K. Simm. **7.0,** Talk by Mr. K. Rurkowski. **7.30,** Programme relayed from **Warsaw.** **9.0,** Weather Report and News **9.30,** Dance Music.

Programmes from Abroad.—

KAUNAS (2,000 metres) ; 7 kW.—**3.0**, Gramophone Selections. **3.15**, Recent Literary Publications. **3.45**, Radio Patarejas. **4.30**, Announcements. **5.0**, Weather Report and News. **5.30**, Agricultural Report. **6.0**, Aviation Notes. **6.30**, Evening Entertainment.

LAHTI (1,504 metres) ; 35 kW.—**6.20**, Variety Programme. **7.0**, Orchestral Selection from The Circus Princess (Kálmán). **7.20**, Humorous Song Recital. **7.30**, Orchestral Selection of Finnish Songs (Jäger). **7.45**, News in Finnish and Swedish and Close Down.

LANGENBERG (462.2 metres) ; 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres), and **Münster** (265.5 metres).—**12.5**, Concert : Mafalda Marsch (Meyer) ; Waltz, Was tut man nicht alles aus Liebe (Ascher) ; Overture to Das Modell (Suppé) ; In Adams Paradies (Urbach) ; Selection from Orpheus (Gluck) ; Weltenland Suite (Knümann) ; Tango, Ninon (Ascher) ; Boston, Ich kann dich nicht vergessen (Ascher) ; Selection from Madame Pompadour (Fall). **1.30**, Household Hints. **2.0**, Porgramme for Children by Els Vordemberge. **2.40**, Arthur Wurbs, Talk : The Bases of Wireless Technique. **3.0**, Psychological Talk for Young People, by Pater Esch. **3.20**, Programme for Children by Maria Weissleder. **3.40**, Dr. Maria Zschokke, Talk for Women : Infant's Ailments. **4.0**, Line Wallerstein, Talk : German Artists on their Travels. **4.20**, English Lesson by Prof. F. Hase. **4.45**, Recital of Songs by Fred Drissen. **5.30**, Dr. Salmony, Talk Chinese Painting. **5.50**, Morse Instruction. **6.15**, Talk for Workers by Dr. Kurt Loose. **6.35**, Prof. Hessen, Talk : What do we know of the Soul ? **7.0**, Variety Programme, followed by News, Sports Notes, Commercial Announcements and Concert from the Café Corso, **Dortmund**. **11.0**, Dance Music from the "Fledermaus," **Dortmund**. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (362 metres) ; 4 kW.—**3.0**, Paul Prina. Talk : Lessing. **3.30**, Orchestral Concert from the Works of Victor Holländer, conducted by the Composer. **4.45**, Wireless News and Talk. **5.20**, Weather Report and Time Signal. **5.30**, Programme relayed from **Königswusterhausen**. **6.0**, Prof. Georg Witkowski, Talk : Lessing as Art Critic. **6.30**, Dr. Raphahn, Talk : The Sentiment of Europeanism—The Middle Ages. **7.0**, Concert by Wanda Schnitzing (Soprano), Willy Strehl (Tenor), Jorgo Chartofilar (Mandoline), Günther Sanderson (Elocutionist) and Emil Klinger (Piano). **9.0**, Labour Market Report, News, Sunday Programme Announcements and Sports Notes. **9.30**, Dance Music relayed from **Voxhaus**.

MADRID (Union Radio), Call EAJ7 (**427 metres**) ; 3 kW.—**7.0** Chimes and Exchange Quotations, followed by Dance Music. **8.0**, Dr. Zito, Talk : Inventors and Inventions. **8.25**, News. **9.45**, Agricultural Report, Market Prices and News. **10.0**, Chimes and Exchange Quotations, followed by Selection from "Campanone"—Musical Play (Mazza and di Franco). In the Interval at **12.0 Midnight** (approx.), News. **12.30 a.m.** (approx.), (Sunday), Close Down.

MILAN, Call 1MI (**504 metres**) ; 7 kW.—**3.32**, Concert of Quintet Selections : Symphony, La moglie rapita (Drigo) ; Moresca (Frontini) ; La fidanzata di Milù (Cuscinà) ; Romanza senza parole (Azzoni) ; Fiore Madrileno (Ferri). **4.0**, Exchange Quotations. **4.20**, Programme for Children. **4.45**, Agricultural Report and News. **7.30**, Time Signal. **7.32**, Wireless Talk and Announcements. **7.45**, G. M. Ciampelli, Illustrated Talk : Verdi. **8.0**, Relay of au Opera from the Scala Theatre. In the Intervals: Reading from L'Innocente (D'Annunzio) News and Economic Notes.

MOTALA (1,365 metres) ; 40 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Malmö** (229 metres), **Ostersund** (720 metres), **Sundsvall** (545.5 metres).—**4.0**, Concert of Light Music. **5.0**, Programme for Children relayed from **Halmstad** (215.8 metres). **5.30**, Sailor's Songs and Waltzes relayed from **Göteborg**. **6.15**, Nils Hasselskog, Talk : From Grönköping, relayed from **Göteborg**. **6.45**, Violin Recital : Rondino on a Theme from Beethoven (Kreisler) ; Tambourin (Leclair) ; Nocturne in C Minor (Chopin-Auer) ; Appassionato (Vidor). **7.0**, Military Band Concert relayed from **Umea** (229 metres) ; Victory March (Blon) ; Overture to Benvenuto Cellini (Berlioz) ; Waltz, Ich liebe dich (Waldteufel) ; Selection from L'Africaine (Meyerbeer) ; Erotica (Grieg) ; American Suite (Turban) ; March (Blankenburg). **8.0**, Topical Talk, News and Weather Report. **8.45**, Programme of Old Time Dance Music, relayed from **Falun** (333 metres). **9.30**, Dance Music. **11.0** (approx.), Close Down.

MUNICH (536.7 metres) ; 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres).—**3.0**, Quartet Concert.

Saturday, January 26th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

4.30, Talk by Hans Priehäusser. **5.0**, Concert : Selections from Oratorios, (a) Arioso from Israel in Egypt (Handel), (b) Confutatis maledictis from Requiem (Verdi), (c) Sonett from Neue Leben (Wolf-Ferrari) ; Five Songs (R. Strauss), (a) Breit' über mein Haupt, (b) Mein Herz ist stumm, (c) Liebeshymnus, (d) Zueignung, (e) Winterliebe. **5.35**, Labour Market Report. **6.0**, The Letter Box. **6.30**, Humorous Talk by Dr. Robert Weil. **7.10**, Musical Parodies by Theo Rupprecht. **8.15**, Carnival Pro-Programme. **9.20**, News and Announcements. **9.45**, Dance Music from the Park Hotel, Munich. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333 metres**) ; 1.5 kW.—**7.30**, Wireless Talk, Announcements, News and Harbour Notes. **8.0**, Time Signal. **8.2**, Comedy and Orchestral Selections : Overture, La serva padrona (Suppé) ; "Il Titano" : Comedy in Three Acts (Dario Niccodemi) ; In the First Interval : Orchestral Selections, (a) Prelude, Alla regata (Manente), (b) Grotesque-Intermezzo, Clown (Culotta), (c) Serenade, Amor che sogna (Manente). In the Second Interval : Orchestral Selections (Siede) : (a) The Star of the East, (b) In Seville. **9.0**, Review of the Week. **9.50**, News. **9.55**, Calendar and Programme Announcements. **10.0**, Close Down.

OSLO (**497 metres**) ; 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**5.0**, Programme for Children. **6.15**, Weather Report and News. **6.30**, Oscar Wisting, Talk : The Discovery of the South Pole. **7.0**, Time Signal. **7.2**, Orchestral Concert : Overture to Don Juan (Mozart) ; Concerto for Pianoforte and Orchestra (Schumann) ; Nocturne, Musette and Elegy from King Christian Suite (Sibelius) ; Fantasia on Popular Norwegian Melodies (Birknes) ; Waltz, Morgenblätter (Joh. Strauss) ; Selection from The Dollar Princess (Fall). **8.30**, Weather Report and News. **8.45**, Topical Talk. **9.0**, Recitations by the Actor Eugen Schönberg. **9.30**, Dance Music from the Hotel Bristol. **11.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**1,488 metres**) ; 5 kW.—**5.0**, Pasdeloup Concert **7.10**, Weather Report. **7.20**, Le Journal Parlé. **8.50** (approx.), Close Down.

PARIS (Petit Parisien) (**336 metres**) ; 0.5 kW.—**8.45**, Gramophone Selections, Talk and News. **9.0**, Concert : Overture to Voyage en Perse (Filippucci) ; Selection from Nelly (Lattés). **9.25**, News and Announcements. **9.30**, Symphony Concert : First Suite of L'Arlésienne (Bizet) ; Symphonic Dances (Grieg). **10.0**, News and Concert : Ballet from Les Héretiques (Levadé) ; La splendeur vide (Saint-Saëns) ; Slavonic March (Tchaikovsky).

PARIS (Radio-Paris), Call CFR (**1,769 metres**) ; 15 kW.—**12.30**, Concert of Columbia Gramophone Records : Tango, Alma Criolla, by Lucchesi's South American Orchestra ; Miss Annabelle Lee, by The Knickerbockers ; The Blue Room, by Fred Rich and his Orchestra ; The Varsity Drag, by Guy Lombardo and his Royal Canadians ; Laugh, Clown, Laugh, by Ted Lewis and his Orchestra ; A Hundred Years from now, by The Trix Sisters ; Popular Songs of White Russia, by the Don Cossack Chorus ; Third Romance, The Hunt (Mendelssohn), by Francis Plante (Piano) ; The Unfinished Symphony (Schubert), by the New Queen's Hall Orchestra under the direction of Sir Henry Wood ; Ballet from Marouf (Rabaud), by Symphony Orchestra under the directiou of M. Rabaud. In the Interval, News. **2.0**, Market Prices and Religious Information. **3.30**, Exchange Quotations. **3.45**, Concert arranged by "Les Rosati." **4.50**, Market Prices and News. **6.30**, Agricultural Report and Exchange Quotations. **6.45**, Gramophone Selections. **7.30**, Pianoforte Lesson by M. Pierre Lucas. **8.0**, Dr. Roubinovitch, Talk : The Mental Condition of the Naughty Child, followed by Market Prices and News. **8.15**, Concert arranged by "Le Matin" : Symphonic Selections ; Selection from Le Médecin malgré lui (Gounod) ; In the Intervals : News and Announcements.

PRAGUE (**343 metres**) : 5 kW.—**4.40**, Mr. Koudelka, Talk : Mr. Lloyd George. **4.50**, Agricultural Talk. **5.0**, German Transmission, News and Lessing Recital. **6.0**, Programme relayed from Brünn. **9.0**, Time Signal and News. **9.25**, Tzigane Music relayed from **Bratislava** (278 metres).

ROME, Call 1RO (**443.8 metres**) ; 3 kW.—**6.50**, Sport. Notes, News, Exchange Quotations and Weathes Report. **7.29**, Time Signal and Report of the International Labour Office at Geneva. **7.45**, Vocal and Instrumental Concert : Overture to Der Freischütz (Weber) ; Concerto in A Minor for Violin and String Orchestra (Vivaldi-Nachez) : News and Fashion Talk ; Selections from Aïda (Verdi) ; "La Reginetta" : Comedy in One Act (Chiarelli) ; Dance Music ; Review of Art and Literature by Lucio d'Ambra ; Dance Music. **9.50**, Topical Talk and News. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAF (**31.48 metres**) . 30 kW.—**11.30 p.m.** White House Coffee Programme from **New York**. **12.0 Midnight**. Phil Spitalny's Music from **New York**. **12.30 a.m.** (Sunday), Musical Programme from **Rochester**. **1.0 a.m.**, National Symphony Orchestra under the direction of Walter Damrosch. **2.0 to 4.0 a.m.**, **New York** Programme. **2.0 a.m.**. Lew White Organ Recital. **2.30 a.m.**, Concert by Mildred Hunt and Marimba Orchestra. **3.0 a.m.** Lucky Strike Programme. **4.0 a.m.**, Dance Music from the Hotel Ten Eyck, **Albany**. **5.0 a.m.** (approx.), Close Down.

STAMBOUL (**1,200 metres**) ; 5 kW.—**3.30**, Concert. **4.30**, Exchange Rates and Grain Quotations. **5.15**, Concert of Turkish Music. **7.30**, Weather Report and Time Signal. **7.40**, Orchestral Concert : Sahara Suite (Ackermann) ; La Belle Berceuse et Musette (Aletter) ; Hungarian Dance (Artok-Liszt). **9.0**, News and Close Down.

STUTTGART (**374 metres**) ; 4 kW.—**2.0**, Concert from the Works of Schubert. **3.0**, Orchestral Music from the Pavillon Excelsior. **5.0**, Time Signal and Weather Report. **5.15**, Herr L. Leibfried, Talk : The Liabilities of Animal Owners. **5.45**, Herr Baumeister, Talk : Within and Without the Prison Walls, relayed from **Freiburg** (577 metres). **6.15**, Time Signal and Sports Notes. **6.30**, Willy Buschhoff Programme : Quartet 1 (Borodine) ; Notes from my Day-Book ; Selection from Master and Man (Tolstoy) ; Quartet 2 (Borodine) ; Drinking Song from Earth's Lament (Li Tai Pe) ; Veltinertraube (Meyer) ; Abendgefühl (Hebbel) ; Nachtgefühl (Hebbel) ; Der Heideknabe (Hebbel) ; Tambourin chinois (Fritz Kreisler). **7.30**, Orchestral Concert of Old Music : Concerto grosso No. 8 in G Minor (Corelli) ; Two Songs to the Lute, (a) Rhenish Ballad, (b) Death in Flanders ; Field Music No. 3 (Krieger) ; Funeral Symphony (on the Death of his Wife) (Locatelli) ; Two Songs to the Lute, (a) Selection from the Song Book of Anna von Köln, (b) Jesus and the Nuns ; Two Dances (Hassler) ; Three Songs to the Lute ; Suite in A Minor (Telemann), followed by Cabaret Programme from Ludwigsburg, and Dance Music from **Voxhaus**.

TOULOUSE (Radiophonie du Midi) (**383 metres**) ; 8 kW.—**12.45**, Concert. **8.0**, Exchange Quotations and News. **8.30**, Concert from the Works of Strauss. Der Kuss Waltz : Roses of the South ; Waltz, Wienerblut ; Waltz, Wine, Women and Song. **8.45**, Selection of Argentine Tangos : Queja Indiana ; Anoche a Las Dos ; Caido del Cielo ; Bandoneon. **9.0**, Concert arranged by "La Dépêche." In the Interval, Argentine Songs with Guitar Accompaniment, (a) Mar bravio, (b) Che papusa, (c) Ramona, (d) El Carretero, (e) Dandy, (f) Adios Muchachos. **10.0**, North African News. **10.15** (approx.), Close Down.

VIENNA (**520 metres**) ; 15 kW.—**3.50**, Play for Children, adapted from Grimm's Fairy Tales. **4.30**, Pianoforte Recital of Beethoven Sonatas : Moonlight Sonata Op. 27 in C Sharp Minor ; Sonata Op. 90 in E Minor. **5.20**, Introductory Talk and Reading from the Works of Alfred Rottauscher (died January 9th, 1926). **6.10**, Talk with Musical Illustrations—Eichendorff as a Song-composer : Wanderlied (Mendelssohn) ; In der Fremde (Schumann) ; Intermezzo (Schumann) ; Die Stille (Schumann) ; Romance (Dr. Franz) ; Anklänge (Brahms) ; Die Nacht (Hugo Wolf) ; Nachtzauber (Hugo Wolf). **7.0**, Time Signal and Weather Report. **7.5**, "Der Hochstapler"—Comedy in Three Acts (Goldoni) translated by Lola Lorme, followed by Orchestral Concert : Overture to Raymond (Thomas) ; Waltz, Acceleration (Joh. Strauss) ; Memories of Grieg (Urbach) ; Violin Solo, Fantasia on Faust (Gounod) ; Potpourri, The Little Dutch Girl (Kálmán) ; Potpourri, Wiener Spaziergänge (Komzák) ; Gallop, St. Petersburg Sleigh Ride (Eilenberg), followed by Phototelegraphy Transmission.

WARSAW (**1,415 metres**) ; 10 kW.—**4.55**, Programme for Children. **5.50**, Miscellaneous Items. **6.10**, "Radio-Chronique," by Dr. M. Stepowski. **6.35**, News and Time Signal. **7.30**, "Adieu Mimi"—Operetta in Three Acts (Benatzky). In the Interval, Theatre Notes. **9.0**, Weather Report and News. **9.20**, Police Announcements and Sports Notes. **9.30**, Dance Music from the Oaza Restaurant. **10.30** (approx.), Close Down.

SUNDAY, JANUARY 27th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Programmes from Abroad.—

ALGIERS, Call PTT (353 metres) ; 1 kW.—12.30, Concert of Instrumental Music by the Station Orchestra, conducted by C. Cerlini. Jota Navara, Violin Solo (Sarasate) rendered by M. A. Gonzalès.

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres) ; 1.5 kW.—11.0 a.m., Relay of Cathedral Chimes. 11.5 a.m., Weather Conditions and Forecast for Europe and Spain, followed by Report on Aviation Route Conditions. 1.30, Musical Programme by the Iberia Trio. In the Interval, Gramophone Selections. 2.45 to 5.30, No Transmission. 5.30, Opening Signal followed by Relay of Part of an Opera from the Gran Teatro del Liceo In the Interval, Stock Exchange Notes and Market Prices. 8.0 to 8.20 Weekly Report from the Catalonian Institute of Agriculture at San Isidro. 8.20, Programme by the Station Orchestra: Scènes foraines (Ed. Mignan), (a) Tohu-Bohu, (b) Au Palais d'Orient, (c) La Danse d'Alsace, (d) Carrousel. 8.40 Sports Results 9.0 (approx.), Close Down.

BERGEN (366 metres) ; 1.5 kW.—9.30 a.m., Divine Service Relay. 11.30 a.m., Weather Report and Forecast, followed by News and Announcements. 7.0, Concert of Orchestral Music. 8.0, "Syndens Sold"—Play in one Act by Hjalmar Meidell, Dramatis Personæ: Harriet—Doris Johannessen, and Her Mother—Jenny Jebsen. 9.0, Weather Report and Forecast, Late News Bulletin and Time Signal. 9.15, Programme of Dance Music. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,250 metres) ; 40 kW.—7 55 a.m., Chimes Relay from Potsdam Garrison Church. 9.0 a.m., Relay of a Recital of Religious Music and Address from **Voxhaus,** followed by Chimes from Berlin Cathedral. 10.30 a.m., Programme of Orchestral Music relayed from **Voxhaus.** 12.45, Experimental Picture Transmission. 1.30 to 2.25, Three Agricultural Talks, relayed from **Voxhaus.** 3.0, Talk. 3.30, Musical Programme. 5.0, Talk. 6.0, Talk. 7.0, Concert, Play or Opera, followed by Late News and Announcements and Dance Music Programme. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475 metres) ; 4 kW.—7.55 a.m., Relay of Chimes from Potsdam Garrison Church. 8.0 a.m., Recital of Sacred Music, Vocal and Instrumental Selections with Sermon, followed by the Chimes from Berlin Cathedral. 10.30 a.m., Morning Concert. 1.0, Morse Lesson for Beginners by Hans W. Priwin. 1.30 to 2.25, Programme of Agricultural Talks for Farmers. 1.30, Notes and Practical Hints for the Agriculturist. 1.45, A Weekly Retrospect of the Market Prices and Weather Report and Forecast. 1.55, Talk on an Agricultural Subject. 2.30, Reading of Fairy Stories for Children. 3.0, Talk. 3.30, Concert Programme. 7.0 (approx.), Opera, Play or Concert, followed by Weather Conditions and Forecast, Late News and Announcements and Sports Notes. 9.30, Programme of Dance Music. 11.30 (approx.), Close Down.

BERN (407 metres) ; 1.5 kW.—9.30 a.m. to 10.30 a.m., Catholic Sermon. 12.0 Noon, Time Signal and Weather Report and Forecast. 12.5, Afternoon Concert. 6.29, Time Signal and Weather Report and Forecast. 7.0, "Don Juan"—Opera in Three Acts (W. A. Mozart) relayed from **Basle** (on 1010 metres). 9.0 (approx.), In the interval Sports Notes, General News Bulletin and Weather Report and Forecast. 9.0, Evening Concert. 9.40, (approx.), Close Down.

BÉZIERS (211 metres) ; 0.6 kW.—6.0 to 7.0, L'heure de la Radio-Agricole française—Concert Programme. 8.45, Concert of Light Music on the Pathé and Pathé-Art Gramophone Records, arranged by the Maison Relin-Minoles at Béziers. 10.30 (approx.), Close Down.

BRUSSELS (396.3 metres) : 1.5 kW.—5.0, Concert Programme by the Orchestra of the Armenonville Tea Room, Brussels. 6.0, Programme for Children organised by the Children's Theatre under the direction of M. Léon Leroy. 6.30, Concert Programme. 7.30, Radio-Chronique. 8.0 (approx), Musical Programme followed by General News Bulletin from the Evening Press. 11.0 (approx.), Close Down.

BUDAPEST (555.5 metres) ; 20 kW.—8.0 a.m., General News Bulletin and Programme for Women. 9.0 a.m., Relay of Church Service with Sermon. 3.15, Programme of the Wireless Lyceum including Talks and Musical Selections.

COLOGNE (263.2 metres) ; 4 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Langenberg** (462.2 metres) and **Münster** (265.5 metres).—6.45 a.m., Self-Defence Lesson by Dr. Ludwig Bach. 7.5 a.m., German Shorthand Lesson by Hans Molitor. 7.25 a.m., Esperanto Review by Alfred Dormanns of forthcoming Programmes. 7.30 a.m., Esperanto Instruction by Alfred Dormanns. 8.0 a.m., Evangelical Musical Festival with Vocal and Instrumental Items and Sermon. 11.0 a.m., Recital of Organ Music by Professor Hans Bachern relayed from the Messehalle, **Cologne,** Magnificat (Delphin Srungk 1601–1664). 12.0 Noon, Orchestral Concert. 1.30, Talk. 5.0, Talk. 7.15, Relay of an Opera or Play followed by Late News and Announcements, Sports Results and Concert of Light Music and Dance Selections. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres) ; 1.5 kW.—8.30, Concert of Vocal and Instrumental Music: Song Selections by Miss Raymonde Amy (Soprano). 11.0, National Anthem and Weather Report and Forecast. 11.15 (approx.), Close Down.

CRACOW (314.1 metres) ; 1.5 kW.—9.15 a.m. to 10.45 a.m., Relay of Divine Service from a Cathedral. 10.56 a.m., Relay of Fanfare from the Church of Notre Dame, followed by Time Signal and Weather Conditions and Forecast. 11.15 a.m., Concert of Orchestral Music from the Philharmonic Hall, **Warsaw.** 1.0 and 1.20, Talks for Farmers. 1.40, Agricultural Report by Dr. St. Wasniewski. 2.0, Meteorological Report. 2.15, Afternoon Concert by the **Warsaw** Philharmonic Orchestra. 4.55, Talk by M. J. Pietrzycki: "Through Switzerland—on the Trail of Polish Memories." 6.0, Various Announcements. 6.20, Talk. 6.56, Time Signal from the Astronomical Observatory. 7.0 Relay of Fanfare from the Church of Notre Dame, followed by Sports Bulletin. 9.0, Relay from **Warsaw.** 9.30, Concert Programme from the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres) ; 1.5 kW.—8.30, Concert Programme, relayed from **Cork:** Selections by the No. 2 Army Band. 11.0, National Anthem and Weather Conditions and Forecast. 11.15 (approx.), Close Down.

GENEVA (760 metres) ; 1.5 kW.—9.0 a.m., Relay of Sacred Service with Address from the Victoria Hall. 8.0, Recital of Organ Music from the Temple de Carouge, by M. Roger Vuataz (Organist), with the collaboration of Mlle. Edmée Defago (Vocalist).

HAMBURG, Call KA (in Morse) (392 metres) ; 4 kW.—Programme relayed by **Bremen** (273 metres), **Hanover** (566 metres) and **Kiel** (250 metres).—7.20 a.m., Time Signal. 7.25 a.m., Weather Conditions and Forecast, followed by News and Announcements. 7.40 a.m., Talk on Problems of Industry. 8.0 a.m., Weekly Legal Notes. 11.55 a.m., The International Time Signal from **Nauen.** 12.5 (for **Hamburg** and **Kiel**), Morning Concert Programme. 12.5 (for **Bremen**), Morning Concert by the Wireless Orchestra. 12.5 (for **Hanover**), Concert of Gramophone Records. 1.0, Entertainment for Children. 3.0, Talk. 10.50 (for **Hamburg, Bremen** and **Kiel**), North Sea and Baltic Weather Conditions and Forecast. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres) ; 5 kW.—12.10, Musical Selections by the Station Trio. 2.10, Lecture with Musical Illustrations: "The Pianoforte Sonatas of Beethoven," Lecturer, Mr. L. Schmidt; Pianist, Mr. Egbert Veen. 7.40, Time Signal. 7.42, General News Bulletin and Communications. 7.55, Musical Programme. 10.40 (approx.), Close Down.

HUIZEN (336.6 metres) ; 4 kW.—Transmits from 6.40 on 1,852 metres.—8.5 a.m., Relay of Divine Service. 12.10, Musical Programme by the Station Trio. 1.10, Talk. 1.40, Talk. 2.10, Musical Selections Programme. 4.55, Relay of Divine Service and Sermon from a Church in **Amsterdam:** Address on the 38th and 39th Verses of the 5th Chapter of the Gospel according to St. Matthew, by Dr. W. E. van Duin. 10.25, Epilogue, rendered by a Choir under the Direction of Mr. Jos. H. Pickkers. 10.40 (approx.), Close Down.

KALUNDBORG (1,153 metres) ; 7 kW.—Programme also for **Copenhagen** (339.8 metres).—9.0 a.m., Relay of Morning Service and Address from a Church in **Copenhagen.** 10.30 a.m. to 10.40 a.m. (**Kalundborg** only), Weather Conditions and Forecast from the Copenhagen Meteorological Institute. 1.0, Divine Service and Sermon. 2.30, Concert by the Station Orchestra. 5.50 (**Kalundborg** only), Weather Conditions and Forecast from the Copenhagen Meteorological Institute. 6.0, Press News Bulletin. 6 15, Time Signal. 6.30 Talk. 7.0, Chimes Relay from Copenhagen Town Hall. 9.0, Concert of Popular Music by the Station Orchestra: Le coin des enfants-Suite (Debussy), (a) Doctor Gradus ad Parnassum, (b) Sérénade à la poupée, (c) Le petit berger, (d) Berceuse d'éléphante, (e) La neige danse, (f) Golliwog's Cake-Walk. 10.0, Programme of Dance Music by the Palace Hotel Orchestra: Conductor, Teddy Petersen; in the Interval at 11.0, Relay of Chimes from the Town Hall. 11.30 (approx.), Close Down.

KATTOWITZ (416 metres) ; 10 kW.—11.20 a.m. (approx.), Musical Selections by the Station Quartet. 1.0, Talk. 1.20 and 1.40, Two Talks on Agricultural Subjects. 2.0, Weather Conditions and Forecast. 2.15, Symphony Concert, by the **Warsaw** Philharmonic Orchestra. 4.30 to 5.20, No Transmission. 5.20, Popular Concert from **Warsaw:** Le Nil (X. Leroux), rendered by Mme. Mankiewicz (Soprano), accompanied by M. T. Goclawski (Violoncellist) and Prof. L. Urstein (Pianist). 6.0, Various Announcements. 6.20, Talk. 6.58, Time Signal. 7.0, Talk. 7.30, Relay of Evening Concert from **Warsaw.** 9.0, Weather Conditions and Forecast, Press News Bulletin and Sports Notes. 9.30, Dance Music Programme. 10.30 (approx.), Close Down.

KAUNAS (2,000 metres) ; 7 kW.—2.30, Programme of Fairy Stories, Songs and Music for Children. 3.0, Young People's Programme. 3.30, Talk on Health and Medicine by Doctor Jurgelionis. 4.0, Talk by J. Ardickas on Industry and Daily Life. 5.0, Programme for **Vilna.** Talks in the Lithuanian and Ruthenian Languages. 6.0, Weather Conditions and Forecast and News Bulletin from the Press.

KÖNIGSBERG (280 metres) ; 4 kW.—Programme relayed by **Danzig** (463 metres). 8.0 a.m. (**Königsberg** only), Recital of Vocal and Instrumental Sacred Music with Sermon. 10.0 a.m. (**Königsberg** only), Weather Report and Forecast. 10.5 a.m. Musical Programme. 11.55 a.m., The International Time Signal from **Nauen,** followed by Weather Report and Forecast. 1.0, Talk on Chess by P. S. Leonhardt. 2.0, Elementary Spanish Lesson by Kurt Metze. 8.5, Programme from **Danzig.** "Im weissen Rössl" Comedy in Three Acts by Oscar Blumenthal and Gustav Kadelburg, produced by Otto Norman, followed by News of the Day and Sports Results and Musical Programme. 11.30 (approx.), Close Down.

LAHTI (1,504 metres) ; 35 kW.—Programme also for **Helsingfors** (374 metres).—7.0 a.m., Sacred Service Relay in the Finnish Language. 9.50 a.m., Press News and Announcements. 10.5 a.m., Concert Programme. 10.59 a.m., Weather Conditions and Forecast and Time Signal. 11.0 a.m., Relay of Church Service in the Swedish Language. 4.57, Time Signal and Weather Conditions and Forecast. 6.25, Concert of Classical Music by the Station Orchestra, conducted by Erkki Linko. Invitation to the Dance (C. M. Weber). 7.45, Late News and Announcements in the Finnish and Swedish Languages. 8.30 (approx.), Close Down.

LANGENBERG (462.2 metres) ; 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres) and **Münster** (265.5 metres).—6.45 a.m., Lesson in Self-Protection by Dr. Ludwig Bach. 7.5 a.m., German Shorthand Lesson by Hans Molitor. 7.25 a.m., Survey in Esperanto of the Programmes of the Week by Alfred Dormanns. 7 30 a.m. to 7.55 a.m., Esperanto Lesson by Alfred Dormanns. 8.5 a.m., Evangelical Morning Festival of Sacred Music with Sermon in the interval. 12.0 Noon, Afternoon Concert of Orchestral Music. 1.30, Talk. 5.0, Talk. 7.15, "The Dollar Princess"—Operetta (Leo Fall), conducted by Küh and produced by Zimmermann, followed by Late News Bulletin, Concert of Light Music and Dance Music conducted by Eysoldt. 11.0 (approx.), Close Down.

LEIPZIG (382 metres) ; 4 kW.—Programme relayed by **Dresden** (276 metres).—7.30 a.m., Programme of Organ Music 8.0 a.m., Morning Concert Programme. 10.0 a.m. Talk. 10.30 a.m., Talk. 11.0 a.m., Musical Programme. 12.0 Noon, Time Signal. 12.2, Talk. 12.30, Talk. 1.0, News from the Foreign Press, followed by Review of Events Abroad. 2.0, Latest Gramophone Records from the "Merkur" Musical Publishers, followed by Advertising Notes. 5.0, Talk: "For and Against Capital Punishment," by Dr. Otto Landsberg, Minister for Justice, relayed from **Berlin.** 5.30, Talk. 6.0, Talk. 6.30, Relay of an Opera. 9.0, General News Bulletin and Sports Results and Dance Music Programme, relayed from **Berlin.** 11.30 (approx.), Close Down.

LYONS (Radio Lyon) (291 metres) ; 1.5 kW.—7.30, The Radio Lyon "Journal Parlé" of News and Announcements, Press Review, Survey of Theatre Programmes and Announcements. 8.0, Programme of Light Music rendered by Madame Ducharne (Pianist), M. Camand (Violinist) and M. Testanière (Cellist): Selections from "La Dame blanche"—Opera (Boieldieu). 10.0 (approx.), Close Down.

Programmes from Abroad.—

MADRID (Union Radio), Call EAJ7 (427 metres); 1.5 kW.—Programme relayed by **Salamanca** (EAJ 22) (405 metres).—**2.0**, Chimes Relay and Time Signal. **2.5**, Concert by the Station Orchestra: Midsummer Night's Dream (Mendelssohn). (a) Scherzo, (b) Allegro appassionato, (c) Nocturne, (d) March. **3.30** to **7.0**, No Transmission. **7.0** Chimes. **7.5**, Musical Selections. **8.0**, Talk and Reading: Famous Voyages —Extracts from Thrilling Narratives of Interesting Travels. **8.30** to **10.0**, No Transmission. **10.0**, Chimes and Time Signal. **10.5**, Musical Selections. **12.0 Midnight**, Programme of Dance Music by the Palermo Orchestra, relayed from the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, MI (**504 metres**); 7 kW.—**9.0 a.m.**, Opening Signal and Lesson in the English Language. **9.30 a.m. to 10.30 a.m.** (approx.), Concert of Sacred Music: Vocal and Instrumental Items. **11.30 a.m.**, Time Signal. **11.32 a.m.**, Musical Programme by the Station Quartet. **3.0**, Opening Signal and Concert of Popular Music by the Station Quintet. **4.15**, Programme by the Tzigana Orchestra, relayed from the Fiaschetteria Toscana. **5.0** to **6.55**, No Transmission. **6.55**, Opening Signal. **7.0**, Press News Bulletin. **7.15**, Talk. **7.25**, Sports Notes and Results. **7.30**, Time Signal. **7.35**, Relay of "La Monacella alla Fontana"—Opera (G. Mule); in the Intervals, Talk; Sports News and General News Bulletin. **10.30** (approx.), Close Down.

MOTALA (**1,365 metres**); 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Malmö** (229 metres), **Ostersund** (720 metres) and **Sundsvall** (545.5 metres).—**10.0 a.m.**, Relay of Morning Service from a Church in **Stockholm**. **4.0**, Entertainment for Children. **4.55**, Relay of Carillon from **Stockholm** Town Hall. **5.0**, Relay of Evening Service. **6.5**, Gotthold Ephraim Lessing Programme on the Two Hundredth Anniversary of his Birth. "Minna von Barnhelm" Play (Lessing). **7.45**, Programme of Choral Music. **8.15**, General News Bulletin and Weather Report and Forecast. **8.40**, Orchestral Concert. **10.0** (approx.), Close Down.

MUNICH (**535.7 metres**); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres) and **Nuremberg** (240 metres). —**9.0 a.m.**, Evangelical Morning Recital and Sermon. **10.0 a.m.**, Chimes Relay from Munich Town Hall. **12.0**, Time Signal, Weather Conditions and Forecast and Survey of Programmes of the Week. **5.15**, Recital of Pianoforte Music, rendered by Alexander Gunselmann. **7.0** Concert Programme. **9.20**, General News Bulletin. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333 metres**); 1.5 kW.—**8.30 a.m.**, Lesson in the French Language by Prof. Etienne Verdier. **9.0 a.m.**, Recital of Religious Music. **3.45**, Children's Programme. **4.0**, Concert of Popular Music. **4.30**, Time Signal. **7.30**, News and Communications. **7.50**, Bulletin of the Naples Harbour Authorities. **8.0**, Time Signal. **8.2**, Concert of Operatic Music by the Station Orchestra, with the collaboration of Soloists: Fra poco a me ricovero, from Lucia di Lammermoor (Donizetti), rendered by R. Rotondo (Tenor), with Orchestral Accompaniment. **9.0**, Sports Review. **9.50**, Calendar and Future Programme Announcements. **10.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**1,488 metres**); 5 kW.—**7.56 a.m.**, Time Signal on 32.5 metres.—**9.26 a.m.**, Time Signal on 1,488 metres. **5.0**, Relay of Pasdeloup Concert. **7.10** to **7.20**, Meteorological Report. **7.20**, Le Journal Parlé. **8.0**, Wireless Concert, Vocal Selection: Un petit cimtière arabe (George Tucca), rendered by Mlle. Marie Louise Welcome accompanied by the composer. **7.56**, Time Signal on 32.5 metres. **8.50**, Silent Night. **10.26**, Time Signal on 1,488 metres

PARIS (Petit Parisien) (**336 metres**); 0.5 kW.—**8.45**, Latest Gramophone Selections. **8.50**, Talk. **8.55**, General News Bulletin from the Press. **9.0**, Concert of Orchestral Music, with the collaboration of Artistes from the Opéra and Opéra-comique. **9.25**, News and Announcements. **9.30**, Concert of Symphony Music, conducted by Prof. Estyle of the Paris Conservatoire. **10.0**, Late News Bulletin. **10.15**, Concert of Orchestral Music: Fantasia on Madame L'Archiduc (Offenbach). **11.0** (approx.), Close Down.

PARIS (Radio Paris) Call CFR (**1,769 metres**); 15 kW.—**8.0 a.m.**, General News Bulletin and Press Review. **8.30 a.m.**, Lesson in Physical Culture, by Dr. Diffre. **12.0 Noon**, Religious Address, followed by Sacred Festival of Instrumental and Choral Music. **12.30**, General News Bulletin. **12.45**. Concert of Popular Music by the Albert Locatelli Orchestra: Interlude by Bilboquet. **4.30**, New Gramophone Selections, arranged by "L'Industrie Musicale"; General News Bulletin in the Interval. **6.30**, Agri-

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cultural Communications. **6.45**, Gramophone Records **7.30**, General News Bulletin. **7.45**, Radio Paris Circus. **8.15**, Programme of Symphony Music, rendered by Soloists and Orchestra conducted by M. E. Bigot; in the Intervals: General News Bulletin and Evening Press Review and Announcements. **10.30** (approx.), Close Down.

POSEN (**343 metres**); 1.5 kW.—**9.15 a.m.** to **10.45 a.m.** Relay of Morning Service from Posen Cathedral. **11.0 a.m.**, Time Signal. **11.15 a.m. and 11.30 a.m.**, Two Agricultural Talks. **11.55 a.m.**, Talk for Peasant Women. **2.15**, Concert of Symphony Music, relayed from **Warsaw**. **4.30** (approx.), Various Items. **4.50**, Entertainment for Children. **5.20**, Vocal Recital by Mlle. Marie Kisielewska (Soprano Soloist from the Opera House) accompanied by M. Sigismond Wojciechowski: Aria from the "Magic Flute" Opera (W. A. Mozart). **6.0**, Report of the Catholic Association of Polish Youth. **6.20**, Programme from **Warsaw**. **6.45**, Talk. **7.5**, Programme of Miscellaneous Items. **7.30**, Musical Programme. **9.0**, Time Signal. **9.5**, Sports Notes and Results. **9.20**, Lesson in Dancing by Mr. Starski. **9.40**, Programme of Dance Music by the Orchestra of the Palais Royal Restaurant. **11.0** (approx.), Close Down.

RABAT, Call PTT (**414 metres**); 2 kW.—**12.30** to **2.0**, Programme by the Radio-Maroc Orchestra. **4.0** to **5.0**, Concert of Military Music. **8.15**, "Le Journal Parlé." **8.30**, Concert of Orchestral Music; in the Interval at **9.30**, Sports Talk and Announcements by M. Barrier. **10.30**, Programme of Modern Dance Music from the "Chaumière de Rabat." **11.0** (approx.), Close Down.

ROME, Call 1RO (**443.8 metres**); 3 kW.—**8.30 a.m.** Opening Signal, followed by German Language Lesson. **9.0 a.m.** Recital of Vocal and Instrumental Selections of Sacred Music. **9.45 a.m.** to **12.0 Noon**, No Transmission. **12.0 Noon**, Opening Signal. **12.5** to **1.0**, Selections of Trio Music. **1.0** to **4.0**, No Transmission. **4.0**, Opening Signal. **4.5** to **5.30**, Concert of Popular Music. **6.50**, News and Announcements and Press Review. **7.10** (approx.) Agricultural Talk. **7.15**, Sports Results and General Communications. **7.29**, Time Signal. **7.31**, Topical Talk. **7.45**, Celebration of the Anniversary of the Death of Giuseppe Verdi: Requiem Mass for Soloists, Choir and Orchestra, rendered by the Station Choir and Orchestra and Soloists; Choral Selection: Dies irae; in the Interval, Reading. **9.50**, Latest News and Announcements. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAF (**19.56 metres**); 30 kW.—**3.30**, Relay of Divine Service from the Emmanuel Baptist Church. **6.30**, Programme by the Peerless Reproducers from **New York**. **8.30**, Recital of Organ Music, by Elmer A. Tidmarsh, from the Union College Memorial Chapel. **9.0**, Sermon for Men, by Dr. Parkes Cadman, from **New York**. **10.30**, Recital of Music for the Violin by Arcade Birkenholz, relayed from **New York**. **11.0**, Stetson Parade Programme, by the American Legion Band, from **Boston, Mass.** **11.30**, The Acousticon Programme from **New York**. **12.0 Midnight**, Relay of the Old Company's Programme, Vocal Selections by Reginald Werrenrath (Baritone), from **New York**. **12.30 a.m.** (Monday). Programme from the Capitol Theatre, **New York**. **2.0 a.m.**, Relay of Lecture on "Our Government," by David Lawrence, from **Washington, D.C.** **2.15 a.m.**, Atwater Kent Programme, from **New York**. **3.15 a.m.** Correct Time. **3.16 a.m.**, Programme by the National Light Opera Company, relayed from **New York**. **4.15 a.m.** Experimental Television Transmission. **4.30 a.m.** (approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (**370 metres**); 2 kW.—**2.0** to **3.0**, Concert of Popular Music by the Seville Wireless Orchestra, followed by Latest Gramophone Selections. **9.30** Concert of Orchestral Music. **11.0**, Flamenco Songs and Programme of Dance Music. **11.30** (approx.), Close Down.

STAMBOUL (**1,200 metres**); 5 kW.—**3.30**, Orchestral Concert. **4.30**, Exchange Quotations and Cereal Market Prices. **5.15**, Programme of Turkish Music. **7.30**, Weather Conditions and Forecast and Time Signal. **7.40**, Concert Programme. **9.0**, General News Bulletin and Announcements. Overture to "The Czar and the Carpenter" Opera (Lortzing). **9.30** (approx.), Close Down.

STUTTGART (**374 metres**); 4 kW.—Programme relayed by **Freiburg** (577 metres).—**1.0**, Programme for Children. **2.0**, Talk or Reading. **2.30**, Concert Programme. **7.15** (approx.), Concert, Opera or Play, followed by Late News Bulletin and Wireless Notes and Sports Results. **10.30** (approx.), Close Down.

TALLINN (**403 metres**); 2.2 kW.—**7.30 a.m.**, Relay of Church Service. **5.0**, Concert of Popular Music. **5.30** Talk. **6.0**, Concert Programme. **9.0** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (**383 metres**); 8 kW.—**12.15**, Wireless Agricultural Programme. **12.45**, Concert. **1.0**, Time Signal, followed by Concert (contd.). **1.45**, Latest News and Announcements from "Le Télégramme," "L'Express" and "Le Midi Socialiste." **8.0**, Stock Exchange Quotations and Cereal Market Prices from Paris. **8.15** (approx.), News and Announcements from "La Dépêche" and "Le Petit Parisien." **8.30**, Concert of Orchestral Music, arranged by the Association des commerçants radio-électriciens du Midi. Selections from "Carmen"—Opera (Bizet), founded on the story by Prosper Merimée. At **9.0** in the Interval, Time Signal. **10.15** The Wireless Journal of North Africa and Late News and Announcements. **10.30** (approx.), Close Down.

VIENNA (**520 metres**); 15 kW.—Programme relayed by **Graz** (354.2 metres), **Innsbruck** (455.9 metres), **Klagenfurt** (455.9 metres), and **Linz** (250 metres).—**10.0 a.m.**, Concert Programme by the Vienna Symphony Orchestra, with Soloist Items. **3.0** Orchestral Concert. **7.15**, Relay of "Der Weltenbummler"—Operetta in Three Acts. Book by Beda and Karl Lindau and Music by Richard Fall. Produced by Victor Flemming and conducted by Karl Lindau, followed by Programmes of Dance Music and Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

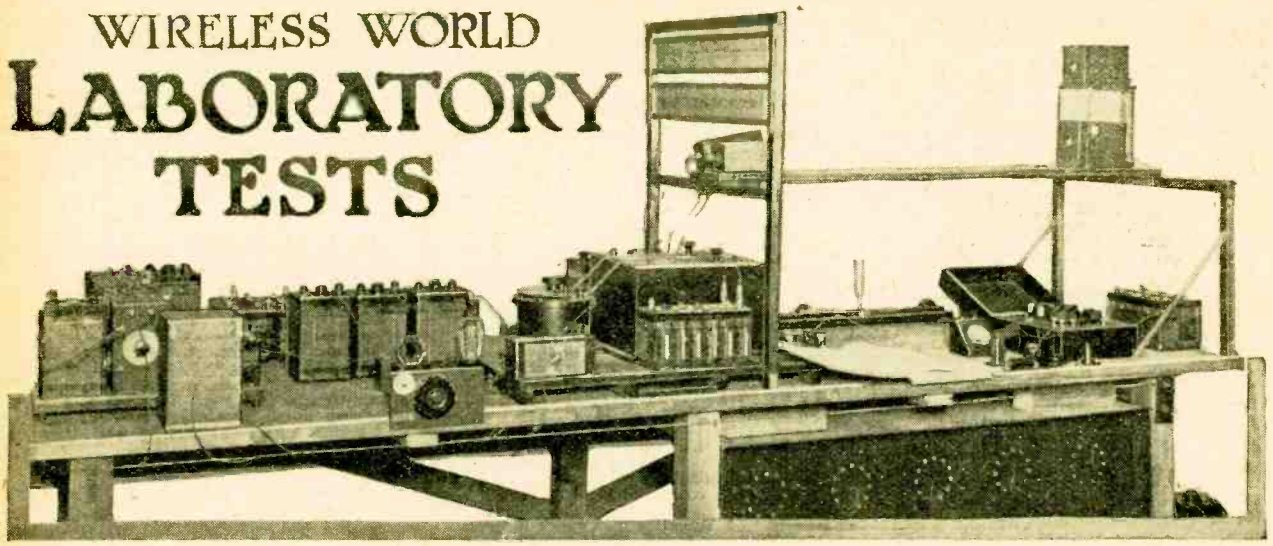
VILNA (**427 metres**); 1.5 kW.—**9.15 a.m.** to **10.45 a.m.**, Relay of Morning Service from a Cathedral. **10.56 a.m.** to **4.30**, Programme from **Warsaw**. **10.56 a.m.**, Time Signal and Fanfare, relayed from the Church of Notre Dame at **Cracow**. **11.5 a.m.**, Aviation Routes Report and Weather Report and Forecast. **11.10 a.m.**, Symphony Concert by the Warsaw Philharmonic Orchestra. **1.0** to **2.0**, Three Talks for Agriculturists. **2.15**, Concert of Symphony Music by the Warsaw Philharmonic Orchestra, conducted by M. Z. Dymnika. Concerto for Pianoforte in D Minor (S. Rachmaninoff), executed by Mme. Olga Martusiewicz (Pianist). **6.45** (approx.), Time Signal. **7.30** to **10.30**, Programme from **Warsaw**. **9.0**, Report on Aviation Routes, and Weather Report and Forecast. **9.5**, News Bulletin supplied by the Polish Telegraph Agency. **9.20**, Police Communications and Sports Notes. **9.30**, Dance Music Programme relayed from the "Oaza" Restaurant, **Warsaw**. **10.30** (approx.), Close Down.

WARSAW (**1,415 metres**); 10 kW.—**9.15 a.m.** to **10.45 a.m.** Relay of Morning Service from a Cathedral. **10.55 a.m.**, Time Signal. **11.0 a.m.** Relay of Fanfare from the Church of Notre Dame, **Cracow**. **11.5 a.m.**, Notes on Aviation Routes and Weather Report and Forecast. **11.10 a.m.**, Concert of Symphony Music, organised by the Department for Education and Culture of the Magistracy of **Warsaw**. **1.0** to **2.0**, Three Talks for Agriculturists. **2.0**, Meteorological Report. **2.15**, Concert of Symphony Music by the Warsaw Philharmonic Orchestra. **4.30** Talk. **4.55**, Talk. **5.20**, Concert of Popular Music. Spanish Serenade (Al. Glazounoff), rendered by Mme. B. Prokopowicz (Harpist) and M. Goclawski (Violoncellist). **6.0**, Miscellaneous Items. **6.20**, Talk. **6.45**, News and Announcements. **6.56**, Time Signal. **7.0** Twenty Minutes of Intellectual Amusements. **9.0**, Notes on Aviation Routes and Weather Report and Forecast. **9.5**, News and Announcements from the Polish Telegraph Agency. **9.20**, Police Communications and Sports Results. **9.30**, Dance Music Programme, relayed from the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (**308 metres**); 0.7 kW.—**10.30 a.m.** Morning Concert. **4.0**, Programme of Light Music. **6.45**, Talk. **7.0**, Opera relayed from the National Theatre, Zagreb. In the Intervals: General News Bulletin and Weather Conditions and Forecast. **10.0** (approx.), Close Down.

ZÜRICH (**489 metres**); 1 kW.—**10.0 a.m.**, Musical Programme. **3.0**, Concert by the Castellano Orchestra, relayed from the Carlton Elite Hotel. **6.30**, Time Signal. **6.32**, Protestant Sermon. **8.0** Relay of Opera—"Don Juan" (W. A. Mozart), relayed from the Municipal Theatre, **Basle** (on 1010 metres). **9.0**, Late News and Announcements, supplied by the "Neue Züricher Zeitung." **9.40** (approx.), Close Down.

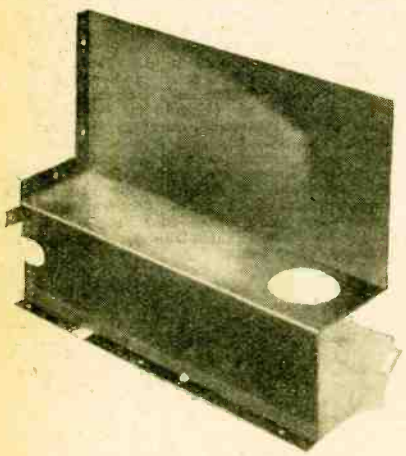
WIRELESS WORLD LABORATORY TESTS



A Review of Manufacturers' Recent Products.

SCREEN FOR EUROPA III.

Such component parts as might present difficulties of construction when building the Europa III are now becoming available. It is realised that the screen is perhaps a little intricate in its design,



Lock-Atkinson screen for building the Europa III.

and Lock-Atkinson Wireless, 107, Bolsover Street, London, W.1, now manufacture a screen tallying in all details with that used in the article.

It is made from hard aluminium and is particularly robust, so that its faces are perfectly flat. When used for the construction of the Europa III the design details can be followed in every way without the need for any modification of dimensions The price is 6s. 6d.

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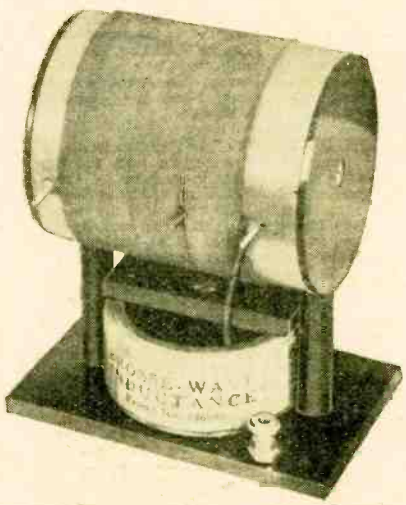
COILS FOR EUROPA III.

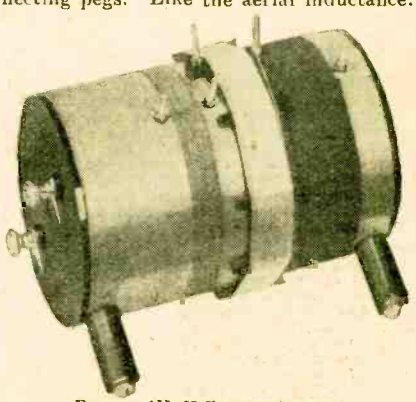
Following quickly on the introduction of this receiver, it was learned that a set of coils built to the design were obtainable from The B. and J. Wireless Company, 2, Athelstane Mews, Stroud Green Road, London, N.4.

The aerial inductance is assembled on an ebonite base very much in the manner shown in the article. A bakelised tube is used, and tinned soldering pegs provide for the aerial and earth connections. The loading coil, which is held down by an ebonite clamp, is a Brosse wave-wound inductance possessing good efficiency, and is entirely wrapped with a waterproof covering. Attractive appearance results from the use of polished ebonite insets at the ends of the former.



The B. & J. aerial inductance as specified for the Europa III.

The H.F. transformer precisely follows the design given, except that the loading coil is totally enclosed within the cylinder and is protected by an ebonite end cap which serves for carrying two small terminals conveying the connections to the coil. Ebonite spacers support the primary coil, while all windings are brought out to conveniently placed connecting pegs. Like the aerial inductance.



Europa III H.F. transformer (B. & J. Wireless).

the H.F. transformer is well finished. A receiver built from a set of these coils can be relied upon to function correctly and give a high standard of performance.

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HUNT'S MEASURING INSTRUMENTS.

The wide range of measuring instruments for which Messrs. A. H. Hunt, Ltd., are noted includes voltmeters, ammeters and milliammeters, functioning on the moving coil and electromagnetic spring-controlled principle. The particular instrument we have tested is a flush type panel-mounting milliammeter. This is a dead-beat moving-coil instrument reading up to 25 milliamps. and fitted with a 2¼in. diameter dial. Tested against a laboratory standard milliammeter the instrument showed a very small error, but at no position was this greater than 2 per cent. As it will be extremely difficult to measure to this degree of accuracy with any small size meter, for all

practical purposes the reading obtained with this instrument can be accepted as a true indication of the current flowing. It is interesting to note that the meter is calibrated by hand, and this undoubtedly accounts for the high order of

Hunt's hand calibrated moving-coil meter. The scale reads to 25 milliamps.

accuracy. The measured D.C. resistance of the meter is 12.3 ohms and the price is 20s.

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POLYMET PRODUCTS.

Messrs. A. H. Hunt, Ltd., H.A.H. Works, Tunstall Road, Croydon, Surrey, have acquired the agency in this country for the Polymet radio products, which are high-grade American wireless accessories not previously available on this side of the Atlantic. They comprise a wide range of components, but those which will appeal most to wireless enthusiasts here are the condensers and heavy duty

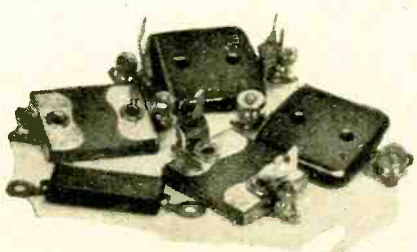
Two examples of "Polymet" large capacity condensers.

wire-wound resistances. Under the first heading are included some large capacity smoothing condensers suitable for eliminators. The larger of the two illustrated has a capacity of 2 mfd., and is tested to withstand a pressure of 600 volts D.C. A similar condenser tested to 1,000 volts is available also for use in high voltage circuits such as medium power transmitting sets or high voltage battery eliminators. The 600-volt type B 2 mfd. condenser is priced at 7s. For low-pressure circuits the 300-volt type A condenser is quite suitable and in this model the 2 mfd. capacity costs 4s. 6d.

A number of small mica dielectric fixed condensers of the same make were tested, and in practically all cases the measured capacities were within 10 per cent. of the marked values. The measurements obtained with a few representative samples are tabulated below.

Type.	Nominal Cap.	Measured Cap.	Percentage of Error.
	mfd.	mfd.	Per cent.
Moulded bakelite type	0.0002	0.000181	−9.5
" "	0.0001	0.000389	−2.75
Postage stamp type	0.0005	0.000509	+2
" "	0.001	0.000993	−0.7
Midget moulded condensers ...	0.0001	0.000102	+2

The prices of the moulded bakelite range from 1s. 6d. for the 0.0001 mfd. size to 3s. for the 0.01 mfd. capacity.



An assortment of "Polymet" small fixed condensers. The postage stamp type is paxolin covered.

The postage stamp type is slightly cheaper, the 0.0001 mfd. being 1s. and the 0.01 mfd. 2s. 6d. Grid leak clips can be supplied for either type at 3d. per pair.

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MARCONIPHONE UNIVERSAL TRANSFORMERS.

These transformers are made in two ratios—2.7 : 1 and 4 : 1. The former is suitable for valves having an A.C. resistance of 20,000 to 30,000 ohms, and

Marconiphone "Universal" transformer.

the latter for valves of about 10,000 ohms. Although the performance cannot be expected to equal that of the "Ideal" range of transformers, the difference could be detected only by a practised ear.

The measured inductance of the primary of the 2.7 : 1 transformer without D.C. flowing was 34 henrys and of the 4 : 1 transformer 18.3 henrys.

Both transformers are fitted with reversible feet and the price in each case is 16s.

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THE "EXACT" TUNERS

These tuners are designed to give a continuous overlap between 250 and 2,000 metres when tuned by a 0.0005 mfd. condenser. They can be used, therefore, as substitutes for the plug-in type of coil in all positions in a receiver where coils of this kind are usually employed. The coils are built up from sectional slab type windings, each section being spaced from neighbouring ones by thin ebonite discs and a seven-point switch is built into the centre of the coil assembly. A single hole fixing suffices to hold the tuner rigidly in position.

A set of "Exact" tuning devices with built-in switches.

On certain models a reaction coil is fitted, and in these cases it will be necessary to drill a further hole to clear the control spindle. The reaction coil is carried on a spring hinge which tends to keep this coil tightly coupled to the main winding. Rotating the reaction control knob drives the spindle backwards, and this, bearing against a conical shaped stud on the reaction former, moves this away from the tuned coil. The action is in effect a slow motion drive, and perfect control should be possible with this arrangement.

The aerial and anode tuners with the reaction coil mounted on the anode coil is priced at 30s. the pair, and aerial coils only with reaction are listed at 14s.

The makers are the Exact Manufacturing Co., Croft Works, Priory Street, Coventry.

THE PHYSICAL SOCIETY'S ANNUAL EXHIBITION.

Some Interesting Apparatus Shown at South Kensington.

IT should be a source of gratification to all concerned with wireless matters that workers in so many branches of science are now bearing a share in the development of our own particular art. It is said that "science is measurement"; if this be true, the excuse for poorly designed apparatus is fast disappearing. At the Physical and Optical Societies' Exhibition, held at the Imperial College of Science and Technology, South Kensington, from January 8th to 10th (inclusive), a variety of specialised electrical measuring instruments were shown on a number of stands.

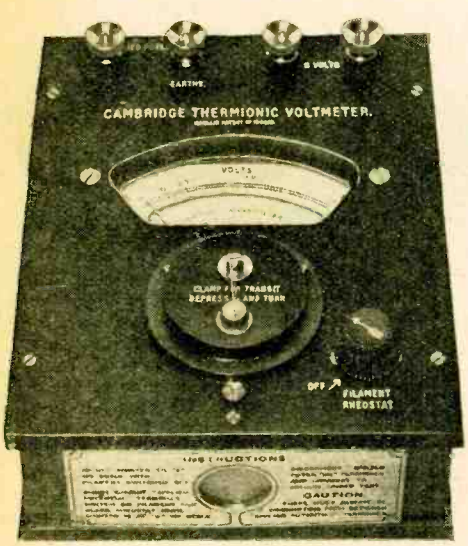
The new Marconi direction finder, with screened grid H.F. amplifying valves and semi-ganged tuning.

Apart from apparatus produced by instrument makers, a number of purely wireless firms were represented. Marconi's Wireless Telegraph Company showed the new type 11G direction finder, which includes two transformer-coupled screened grid H.F. amplifying valves of the S.625 pattern. The arrangement of this amplifier is interesting; each stage is, as usual, completely screened, and it was observed that special care had been taken to ensure good electrical "seals" at all joints of the shielding cases. The method of tuning is attractive, being that of the Marconi naval receiver, already described in this journal. Complete ganging is found to be impracticable in a receiver covering a wide waveband (425-1,100 metres in this case); instead, each of the three condenser dials are calibrated at "landmarks" every hundred metres or so, and, to tune in a given transmission, each dial is set at the nearest wavelength calibration. By operation of a fourth knob, the mechanically linked stators may then be swung through an arc of a few degrees. The facility for quick tuning thus afforded is important when bearings have to be taken quickly on a transmission of short duration.

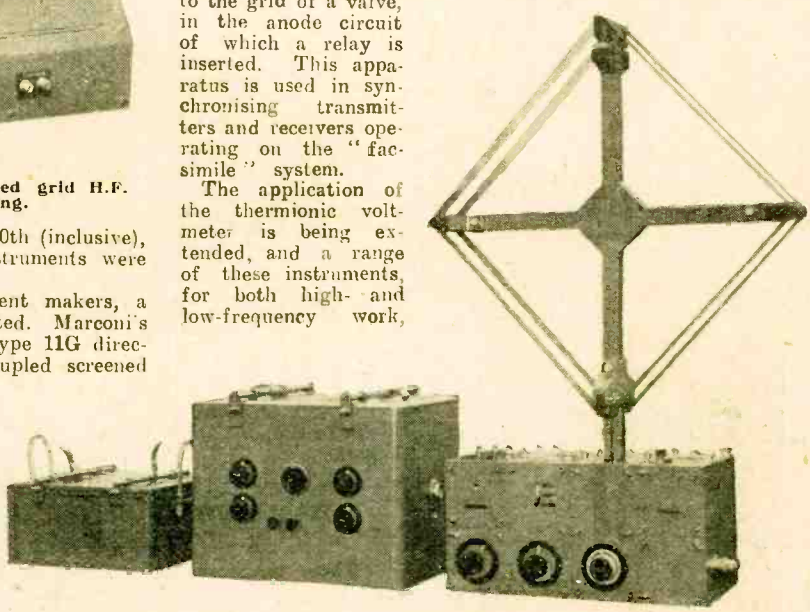
A signal strength measuring unit, covering wavebands between 14 and 5,000 metres, is another new product of the Marconi research laboratories. This contains an oscillator, of which the output can be made to coincide in intensity with received signals, and then measured.

Another new Marconi exhibit was a tuning fork and thermostat for controlling a synchronous motor. The interior of the box containing the fork is maintained at a constant temperature by an arrangement in which a tendency towards a rise beyond a fixed point causes a negative voltage to be applied to the grid of a valve, in the anode circuit of which a relay is inserted. This apparatus is used in synchronising transmitters and receivers operating on the "facsimile" system.

The application of the thermionic voltmeter is being extended, and a range of these instruments, for both high- and low-frequency work, were exhibited by the Cambridge Instrument Company, Ltd. Direct voltage calibration is provided. A new model has scales for measuring both peak and mean values; it also gives an indication as to whether the applied wave form is truly sinusoidal. Another type has three ranges, with maximum readings of 2, 12, and 120 volts.



A Moullin type valve voltmeter by the Cambridge Instrument Company.



Three units comprising a device by which incoming signals are compared with measured locally generated oscillations. (Marconi's W. T. Co.)

The range of Ferranti measuring instruments now includes an A.C. microammeter giving accurate readings on speech-frequency currents up to about 3,000 cycles per second. It includes a Westinghouse copper oxide rectifier, and reads up to 750 microamperes on full-scale deflection. This piece of apparatus should be useful in tackling some of the problems involved in L.F. amplifier design, and its price is low enough to bring it within reach of the amateur experimenter.

Many wireless users living in remote districts have to depend on a primary battery for L.T. supply, and will be interested in the Codd single-fluid gravity cell, relating to which a curve was shown which revealed that, on a steady discharge of about

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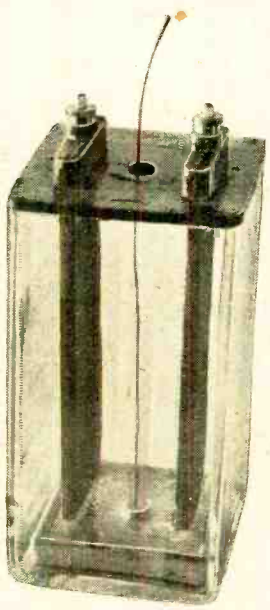
0.15 amp., voltage was maintained at an average value of over 1.35 for more than 500 hours. The electrolyte contains ferric chloride with pumice in suspension, which is precipitated and forms a coating over the zinc electrode situated at the base of the container; this precipitation serves the same purpose as a porous pot. The cells can be recharged at low cost.

The Marconiphone Company showed a new power unit, type D.C.B., for operation on D.C. supplies of 200 volts or over.

A Ferranti A.C. microammeter.

This comprises a pair of P.625 output valves in push-pull, and the necessary voltage-reducing apparatus, etc., to enable them to derive H.T., L.T., and grid bias voltages from the mains. The unit is intended for connection to an existing set when it is desired to increase output for operating a moving coil loud-speaker or other reasons.

A new Ediswan short-wave transmitting valve has a special form of base arranged to reduce self-capacity. A plate terminal is mounted on the top of the bulb. The makers also exhibited an L.T. supply unit.



Codd single-fluid cell.

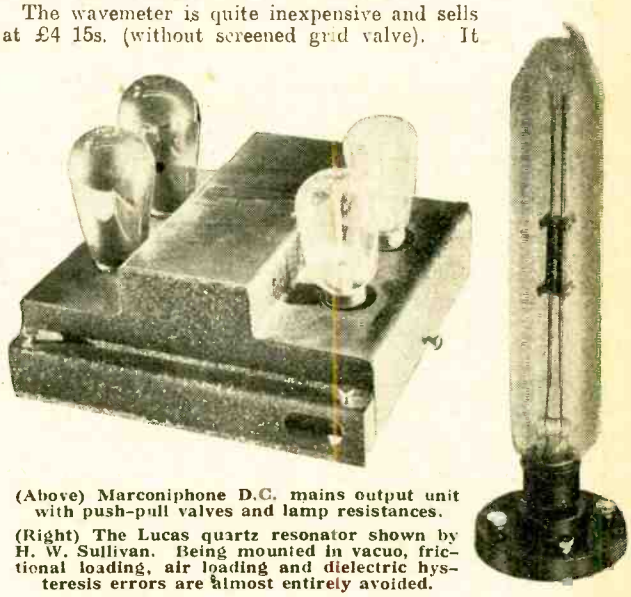
The Fuller L.T. battery trickle charger, already described in this journal, has been modified by the substitution of an improved transformer. The firm also showed a range of inert dry cells.

The British Metalising Company, which exploits a process by means of which a metallic coating may be made to adhere firmly to a non-metallic base, such as ebonite, had exhibits showing the application of their method to the construction of wireless apparatus.

An exhibit of especial interest to the wireless listener and to those interested in precision measurements was the McLachlan-Sullivan modulated C.W. wavemeter shown by Messrs. H. W. Sullivan. This instrument is the invention of Dr. N. W. McLachlan and depends upon a new electrical effect. When the anode voltage of a screened valve is less than that of the screen the valve has a negative resistance. In the anode circuit a coil and condenser tuned to a radio frequency are connected in series with a similar arrangement tuned to an audio frequency. With suitably proportioned coils and condensers a radio frequency modulated by an audio frequency is obtained. If this modulated C.W. wavemeter is placed near a radio receiver the audio frequency is reproduced by the loud speaker, provided the receiver circuits are tuned to the wavemeter. Thus a receiver can be tuned without the aid of a transmitting station. Alternatively, if the receiver is tuned to an unknown station its wavelength can be found at any time, even when the station is shut down.

The wavemeter can also be used as a master oscillator to control or to check the wavelength of a transmitting station. For check purposes the radio frequency of the meter is held constant by a quartz crystal. A note of the same pitch as the audio circuit is obtained by heterodyning the radio frequencies from meter and transmitter. If the latter frequency alters, a slow beat will occur between the two audio frequencies, which can be made visible on a meter.

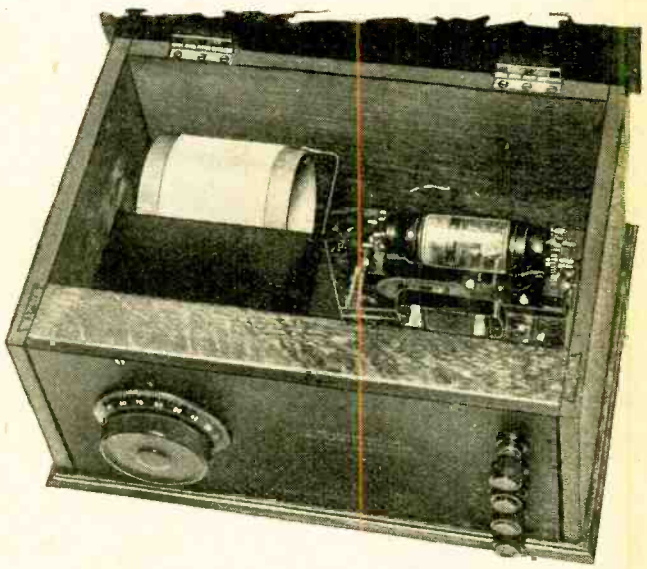
The wavemeter is quite inexpensive and sells at £4 15s. (without screened grid valve). It has the great advantage that no heterodyne oscillator is required, since a modulated wave is produced with only one valve without the use of a reaction coil; furthermore, the calibration is independent of the valve. The latter is a very important feature, since it is possible, by using special coils and condensers, to construct a wavemeter of great accuracy for precision measurements.



(Above) Marconiphone D.C. mains output unit with push-pull valves and lamp resistances.

(Right) The Lucas quartz resonator shown by H. W. Sullivan. Being mounted in vacuo, frictional loading, air loading and dielectric hysteresis errors are almost entirely avoided.

Another instrument of importance on this stand was the Lucas quartz resonator of 100 kilocycles frequency. It is now common knowledge that the orthodox quartz resonator cannot be relied upon as a frequency standard to better than one part in 3,000 unless special precautions be taken in the mounting. The model



The McLachlan-Sullivan modulated C.W. wavemeter. A screened grid valve working on the negative-resistance portion of the characteristic is employed to produce oscillations so that no reaction coil is needed.

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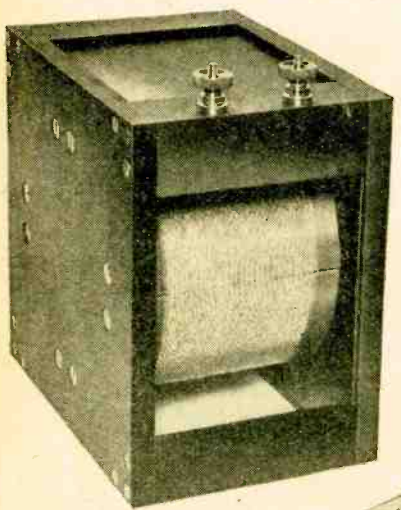
exhibited is mounted in vacuo, resulting in the reduction to negligible proportions of the normal errors produced by frictional and air loading and by dielectric hysteresis. Absolute stability as regards readings can be produced within one part in 250,000 indefinitely.

This company also exhibited a wide range of laboratory apparatus for the standardisation and measurement of radio frequencies. The modern ultimate standard of frequency is a valve-maintained tuning fork having a frequency of 1,000 per second accurate to a few parts in a million and having a temperature coefficient of the same low order. One of these was shown together with the specially designed valve-driven phonic wheel. This wheel is run up to the synchronous speed as a self-driving motor by means of two electro-magnets connected to the input and output of a three-valve amplifier. A small E.M.F. is taken from the fork whose frequency is being determined, amplified by another three-stage amplifier and applied to another driving magnet of the wheel, which then runs as a pure synchronous motor. A contact operated by the wheel impulses the pen of a chronograph at each vibration of the fork, which can thus be compared with the standard clock also operating the chronograph. The frequency of the fork can be determined to within 0.001 per cent. by running the wheel synchronously for 1,000 seconds.

In the sub-standard wavemeter section of the exhibits of Messrs. Sullivan were to be seen the Sullivan-Griffiths precision variable condenser, the latest design of which is described by W. H. F. Griffiths in the present issue of "Experimental Wireless." For use with condensers such as this, W. H. F. Griffiths has designed inductance coils having negligible temperature coefficient, and the first of these to be constructed was also exhibited. The principle employed is that of constructing the former from insulating materials having different temperature coefficients of linear expansion in such a manner that the diametrical and axial thermal expansions compensate in their effect on inductance value and at the same time will not permit the winding to loosen.

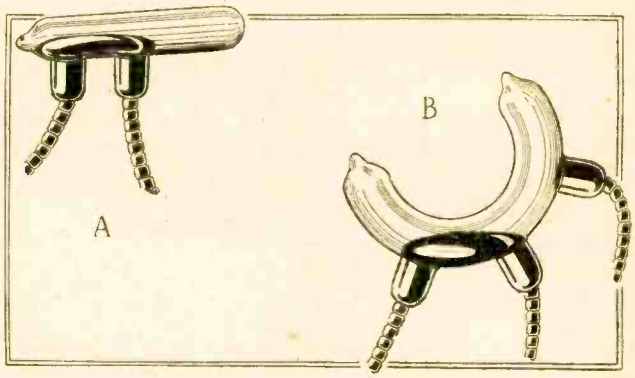
Many attractive remote-control relay schemes for L.T. and moving-coil field current switching can be evolved with the small mercury switches shown by Isenthal and Co., Ducon Works, Victoria Road, North Acton, W.3. Consisting of sealed glass tubes containing an inert gas, these switches are so arranged that contact is always made between mercury and mercury, resulting in the contact resistance remaining unchanged over a period of time, which is not the case with metallic contacts exposed to varying atmospheric conditions.



For use in standard wavemeters this inductance is wound on a former of such material that diametrical and axial thermal expansions compensate in their effects. Designed by W. H. F. Griffiths and shown by H. W Sullivan.

By mounting these devices in small cradles actuated by a solenoid consuming but a few milliamperes, it is possible to make or break about 5 amperes with a tilt of 6°. The price of the single-pole single-throw switch illustrated is 2s. 6d.

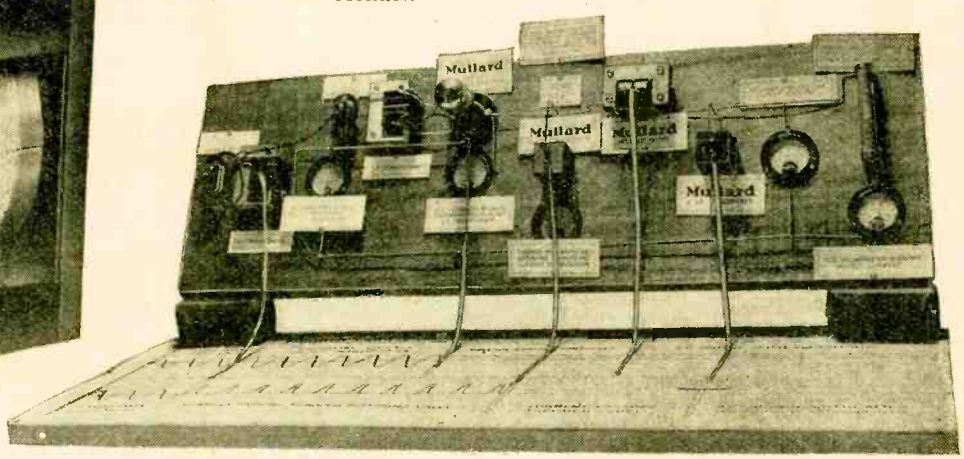
An extremely interesting demonstration of the various processes involved in the rectification and smoothing of A.C. mains to provide H.T. current for a receiver was given by Messrs. Mullard and Co. Meters were interposed after each successive filter component and a diagram showing the decreasing amplitude of ripple current was given. The large current (about 80 mA.) passed by an early smoothing condenser as registered by a thermo-ammeter was of interest, but it should be pointed out that this is not a serious load on the rectifier, as the current under these circumstances is practically wattless. The Mullard



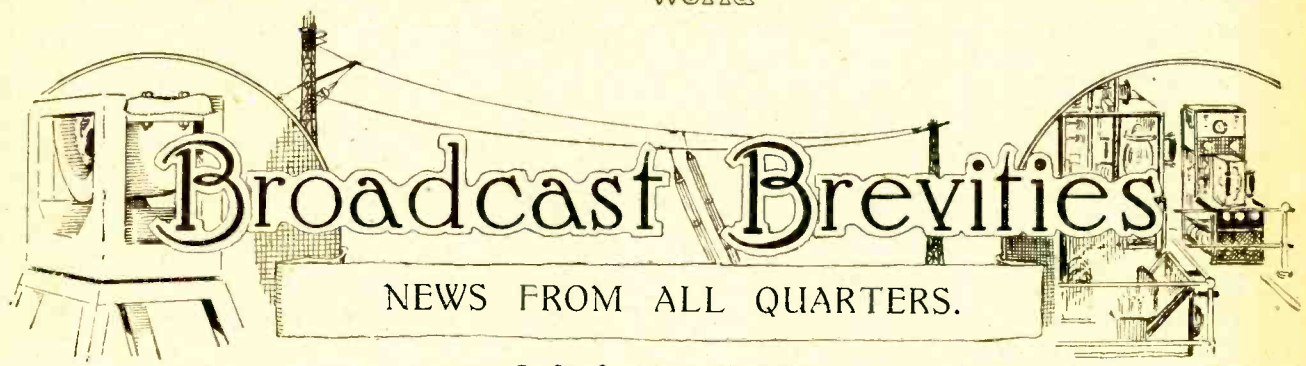
Two examples of the Isenthal mercury switch suitable for remote control relay work. Contact is made between mercury and mercury in a non-oxidising atmosphere. With A contact is made with a tilt of 10°, with B a tilt of 25° is necessary.

power output valve—the D.O.20—consuming 1.3 amperes at 7.5 volts should appeal to those employing moving-coil loud speakers. An H.T. voltage of 425 can be applied to the anode and an impedance of 1,700 ohms, together with a magnification factor of 5, gives the satisfactory mutual conductance of about 3 under amplifying conditions. There is a new full-wave rectifying valve known as the D.W.8 giving a D.C. output of 60 mA.

It is now well known that with certain loud speakers the pentode gives a predominance of the higher frequencies due to its comparatively high impedance. To arrange a suitable matching of impedances the Igranic Co. are now manufacturing a tapped output tranformer known as the Pentoformer, which was exhibited. Another component of interest on this stand was a new mains transformer designed to precede a metal-oxide rectifier.



An H.T. eliminator for A.C. mains with spaced components demonstrated by Mullard. Meters interposed in the various filter circuits indicated the amplitude of A.C. and D.C. components, while a schematic diagram attached showed the successive changes in waveform.



Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

A Television Broadcast.—New Wavelengths on Trial.

Truth and Television.

Some of the cynics will exclaim at the apparent incongruity of the above title, alleging that the two terms have not so far shown signs of harmony. The incredulous, not excluding a Savoy Hill contingent, exclaimed in the same manner when *The Wireless World* made a prophecy in these columns on November 7th last concerning the probability that a B.B.C. station would shortly be lent to the Baird Company for experiments in the early morning hours.

"Impossible!" they said, fortified by the official announcement that the tests were "off."

oooo

A New Decision.

Was it generally realised, however, that the B.B.C. decision constituted a rebuff to the Post Office? The engineers of that much-maligned institution had expressed the opinion that the Baird system was worthy of tests, and, as can easily be imagined, St. Martin's-le-Grand was not altogether pleased when its own opinion was cast aside.

With these reflections in mind, it is not so very difficult to account for a new B.B.C. decision, unannounced, to give the system a broadcast trial next month.

oooo

A Stealthy Test.

I am able to state that, unless something unforeseen occurs, a television test will take place at one of the Daventry stations early in February. The transmission will, of course, be made at a time when most other European stations are out of operation. This point is of the utmost importance, for it is common knowledge that the frequency bands required for television are sufficiently extensive to wreck all the European frequency schemes ever invented.

oooo

The New Wavelengths.

The *Plan de Bruxelles*, which takes no cognisance of such a thing as television, is proving fairly satisfactory in the conditions for which it was intended.

So far as the B.B.C. are concerned, the new wavelengths are causing no trouble beyond the fact that each station has to pay greater attention than ever to the maintenance of its exact frequency. Decidedly less interference is noticed at the majority of stations, though Newcastle, which dropped to the prodigiously low wavelength of 243.9 metres, reports "slight interference, but not more than before the change."

oooo

Will the Common Wavelength Scheme Succeed?

Only Bournemouth and two of the relays—Bradford and Edinburgh—are at present on the national common wavelength of 288.5 metres, which is ultimately to be shared by all the relays. Hull will probably follow next. On this wavelength there has already been trouble, due to "wobbling" on the part of Bournemouth. This is not a happy augury for the common wavelength arrangement, for if three stations cannot avoid jostling one another at such distances, what will happen when there are ten?

It appears that only "knife edge" tuning can make a common wavelength practicable.

oooo

Trouble on the Continent.

On the Continent conditions are less happy. A calibration trip all round the dials shows that the European stations almost without exception are making a loyal effort to adhere to the new scheme. Unfortunately, their zeal is greater than their technical attainments.

The separation of only 9 kilocycles between the frequencies allows a very small margin of safety, and although every station is provided with a Brussels standard wavemeter, a good deal of heterodyning is still going on.

oooo

Interference with 2LO.

There has been a pronounced heterodyne on 2LO during the last two weeks. Many readers must have noticed it. The offender is believed to be Graz, which is now supposed to be working on 354 metres. 2LO itself is not straying; the engineers will swear to that!

oooo

On the Black List?

A Blackburn reader tells me that there has been a scurry towards the Post Office counters in his district following the appearance of the G.P.O. anti-oscillation van. Apparently there are grounds for supposing that the van does not confine its attentions to oscillators.

oooo

High-power Broadcasting for Ireland.

Irish listeners are expecting an official announcement shortly regarding the mooted high-power broadcasting station, which is to be similar to the stations of the B.B.C. regional scheme. The proposals have been submitted by the Post Office to the Ministry of Finance, and are now awaiting the consideration of the Dail. I hear that several possible sites have been explored, technical opinion being in favour of a central position in the Queen's County or Tipperary districts, midway between Cork and Dublin.

oooo

A Vicious Circle.

Only a heart of granite could remain unaffected by the touching New Year message which the Indian Broadcasting Company prints in the *Indian Radio Times*. Unlike the B.B.C., the I.B.C. is never in possession of more capital than it knows how to spend. It has never had enough to spend, and the result is that, in the words of its directors, it "moves in a vicious circle."

The I.B.C. gets its revenue from licence fees, but the receipts from this source are lamentably small, because the public is waiting for the programmes to improve before buying sets and licences. And the company can only improve the programmes when it gets more money . . . !

oooo

Fatal Optimism.

Faced with this "unfortunate situation," the company appeals to all classes in India to buy receivers in large numbers. If the public will do this the company promises, on its part, to extend the scope of the programmes beyond the present gramophone recitals and one-man performances on the umpty-tum-tum.

Fatal optimism! As well expect the public to buy tickets for National Concerts at the Queen's Hall on the understanding that the concerts will not be so bad if sufficient tickets are taken. The man-in-the-street refuses this kind of lottery. The I.B.C. will have to learn the hard lesson that in matters of broadcasting the demand follows the supply.

LETTERS TO THE EDITOR.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

ECHOES.

Sir,—With reference to your recent article on the "Long-interval Echo on Short Waves," I would like to report an excellent echo on station PMC (ex ANC), Java, at 10.30 G.M.T. on Saturday, January 5th. This station was R8 with a 1 sec. (approximate) echo at R3-4.

To illustrate the time interval, I might add that, in the call PCG de PMC, the "de" could distinctly be heard twice at about 20 w.p.m., the effect persisted till about 11.30 G.M.T. Incidentally, one can also report very excellent L.S. reception every Wednesday of the two Bandoeng telephone stations, ANE and ANF.

One wonders that more relaying is not done on the 17-14 metre band, which seems to be excellent for daytime work for distances over a few hundred miles, though PCLL cannot be heard on 18 metres. Possibly this is too near.

King's Lynn. EDWIN J. ALWAY, Sergeant, R.A.F.

NEW YEAR RESOLUTIONS.

Sir,—I noticed sundry suggestions for New Year resolutions in your January 2nd issue, and I would like to emphasise, if you can spare the space, the very bad practice at present in vogue amongst the valve makers of publishing particulars of valves which they apparently have no intention of ever trying to put on the market. This happened with one firm in 1927 over the 6-volt screened grid valve; the same firm this year published particulars of a special super-power valve at the Show, and are only now starting to produce them. Another equally well-known firm have done the same this year over a 6-volt screened-grid valve, and can give no date of delivery, and frankly own that none has been made yet.

The valve makers are not the only ones to blame in this matter, but they are by far the worst. The others do produce the goods in the end.

If you could obtain a list of all makers' valves that can actually be bought on, say, February 1st, and publish this together with the same makers' lists as published at the Show, you would be doing a great service to the public and to the trade. GUY S. M. ASHBY.

Hermitage, Bucks.

STANDARD FREQUENCY BROADCASTS.

Sir,—In these days when purity of reproduction is, with most listeners, a matter of paramount importance, and when such great pains are taken with both receivers and loud speakers, it seems a pity that the final judgment should still be left to the listeners' ear as to the efficiency of his receiver or speaker and as to its capability of reproducing the various notes of the musical scale as transmitted.

It would seem to convey an obvious benefit amongst the searchers for natural reproduction could they be provided with a standard of comparison.

It is suggested, therefore, that a short period should be devoted some time during the evening programme to the transmission of separate notes of the scale with their accompanying names, the named notes to be more especially those at the extreme ends of the scale, as it is quite probable that many receivers would not respond at all to the extremely high and low frequencies, and listeners would not be conscious that they had missed part of the transmission without the accompanying announcement.

Further to the above scheme, it is suggested that the programme could be extended to include the transmission of a few bars of music consisting of notes from the highest and lowest ends of the scale with a chord or two from the middle by way of a comparison.

Again, various musical instruments could be played and named during the transmission as a further guide to the efficiency of the set in natural reproduction.

Although the listeners' ear is still the final judge, it would no doubt bring to his notice the deficiency of his set could a programme as outlined be transmitted as a guide.

It is further suggested that in the event of improved reception following on such experiments, listeners would use their sets more frequently as there is no comparison between listening to a medium class of set and a set capable of natural reproduction, and it is thought that many a selection is condemned mainly because the receiver is not capable of rendering the completo programme transmitted, to the detriment of quality. C. R. MASON.

Kenley, Surrey.

EMPIRE BROADCASTING.

Sir,—My mail this Christmas week consisted of, among other matter, (1) your paper, (2) *Daily Mail* Year Book, a letter from a friend, and (4) *World Radio*. I wish to deal with these in turn:

(1) Your paper has alone fought the case of Empire broadcasting, and good luck to you.

(2) Page 249, "Year Book," contains an article, and in the second paragraph and in bold type is the following: "5SW is a very great Empire propaganda station and . . . that the Dominions should contribute something to the upkeep of 5SW. . . ."

(3) The letter contained the news that 5SW had changed its wavelength to 25.53.

(4) As I have not been getting 5SW for some time, I thought this had happened, and the change is noted for the first time in *World Radio*. However, I note that this famous Empire station has still a holiday on Saturdays and Sundays.

Now let us have a few home truths. First, we Colonials visit the Homeland in thousands yearly. We buy sets and licences and use them for a few months, and on return to "our respective spheres of influence" we pay a fee also for our own broadcasts, plus customs, etc. While at home I paid nothing to Hilversum or Radio Paris, and I am ashamed to say PCJ has asked me for nothing towards the upkeep of their station though I am a regular listener-in and have been long before 5SW was thought of. The sentiment expressed in the extract I note smacks of "shopkeepers," as Napoleon called us more than a century ago. Secondly, where is this propaganda, when a Marconigram weeks ago would have put us right as to change of wavelength? What do we know of Christmas programmes? Being in the wilds I go to church either to Calcutta or Bombay, sometimes Sydney, and more often Nairobi, but never do I hear St. Martin's or any other London service. I hear 2XAD experimenting with 5SW, but not *vice versa*. If I were sure of 5SW at 11.30 p.m. and after (Indian standard time) I might spend some nights at the game, but why should the engineers of 5SW have a rest after the 1.30 hour (G.M.T.)? Last evening (Christmas) I tried all I knew to get the lunch-hour music, but nothing doing. I honestly believe that the veriest "fan" in England would object to any broadcast confined to midnight hours of the week, for be it understood that on the days when we could revel in this way they down valves and turn off the juice—at 5SW.

PCJ always lets us know in the Press, days before, any change in programme hours, and I may remark that on their broadcasting days my loud speaker at full strength with fading only after 8 a.m. gives me a perfect gramophone concert. PCJ does not pretend to do anything else. We are glad to send them reports. The League of Nations has selected Holland for world-wide broadcast. England wants an Æther Blake at the microphone of 5SW, so Mr. Editor, please find one before any more talk takes place and before the whole of the 0.1 per cent. of the B.B.C. revenue for next year is frittered away on this Empire monopoly.

Roorkee, India. RADIOX.

READERS' PROBLEMS ANSWERED

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves.

A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

"The Wireless World" Supplies a Free Service of Technical Information.

Gramophone Amplifier.

Will you refer me to a published description of a gramophone amplifier capable of giving reasonable volume with high quality? M. W. T.

A three-valve amplifier with low-gain stages designed to load up an ordinary super-power output valve was described with full details in *The Wireless World* for March 14th, 1928. This instrument would appear to be quite suitable for your purpose.

o o o o

A Combination Set.

I propose to use the coils and switching arrangement as described for the "Europa III" in the "Megavox," in order to receive medium and long wavelengths without changing coils. Is this possible? J. D. M. S.

Yes, the plan you propose is quite practicable, but you will probably find it convenient to omit the alternative rectification switch, and to make the detector operate on the grid circuit principle only.

o o o o

A Testing Unit.

I believe it is possible to make up a simple and inexpensive unit whereby a receiver may be tested for defective connections, etc., a flash lamp or pair of phones being used as an indicating instrument. If so, will you please give me a circuit diagram of a suitable arrangement? H. G. C.

Various simple devices of this sort have been described from time to time in this journal. We think you will find the arrangement given in Fig. 1 to be most useful; properly handled, it is capable of revealing the great majority of faults.

As a rule, the flash lamp will be used to test circuits and components which have (or should have) a low D.C. resistance: to apply this test, the TEL. terminals must be short-circuited, and test leads applied across the points between which continuity is doubtful. If the lamp glows at full brilliancy it can generally be taken that everything is in order. Occasionally it is necessary to test through the windings of a tuning coil which, if it has a large number of turns, may have a resistance of several ohms. In this case the lamp may glow less brightly, although there is no broken connection.

For testing high-resistance circuits, such as the windings of L.F. transformers, anode resistances, potentiometers, etc., the short-circuiting connection between the phone terminals must be removed, and a pair of phones connected in its place. The course of procedure is now similar,

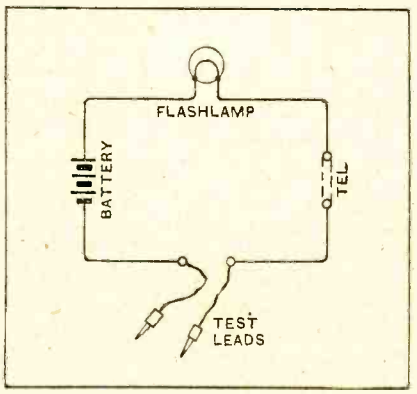


Fig. 1.—An invaluable aid in tracing faults: a simple testing unit.

except that continuity will be indicated by a click—of an intensity depending on the resistance of the external circuit—in the telephones. The click will only be produced when the circuit is "made" or broken, but an intermittent disconnection is often revealed by a scratching sound.

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Three H.F. Stages.

Is there any real reason why I could not add a third H.F. stage to the "Kilo-Mag Four" receiver, the idea being to use a small frame aerial? M. V. J.

A three-stage H.F. amplifier with screened grid valves is not impossible, but there are considerable obstacles in the way of its satisfactory realisation. For instance, all circuits should be completely decoupled and screened, and in particular you should pay careful attention to the separation of H.F. and L.F. components in the anode circuit of the detector valve. Also it would perhaps be best to satisfy yourself with an amplification per stage somewhat less than that of the receiver to which you refer.

o o o o

An Economy Measure.

Why is it that it is always recommended that valve filaments should be connected in series when they are to be fed from a D.C. mains supply? Surely it would be much simpler to retain the ordinary parallel connection; if this were done, a conventional receiver could be connected to the mains with no internal alteration. E. S. S.

The point here is that it is much more economical to adopt the series connection, because there is always a large surplus voltage to be absorbed in an external resistance. Assuming that all the valve filaments consume the same current, it costs no more to supply a five-valve set than one with a single valve, provided the filaments are joined in series. With the parallel method of connection, the five-valve set would consume five times as much current as the other.

o o o o

Variable Condensers.

For the set which I am about to construct, the designer specifies logarithmic condensers. Now I have on hand one of these, and another with square law vanes. Is there any serious objection to using them? S. M.

If both condensers are to be used for tuning purposes, the only disadvantage will be that it will be impossible to arrange matters so that the dials are more or less "in step" over the tuning scale This is not a very serious disadvantage.

Eliminator Output Voltage.

Will it be safe to connect the "power" terminal of my D.C. eliminator to a pentode valve, for which a maximum voltage of 150 is specified? I hesitate to try this, because I believe that in some eliminators the "power" terminal delivers the same voltage as that of the mains—in my case 240 volts. V. T. L.

Without any data concerning the arrangement of your eliminator, we fear it is quite impossible to help you. It is usual to include some means of reducing the mains voltage, but, to be on the safe side, we think you would be well advised to get in touch with the makers of your eliminator.

o o o o

An R.C. Coupler.

When a commercial resistance-capacity coupling unit is used, is it possible to insert an H.F. stopping resistance in the grid circuit of the first L.F. valve without taking the unit to pieces? I ask this because it seems to me that there is a good deal of H.F. energy in my L.F. amplifier; when the loud speaker terminals are touched the set goes into oscillation. Accordingly, I should like to do something to make the apparatus more stable. F. W. K.

It is quite unnecessary to make any internal alterations to your unit, provided it is of the conventional type. All you have to do is to connect the present terminal marked "grid" to one side of the stopping resistance, and to join the other side to the grid terminal of the valve-holder.

o o o o

Choke Coupling.

I have an L.F. choke rated at 30 henrys, and would like to use it for coupling an anode bend detector to the first L.F. stage. Do you think it will be suitable? The valve has an impedance of 60,000 ohms. M. H. L.

Generally speaking, we think that the choke has an insufficient inductance for your purpose. It is assumed that you refer to the rated impedance of the valve under amplifying conditions; 60,000 ohms is distinctly high, and it must not be forgotten that this figure will be increased when the valve is biased for detection.

o o o o

No Grid Bias.

My "New All-Wave Four," after working satisfactorily for a considerable time, has developed a fault; quality has become very bad, and I notice that the plate current consumed by the last valve has risen to almost double its previous value. P. M. R.

We think it almost certain that the fault will be found in the grid circuit of the output valve, as it appears that this valve is not getting the necessary negative bias; consequently its anode current has increased. You should accordingly make careful tests of this circuit, paying attention to the transformer secondary and the grid bias battery, which, of course, may itself be at fault.

Loud Speaker Polarity.

In wiring a receiver in which the loud speaker is connected directly to the anode of the last valve, how should the terminals be connected? A. W. S.

One of the loud speaker terminals will be joined directly to the plate of the valve; this will be the negative, while the positive terminal will be connected to the positive side of the H.T. battery.

o o o o

H.F. Stage for a Portable.

Will you please give me a circuit diagram of a screened grid H.F. amplifier suitable for inclusion in a self-contained receiver with a frame aerial? I intend to follow the amplifier by a grid circuit detector with reaction, and should like to use transformer coupling. To avoid complications, I propose to restrict myself to the medium broadcast waveband. E. W. T.

The circuit diagram of a suitable arrangement is given in Fig. 2. It will be necessary to screen the H.F. stage,

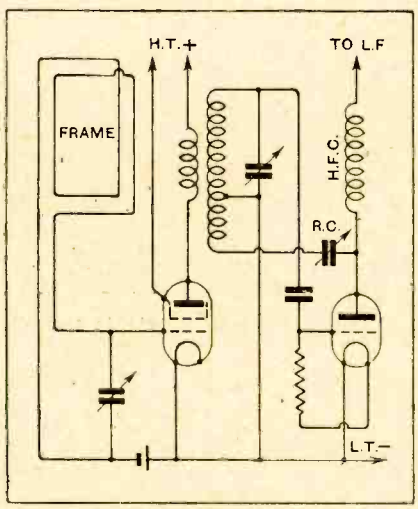


Fig. 2.—Screened grid H.F. stage with frame aerial

and if you are aiming at high amplification, you will probably find it easier to attain complete stability if you include the decoupling devices which have been described from time to time.

o o o o

Choice of H.F. Valve.

Will you please tell me if the H.L.610 valve, reviewed in your issue of January 2nd, will be suitable as an H.F. amplifier in the "New All-Wave Four," or would it be better to choose a valve with lower impedance? B. H. C.

This valve should be entirely suitable, and in your geographical situation (close to a broadcasting station) we would certainly not recommend a valve of lower impedance, as this would tend to reduce selectivity. In any case, the impedance of the valve in question approximates closely to the value usually recommended.

Long-wave "Everyman Four."

Have you published instructions for modifying the original "Everyman Four" to include H.F. amplification of the long wavelengths as well as on the medium band? R. A. L.

No specific instructions on this matter have been published, but where it is desired to modify the set it is recommended that the general arrangement and layout of the "Standard Four" (*The Wireless World*, November 30th and December 7th, 1927) should be followed.

o o o o

An Unstable "A.C.3."

My A.C.3 receiver, built from the description published in your issue of September 5th, 1928, cannot be neutralised properly over more than half the tuning scale. Can you suggest what is wrong? I have used a cabinet of slightly different dimensions from that specified, but the departure from the original layout is not considerable, although it has been necessary to move the aerial-grid coil and the H.F. transformer. There is no alteration in the circuit arrangement. R. P. H.

In a receiver of this description, in which coils of low H.F. resistance are used, it is important that the relative position of the inductances should be suitably chosen, and you must align them as in the original set. Other readers have reported failure when the design has been modified in a similar way.

o o o o

L.F. Reaction.

When I increase H.T. voltage beyond about 36 volts, a low howling sound is emitted from my loud speaker; naturally, with a smaller applied voltage, quality and volume are poor. From this information, can you tell me what is wrong? H. S. W.

We expect that your battery has a high internal resistance, and that L.F. reaction is taking place. Short of replacing the battery, you might try the effect of reversing the primary connections of one of the L.F. transformers (if these are used), or, alternatively, you could instal the anode feed resistance scheme.

It is just possible that some of your trouble may be due to microphonic action, and you should try the experiment of placing the loud speaker at a distance from the receiver.

o o o o

The Most Suitable Milliammeter.

Will you give me a word of advice as to the best type of milliammeter to purchase? The main use to which it is to be put is for measuring the current passed by the output valve, and for detecting distortion, but I should like to obtain an instrument with as wide a range of usefulness as possible. E. B. R.

Unless you are using an output valve of exceptionally low impedance, with an abnormally high anode voltage, we consider that a meter reading up to 30 milliamps is likely to be most generally useful. A two-range instrument is also to be recommended.

The Wireless World AND RADIO REVIEW

(16th Year of Publication)

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CONTENTS OF THIS ISSUE.

AERIALS FOR BROADCASTING STATIONS.

THE record of the development of aerial systems for transmitting stations provides quite an interesting little history of its own, and dates, of course, from the earliest attempts at wireless communication. Since most of us are now concerned with broadcast reception when it is unnecessary, for ordinary purposes, to pay very particular attention to the aerial system, we are apt perhaps to look upon the aerial as the least interesting part of wireless equipment, and to forget that its design, in the case of transmitting stations, at any rate, may be of the utmost importance.

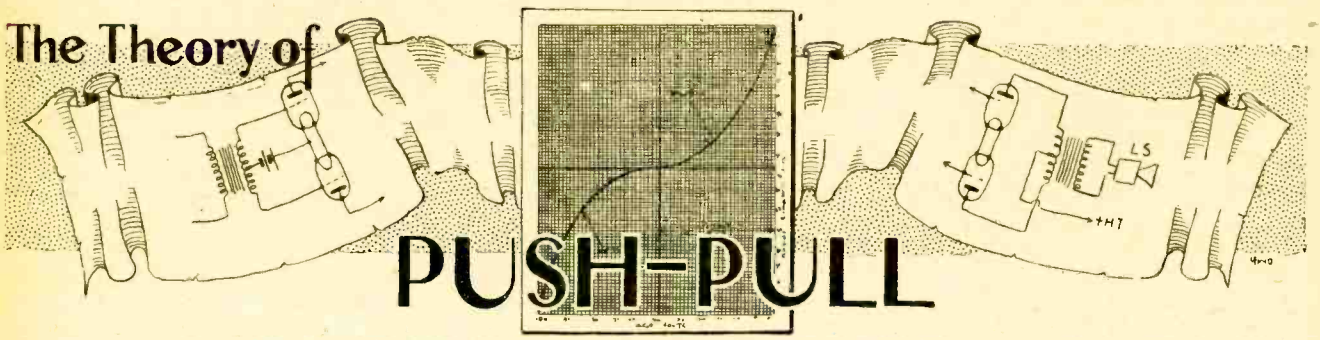
In the early days of transmission, before telephony or broadcasting were even contemplated, the aim in view in the design of all aerials for transmitting stations was undoubtedly to obtain the greatest possible range. With aerials of simple type some attention was later paid to their shape and dimensions, with the object of endeavouring to conserve the energy so that it was principally radiated in one direction.

Short wavelengths were found to be particularly amenable to discipline, in that they could be directed almost in the form of a beam, and this property has been utilised in the development of the beam short-wave transmitters, with special aerials designed to concentrate the energy transmitted in one direction. So far, we believe, little attempt has been made to adopt the same, or similar methods, in the case of the longer wavelengths; it would seem that there is scope for experimental work in this direction, though the cumbersome nature of the aerial system which would be required might bring us to the conclusion that it was not worth while in practice.

Now, with the development of broadcasting, a very different problem is involved. The last thing that is required of a broadcasting aerial is that it should have any directional properties; on the contrary, it is desirable that it should radiate in all directions with approximately equal intensity. It is easy to see that a broadcasting station on this account alone, and leaving out of consideration altogether the question of the wide frequency band required for broadcasting purposes, is more liable to cause interference with neighbouring stations than transmitters of other types. In wireless transmission we may describe the radiation from the transmitting aerial as divided into two components, the horizontal or ground radiation and the vertical radiation. It has been found that the range of a station is improved in proportion as the intensity of the vertical radiation is increased, but that if the design of the aerial can be such as to limit the vertical radiation and confine the radiated energy to the horizontal component as far as possible, then the intensity of the field around the transmitter is increased, but the range is limited.

It is considered by some authorities that this latter arrangement would be ideal for broadcast transmitters, and a paper recently read before the Institution of Electrical Engineers by Messrs. P. P. and T. L. Eckersley and H. L. Kirke discusses the problem of the design of broadcasting aerials where the endeavour is to realise this objective.

There are, of course, many arguments which can be advanced in support of such a proposition, but, on the other hand, to so limit the range of a transmitter that there is little choice given to the listener beyond his own local station, is a disadvantage which many of our readers might consider would offset the admitted gain in other directions. It would seem that some alternative solution to ether congestion could be found which would not deprive us of the opportunity of listening to the programmes of our neighbours, and we shall hope to refer to this matter again in the near future.



Consideration of Loud Speaker Windings for Optimum Performance.

By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

IN the first article [1] on the above subject it was shown that there were two salient methods of using push-pull amplification so far as grid bias was concerned. One method was to bias the valves to the middle of the curved portions; the other, to bias to the middle of the straight portions of their characteristics. Both methods have limitations where the valve characteristics are appreciably *different*, but less latitude can, in general, be allowed where the bias is fixed on the curved portion. For example, assume we have two valves whose linear portions are of different slopes (inclination to the horizontal axis). Then each extremity of the complete push-pull characteristic will have the same slopes as the respective valve characteristic. But, since the slopes are different, the combined characteristic will not be a single straight line. Thus distortion will ensue.

In using the latter method of biasing, it is desirable to obtain the valve curves and determine the proper value of grid bias for a particular pair of valves. It

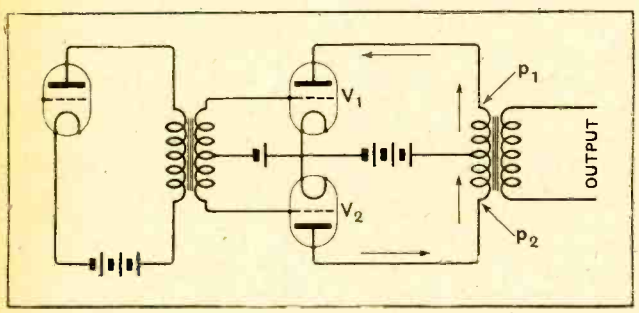


Fig. 1.—A simple push-pull arrangement. Observe that the currents are flowing in V_1 and V_2 in opposite directions. The magnetic effects, however, are clearly additive, i.e., V_1 pulls and V_2 pushes.

may easily happen that where an experimenter buys a couple of valves at random, this mode of push-pull working will be out of the question. Moreover, it is possible to work the valves biased to the approximate mid-points of the linear portions of their characteristics. This is the safer procedure when the valve characteristics are unknown. Even here it is better to pair the valves by ascertaining their characteristics.

In this article I propose to treat the mid-point method of biasing only. Before embarking upon the main theme of the article it will be well to get a clear conception of the physical differences between the two methods of biasing. The original push-pull idea embodied two valves, back to back, each dealing with *one-half* of the incoming wave. The valves are stated in patent specification 275/15 to operate unidirectionally. Moreover, to simulate this condition, the grid bias must be fixed substantially near the rectification point. This immediately determines that the middle of the *curved* portion is the proper place. Of course, there is a certain amount of action of the valve V_1 of Fig. 1 in a negative direction, this being indicated by the shaded portion in Fig. 2, but it is substantially negligible. In a practical sense, therefore, V_1 deals with the positive half of the wave, and V_2 with the negative half. Each valve performs only one operation, i.e., metaphorically speaking it either *pushes* or it *pulls*, but it *does not push and pull*. In other words, V_1 is active, whilst V_2 is dormant and vice versa.

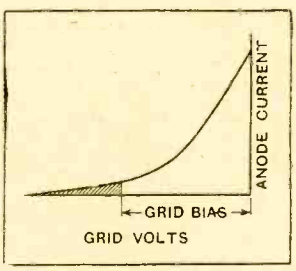


Fig. 2.—Shaded portion shows field of activity of V_1 of Fig. 1 when V_2 is in operation. Valves are biased to mid-points of curved portions of characteristics.

Biasing to Mid-point of Straight Portion.

Now when we bias to *the middle of the straight portions* of the valve characteristics, the physical action is quite different. Under this condition both valves, V_1, V_2, of Fig. 1, deal with the positive and the negative halves of the wave. The wave under consideration is viewed from the anode side of the valve preceding the power stage. It so happens that, with respect to the negative pole of the filament, the grid of V_1 is *relatively*

[1] June 13th, 1928.

[The present article was prepared some months before those on the pentode by the same author, which appeared in July, 1928. Publication has been held back to allow for other articles of immediate interest by Dr. McLachlan.—ED.]

The Theory of Push-Pull.

positive, whilst that of V_2 is negative, but that is merely due to the transformer secondary being split and *virtually* converting the positive half of the wave into two parts equal numerically. In a system where the valves are placed back to back throughout, as shown in Fig. 3, each valve in the amplifier deals with both halves of the wave. Whether the scheme of Fig. 1 or of Fig. 3 is employed, the voltage applied to the grid of V_1 is always 180° out of phase (anti-phase) with that applied to V_1. Similarly, the voltage changes at the anodes of the two valves are 180° out of phase. Since *each* of the valves V_1, V_2, of Fig. 1, deals with *both halves* of the wave, we immediately ask, "Is this push-pull amplification?" If we interpret push-pull as explained above, where each valve performs on alternate half waves only, then biasing to the middle points of the linear characteristics must be regarded as a different thing. In the latter arrangement we have virtually two amplifying systems in parallel, but 180° out of phase. Moreover, it would not be inappropriate to describe this method of amplification as the "parallel anti-phase," abbreviated p-a-p, as against the other method of p-p.

Matching of Power Valve and Loud Speaker.

To get a proper perspective of the problem of load impedance associated with the power valve, it is well to begin with the usual simple circuit shown in Fig. 4 (*a*). The loud speaker is arranged so that the anode feed current does not pass through its winding, and the usual associated filter circuit is connected to reduce the A.C. through the H.T. supply to a very small amount, thereby eliminating feed-back effects. Now we know that for maximum output the impedance of the loud speaker must bear a certain relationship to that of the power valve. Since the impedance of a loud speaker varies with the frequency of the current

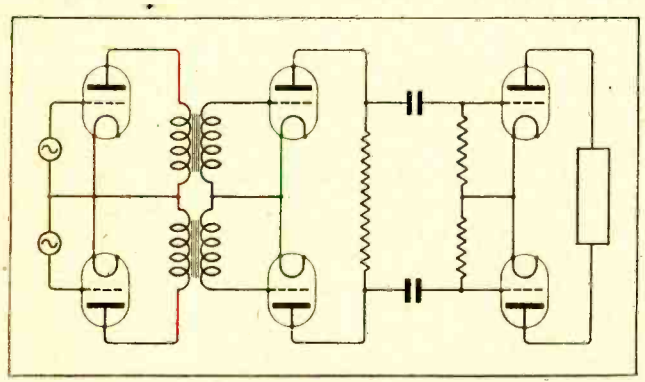


Fig. 3.—Diagram of amplifier in which each stage is arranged with valves back to back and biased to the mid-points of their linear characteristics.

in its winding, how is the desired relationship to be computed? The matching of loud speaker and valve cannot be effective at more than one frequency, so we have the unsatisfactory answer that it can't be done. Having got into this difficulty, we must find some loophole of escape. We cannot solve our "quantity" or optimum intensity problem; let us look, therefore, at the other attribute to the problem, namely, quality. Here again the strictly scientific aspect of the subject imposes peculiarities at various frequencies which baffle us in obtaining a straightforward solution. If, however, we agree to work with a certain degree of current variation over part of the frequency range, the problem at once becomes soluble. I have found in practice that, so far as moving-coil loud speakers are concerned, this is a reliable mode of attacking the problem. Referring to Fig. 4 (*a*), it is clear that, so far as alternating current

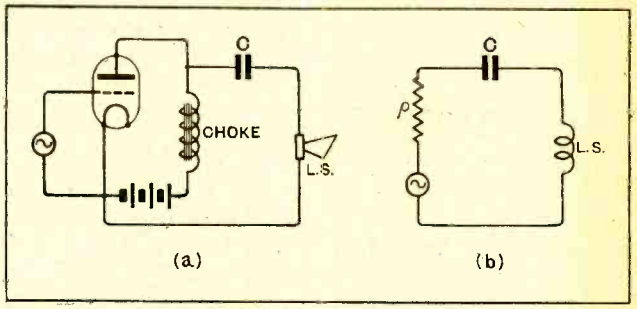


Fig. 4.—A simple power valve circuit with loud speaker is shown in (a). The choke and the condenser cause the A.C. to pass through the loud speaker, but to avoid the battery. In (b) the equivalent circuit of Fig. 1 is shown as a first approximation.

is concerned, the power valve circuit can be represented by Fig. 4 (*b*). Since in a moving-coil loud speaker (or any other loud speaker in varying degree) the moving armature or coil generates a back E.M.F. due to its motion in the magnetic field, the diagram of Fig. 4 (*b*) requires modification to take this into account. In *The Wireless World*, March 30th, 1927, I gave the equivalent circuit of a coil-drive speaker, for high- and for low-resistance coils, the latter being associated with a transformer. It was shown that at any particular frequency the coil—apart from its usual static A.C. inductance and resistance—in motion was equivalent to a *condenser* in series with a resistance. The resistance is such that resistance × (current)^2 = power radiated as sound. The circuit for a high-resistance coil without output transformer is shown in Fig. 5 (*a*). So far as the resistance (termed the radiation resistance) is concerned, its magnitude is too small to affect the value of the current in the coil to any extent that is appreciable.

There are three audio-frequency ranges to be considered: (1) low, (2) medium, (3) high. At low frequencies the coil impedance [2] is due mainly to its motion in the magnetic field. It is then equivalent to a condenser whose value in microfarads is

$$C_m = \frac{\text{Effective mass of diaphragm and coil} \times 10^{15}}{[\text{Length of wire on coil} \times \text{strength of magnetic field}]^2} = \frac{m}{C^2} \times 10^{15}$$

In a typical case at low frequencies,

$m = 25$ grams (this includes accession to inertia due to air moved [3]),

[2] Assuming the resonance due to the diaphragm support to be below audibility.

[3] See *The Wireless World*, March 30th, 1927, or "Loud Speakers," by this author.

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$C = \pi dn H$, where d = dia. of moving coil in cm.
n = turns on moving coil.
H = strength of field.[4]

$= \pi \times 5 \times 10^3 \times 7 \times 10^3$
$= 3.5\pi \times 10^7$
Thus $C^2 = 1.25 \times 10^{16}$
Hence the equivalent capacity in microfarads is

$$C_m = \frac{25 \times 10^{15}}{1.25 \times 10^{16}} = 2.0 \text{ mfd.}$$

At 32 cycles the impedance of this condenser is

$$\frac{1}{2\pi f C_m} = \frac{10^6}{2\pi \times 32 \times 2} \doteq 2{,}500 \text{ ohms.}$$

In case (2) for middle frequencies neither the condenser nor the inductance of the coil offers serious impedance. In fact, one counteracts the other, and there is an electromechanical resonance frequency at which the current is found from the formula $I = V/R_1$. Here R_1 in Fig. 5 (*b*) is the A.C. resistance of the coil *plus* the internal resistance of the power valve. For the 1,000-turn coil assumed above, the A.C. resistance at 500 cycles would be about 1,000 ohms.

The Concertina Effect.

For the high-frequency register (case 3) we have to consider mainly the reactive impedance. The inductance of the coil at 4,000 cycles is about 0.1 henry, and the corresponding reactance is 2,500 ohms. Thus we have at each end of the acoustic register 32 to 4,000 cycles, a coil reactance of 2,500 ohms in addition to

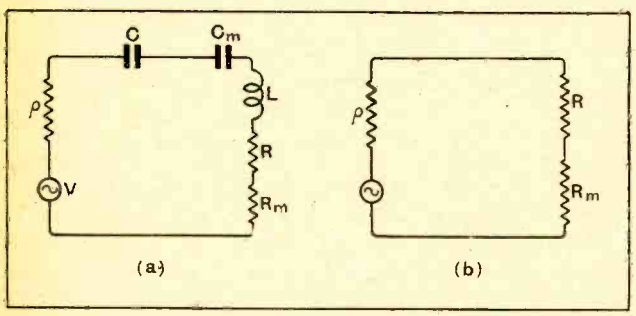

Fig. 5.—The true equivalent circuit of Fig 1 is shown in (a). P is the A.C. valve resistance; C, the by-pass condenser; L, the inductance of moving coil (at rest); R, the A.C. resistance of the moving coil; R_m, the radiation resistance due to sound energy emitted; C_m, the motional capacity due to motion of coil in magnetic field, and V the voltage of the fictitious alternator. Diagram (b) is the equivalent circuit of Fig. 3 at resonance when the inductive and compacitive impedances are equal.

the A.C. resistance. For constant current over this frequency range, the impedance of the power valve *circuit* of Fig. 4 (*a*) must be constant. This means that the internal resistance of the power valve should be large enough to swamp the reactance of 2,500 ohms.

[4] In the loud speaker design (see *The Wireless World*, April 13th, 1927) a rather large allowance was made in the magnet winding to prevent overheating. A stronger magnetic field can be obtained if a pot wound for 160 to 180 volts is used on 200 volts, or one for 200 volts is used on 240 volts. The pot will get warm, but a dull black coating will help heat dissipation. The increased output is an advantage of this arrangement, which in the hands of a competent amateur is quite safe.

With a triode [5] this would result in a somewhat puny output from the loud speaker, owing to the small current change. It is possible, of course, to reduce the loud-speaker reactance by decreasing the number of turns, but here again the output suffers. Moreover, some compromise must be made, and, judging from results, the power valve resistance can be taken as about 3,000 ohms.

Although the current at the upper audio frequencies decreases appreciably due to inductive reactance and enhanced resistance, the output is not *correspondingly*

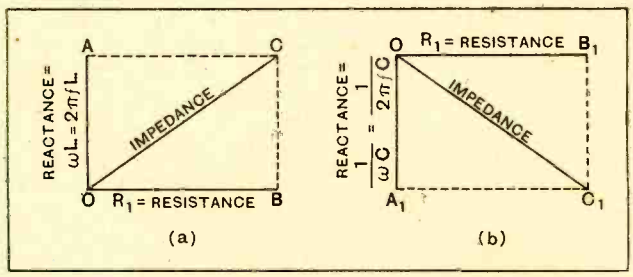

Fig. 6.—Vector diagrams giving method of obtaining impedance of loud speaker circuit. (a) is for frequencies above resonance, (b) for frequencies below resonance.

diminished. This effect is due to a high-frequency resonance associated with the junction of cone and coil. The "neck" or connection between the two acts like a spring, so that there is a "concertina effect."[6] Furthermore, this is accentuated if the cone is made of stiff paper. When using a pentode the current will be relatively greater at the extremities of the acoustic register than with a triode. Moreover, when used with a cone having prominent "neck" and "surround" resonances in the audio-frequency register, the results are likely to be disconcerting. Judging from accounts, I fear that a few experimenters have been hit by this misfortune.

Optimum Results from Two Valves in Push-pull.

The combined impedance of loud speaker and power valve is obtained from the vector diagrams of Fig. 6. The reactive component in each case is drawn at 90° to the resistive component, since the respective voltages are in quadrature (phase displacement of 90 electrical degrees). The numerical value of OC_1 is 4,700 ohms and of OC 5,700 ohms. In the latter case the resistive component is increased, due to the eddy current and hysteresis loss in the iron of the electromagnet. The D.C. resistance of the *coil* is about 930 ohms, but its A.C. resistance at 4,000 cycles is 2,200 ohms. Thus the influence of the extra resistance due to iron loss is to augment the total circuit impedance at 4,000 cycles, so that the current falls away as the frequency rises. An actual current-frequency curve for equal voltages on the grid of the power valve is shown in Fig. 7.

The net result of the preceding investigation is that we have jockeyed ourselves on certain grounds, to the

[5] See *The Wireless World*, July 11th, 18th, 25th, 1928, also later in the present article.
[6] See *The Wireless World*, October 17th, 1928.

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position of a moving coil having 1,000 turns of wire on a former 2in. in diameter (5 cm.), this being operated by a power valve whose internal resistance should—for good quality—not be less than 3,000 ohms.

The next step is to extend the above analysis from the single stage power valve to the push-pull arrangement. The governing condition is that we shall on all occasions have a circuit which gives acoustic quality equivalent to a 2in. coil of 1,000 turns operated by a power valve of 3,000 ohms internal resistance. The arrangement to be treated is that where the power valves are *biased to the mid-points* of the straight portions of their characteristics. A circuit arrangement is shown in Fig. 8(a) suitable for a high-resistance coil. Both valves are always operative and conductive. If the voltage change at the anode of V_1 at any instant is $+v_1$, that on V_2 is $-v_1$, hence the total A.C. voltage round the circuit is $2v$. The A.C. impedance of the circuit is the vector sum of the coil impedance and twice the A.C. valve resistance. The equivalent arrangement of the circuit is shown in Fig. 8(b). Here we have a generator of voltage $2v$ in series with the internal resistance, etc., of both valves and the coil. Taking approximate figures, for equal grid volts,[7] the value of the current in Fig. 8(b) is equal to that of the simple circuit of Fig. 4(a) (neglecting coil impedance). Thus with *the same coil* in both cases the output from the push-pull circuit is little better than that of the ordinary circuit. But since the valve resistance is doubled, the coil impedance is relatively smaller, so that

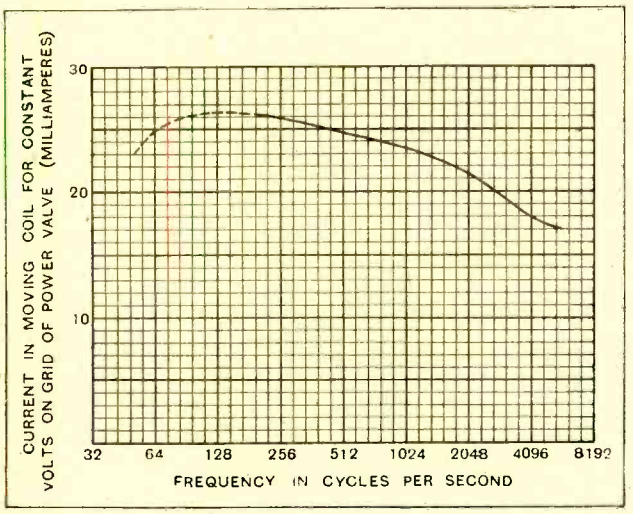

Fig. 7.—Diagram showing variation in coil current of loud speaker with frequency. The current falls away as the frequency rises due to the inductance of the winding. One LS5A valve was used.

the current is reduced less at high and at low frequencies. Moreover, the quality is better, although in practice it might not appear to be altered appreciably.

Obviously, to get our standard condition of coil and valve (1,000 turns and 3,000 ohms), we must add a valve in parallel on each side. This will give a voltage $2v$, and a valve resistance of 3,000 ohms, the coil being as before. But since the voltage has been doubled and the impedance of the valve circuit unaltered, the power output is *quadrupled* (four times).

Now the reader will say: Yes. That is all very well, but I cannot afford to use four power valves. With this I entirely agree, so we must endeavour to ascertain whether two valves back to back can be used to better advantage. The total valve resistance is 6,000 ohms,

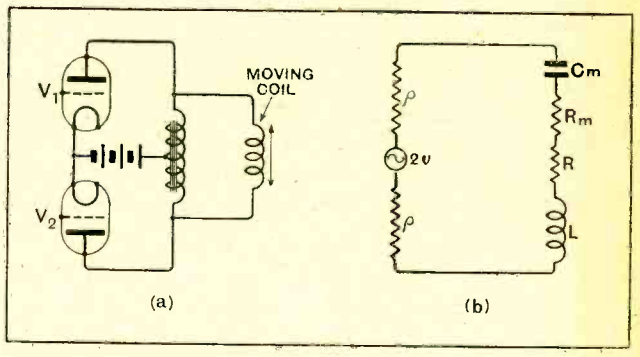

Fig. 8.—Simple push-pull circuit (a) with two power valves and a centre-tapped output choke. In (b) the equivalent circuit of 5(b) is given. See Fig. 3 for meaning of symbols. 2v is the voltage of the fictitious alternator which represents the next change in anode voltage of V_1, V_2 of Fig. 5 (b).

so that we can raise the coil impedance to match. The coil impedance depends upon the square of the number of turns, *i.e.*, if the inductance of 1,000 turns at 4,000 cycles is 0.1 henry, that of 2,000 turns is 0.4 henry. Since we have doubled the valve resistance, we must *double* the coil impedance to secure the constant quality and conform to our above condition. Clearly the coil turns must be multiplied by $\sqrt{2}=1.414$. Thus our coil will have approximately 1,400 turns. For a given current[8] the power output is proportional to the square of the turns on the coil. Moreover, by using a coil of 1,400 turns in the push-pull circuit, the acoustic power output is doubled. In practice the augmented acoustic energy would not appear aurally to be considerable, but it would be comfortably noticeable on loud intensities. This is due to the fact that the aural appreciation of acoustic intensities follows substantially a logarithmic law.

Moreover, to make any real difference, the output should be quadrupled. This can be done as shown above, with four power valves; alternatively, it can be accomplished with two valves by increasing the H.T. and grid bias $\sqrt{2}$ times. The reader should test this aspect of acoustic appreciation for himself. There are various ways of doing it. One is to tap down the grid leak a known amount and then by a switch go back quickly to the original setting. Another method is to insert a resistance of any convenient value in series with the loud speaker and short circuit it (the resistance). If the resistance is equal to that of coil plus power valve, the power output can be approximately reduced to one

[7] To secure this the swing on V_1 and on V_2 must equal that on the valve in Fig. 4.

[8] The current is the same as for the simple circuit, since both volts and impedance are doubled.

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quarter (the output is proportional to the square of the coil current) as depicted in Fig. 9.

The preceding argument is based upon the assumption that the power valves are triodes. Since the article was written the pentode has popped up. The theory, however, is by no means invalid, but merely requires extension. As I showed in a recent contribution[9] the impedance (assuming no surround resonance) of a 1,000-turn coil 2 inches diameter is negligible compared with the internal resistance of a pentode (at any rate, the pentode as manufactured now). Push-pull can be conducted equally well with pentodes associated with such coils. The coil current will be practically constant over the working band of audio frequencies, and will probably give rather powerful upper and lower registers, as explained above.

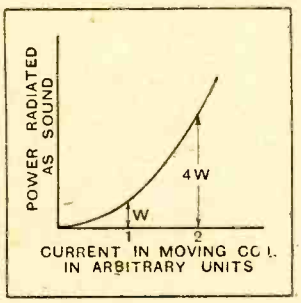

Fig. 9.—Curve showing how the acoustic power radiated by a loud speaker increases more rapidly than the current in the moving coil.

[9] *The Wireless World*, July 11th, 18th, 25th, 1928.

Let us assume the pentode to have an internal resistance of 30,000 ohms[10], then the quality will be identical with the former case if the number of turns is increased to $1{,}000 \times \sqrt{\frac{30{,}000}{3{,}000}} = 3{,}100$, say, 3,000. The desired number of turns can be accommodated if 48 enamelled wire is used. For reasons given previously[11] the number of turns has been limited to 2,500. Compared with a 3,000-ohm triode LS5A and 1,000-turn coil, the power output from the pentode with a 2,500-turn coil *for equal grid swings*, will be about 60 times as great. We must avoid confusion here regarding the maximum possible output. By increasing the grid swing on either pentode or triode the output can be augmented. But there is a limit in both cases, beyond which either grid current ensues or the valves are operated on the non-linear parts of their characteristics.[12] (*To be concluded.*)

[10] If the internal resistance of the pentode were 60,000 to 80,000 ohms, the argument is destroyed. In practice my experience shows that these higher resistance values may be expected. In the preceding analysis, where the ratio $\left[\frac{\text{coil impedance}}{\text{valve resistance}}\right]$ has been preserved constant, no allowance has been made for feed back (input impedance).

[11] *The Wireless World*, July 11th, 18th, 25th; October 31st, 1928.

[12] *The Wireless World*, October 31st, 1928.

More Peace on Higher Wavelengths.

Now that the Washington regulations have come into force considerable interference is being experienced by amateurs working on the 7,500 kc. (40 metres) band. It has been found that of the three amateur short-wave bands, 30,000 kc. (10 metres), 14,284 kc. (21 metres), and 7,143 kc. (42 metres), the latter is the most reliable channel for long-distance working. The natural result is that considerable interference is caused, especially at night, by the united efforts of the world's amateurs to occupy a small frequency range.

We would suggest, however, that more attention be devoted to the 1,970 to 1,740 kc. (152.2 to 172.2 metres) band. Long-distance C.W. communication is easily effected on this band, and while the range of a transmitter is somewhat limited when working on the longer amateur band, this disadvantage is balanced by the comparative freedom from fading and interference.

o o o o

The New Telegraphic Abbreviations.

Some confusion still exists with regard to the new radio telegraphic abbreviations. A number of stations are observing the original meanings of the "Q" code, with the consequence that when they are in communication with stations using the new code a rather unhappy state of affairs is occasionally brought about.

The modified "Q" code should, of course, be used without exception.

The revised signal strength scale is deserving of a little more attention. The abbreviation QSA must precede the signal strength number (1 to 5). By the old method a station being received very powerfully would be given a strength of R8 or R9. The modern equivalent of this is QSA5, while a strength of R3 is now termed QSA2, or thereabouts.

TRANSMITTERS' NOTES.

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Skip Distance Effects.

Mr. John H. Hopkins (G2ASA), of Kildare, Winscombe, Somerset, wishes to arrange tests with other amateurs, preferably in connection with skip effects and cloud absorption.

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German Amateur Seeks Tests.

Tests with British amateurs using 'phone or C.W. on the 42-metre band are being sought by Radio D(ek)-4SM, an experimenter in the Saarbrücken district. He is using low power, but hopes that someone in England has heard him. Reports should be addressed c/o DFTV, Blumenthralstrasse 19, Berlin W57, or c/o BRS90, 34, West Street, Stalybridge.

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Call Signs of the World.

Readers who have experienced difficulty in obtaining copies of the Radio Amateur Call Book, published in New York, will be glad to learn that copies can now be obtained direct from the English representative, Mr. F. T. Carter, Flat A, Gleneagle Mansions, Streatham, London, S.W. The price per copy is 4s. 6d. The Call Book is a quarterly publication, not semi-annual as stated in our issue of January 2nd. The next issue will appear in March.

We understand that negotiations are in progress for the compilation of a joint international call book by the present American publishers and the Radio Society of Great Britain.

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The New Intermediates.

The new nationality prefixes are being conscientiously adopted by the majority of transmitters. The prefixes of the principal countries are as follows:—

America W, Austria UO, Belgium ON, France F, Germany D, Great Britain G, Finland OH, Denmark OZ, Spain EE—EAR, Sweden SM, Switzerland HB, Portugal CT, Poland SP, New Zealand ZL, Canada VE, Australia and Tasmania VK, Irish Free State EI.

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Dirty Weather Ahead?

We understand that although an unruffled calm of acquiescence with the new order of things is being maintained in most countries, storms are brewing in Belgium. A well-known Belgian amateur informs us that certain transmitters in his country have approached the Government and obtained leave to maintain the old EB prefix. This is asking for confusion.

The Belgians complain that French stations are "spoiling the game" with raw notes, but it seems to us that, if any old call letters are to be used, it hardly matters much what sort of note goes out, provided that it is illegible. If the Belgians wish to stick to obsolete prefixes the sooner they use bad notes the better. However, certain Belgian amateurs have signified their intention to adhere to the new regulations. More strength to their signals!

Sydney Talks to New York

Australia's Latest Short-wave Feat.

By A CORRESPONDENT.

IT seems to have escaped general notice in this country that on November 1st Australia and the United States made a noteworthy contribution to the history of short-wave communication by achieving two-way wireless telephony of a commercially useful standard between Sydney and Schenectady—a distance of 10,000 miles—and between Sydney and Java. The occasion was a Press demonstration of the new equipment evolved by Amalgamated Wireless (Australasia), Ltd., under the managing directorship of Mr. E. T. Fisk, who has organised a scheme of centralisation whereby practically all the wireless stations of New South Wales are concentrated on two sites under the direction of a central control office. On one of these sites—Pennant Hills—is the transmitting centre, with the 20 kW. telephony plant used in the Sydney-Schenectady experiment. The other site is on the coast at La Perouse, and here the receiving centre for the New York telephony is installed. The station is shown in our title illustration. The control centre is at the headquarters of Amalgamated Wireless, 47, York Street, Sydney.

Calling Java and New York.

The demonstration test with New York was scheduled for 10 p.m. on the evening of November 1st, but earlier in the day the Press representatives were taken over the transmitting and receiving centres to give them an adequate conception of the methods employed. When the party returned to headquarters, Mr. Fisk, seated at his office desk, telephoned instructions to La Perouse to get in touch with Bandoeng, Java, over 2,000 miles away. Within a few minutes the station was heard on the desk telephone, and a representative of the *Sydney Morning Herald* conversed with officials at Java for more than half an hour.

The *pièce de résistance,* however, was the telephonic communication with New York. Shortly before 10 p.m. it was announced that the line was clear to the G.E.C. station at Schenectady, New York. Mr. Fisk spoke for a few minutes and then introduced Mr. Lawton, Consul-General of America, who exchanged greetings with Mr. Dow, Secretary of the Australian Commissioner's office in New York. Then followed what might be termed a general conversation between the New York and Sydney pressmen. That the test was, in every way, an undoubted success was partly due to the General Electric Company of America and also to the Dutch East Indies Radio Company, who willingly consented to co-operate with the A.W.A.

Successful telephony tests were again carried out on Monday night, November 5th, between Amalgamated Wireless headquarters, Sydney and Schenectady, New York, the voices from the U.S.A. coming through with great clarity.

The Australian Station.

Station 2ME at Pennant Hills, some 14 miles from Sydney, operates on a wavelength of 28.5 metres. The equipment, specially designed by A.W.A. engineers, was manufactured at the company's "Radio-Electric Works," Sydney.

The new 20 kW. short-wave transmitter is of the very latest design, and it is of interest to note that the main

Sydney Talks to New York.—

modulator and amplifier bank employ the latest valves in which the anodes are cooled by means of oil circulating through specially constructed jackets.

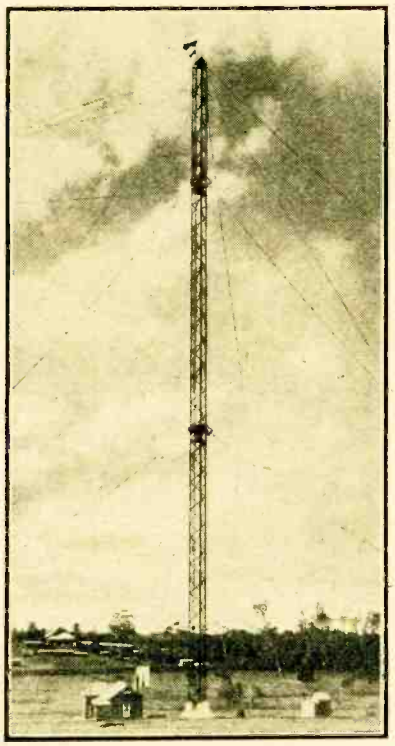
The transmitter itself consists of seven main units:—

1. Drive and No. 2 Magnifier (1 kW. each).
2. No. 1 Magnifier (3 kW.).
3. Power Magnifier (20 kW.).
4. Keying Unit (20 kW.).
5. Modulator Unit (25 kW.).
6. Large Rectifier.
7. Small Rectifier.

The filaments of the valves in the first 5 units are heated from two 140-amp. 25-volt D.C. generators, with the exception of the drive and sub-modulator valves, which are heated from a 500-ampere-hour battery.

The filaments of the rectifying valves are heated by current of $12\frac{1}{2}$ volts, 50 cycles, stepped down from 240 volts.

Power for the anodes of the valves in the transmitter circuit proper is obtained from a 30 kW. rectifier unit comprising six large glass rectifying valves and appropriate smoothing circuits composed of inductances and condensers, whilst power for the anodes of the drive and buffer circuits is obtained from a low-power rectifier of approximately 3 kW.



2ME, SYDNEY. The 400ft. mast of Australia's best-known short-wave transmitter, situated at Pennant Hills, near Sydney. Besides establishing telephonic communication with New York, this 20 kw. station has provided relays for British listeners.

The wave range of the transmitter is from 15 to 50 metres, and the apparatus can be used for telegraph signals up to 300 words per minute.

The aerial, which is of the vertical type, is about 400ft. from the transmitter, and is fed by means of lecher wires.

The Pennant Hills station has done some praiseworthy work in the development of Empire broadcasting, and it is specially disappointing that the test relay of New Year greetings to British listeners, which had been arranged for December 31st, was not fulfilled owing to dislocation caused by fire at Ballan.

The receiving centre at La Perouse is to-day the largest and most modern station of its kind in the Southern Hemisphere. During the last eighteen months the station has become famous for several feats of reception. One of particular interest to Australians was the reception and relaying of messages from the "Southern Cross" plane on its Pacific flight. Another triumph of which the engineers at La Perouse are justly proud is the reception of messages from Australian ships lying in Tilbury Docks.

USEFUL DATA CHARTS. (No. 21.)

Ratio of H.F. Resistance to D.C. Resistance of a Coil.

THIS ratio may be written as

Skin Factor + g^3 [Litz number + A]

or Skin Factor + Proximity Factor.

Where the skin factor and g depend only on frequency and diameter of wire or strand, the Litz number depends only on the particular Litz used, and A depends on the shape and diameter of the coil, number of turns, and kind of Litz used.

It was pointed out in connection with Abac 20 that, when the correct gauge of wire is used to give minimum decrement, the skin factor is approximately equal to the proximity factor, so that it is unnecessary to ascertain the latter. This rule, however, does not always give sufficiently accurate results, and in any case the nearest available gauge of wire may differ considerably from the gauge calculated, so that it is sometimes necessary to calculate both skin factor and proximity factor. To illustrate the working of Abac 21 we shall take the following example, referring to a coil wound with stranded wire, the best diameter of strand having been found from Abac 19.

Single-layer Coil.

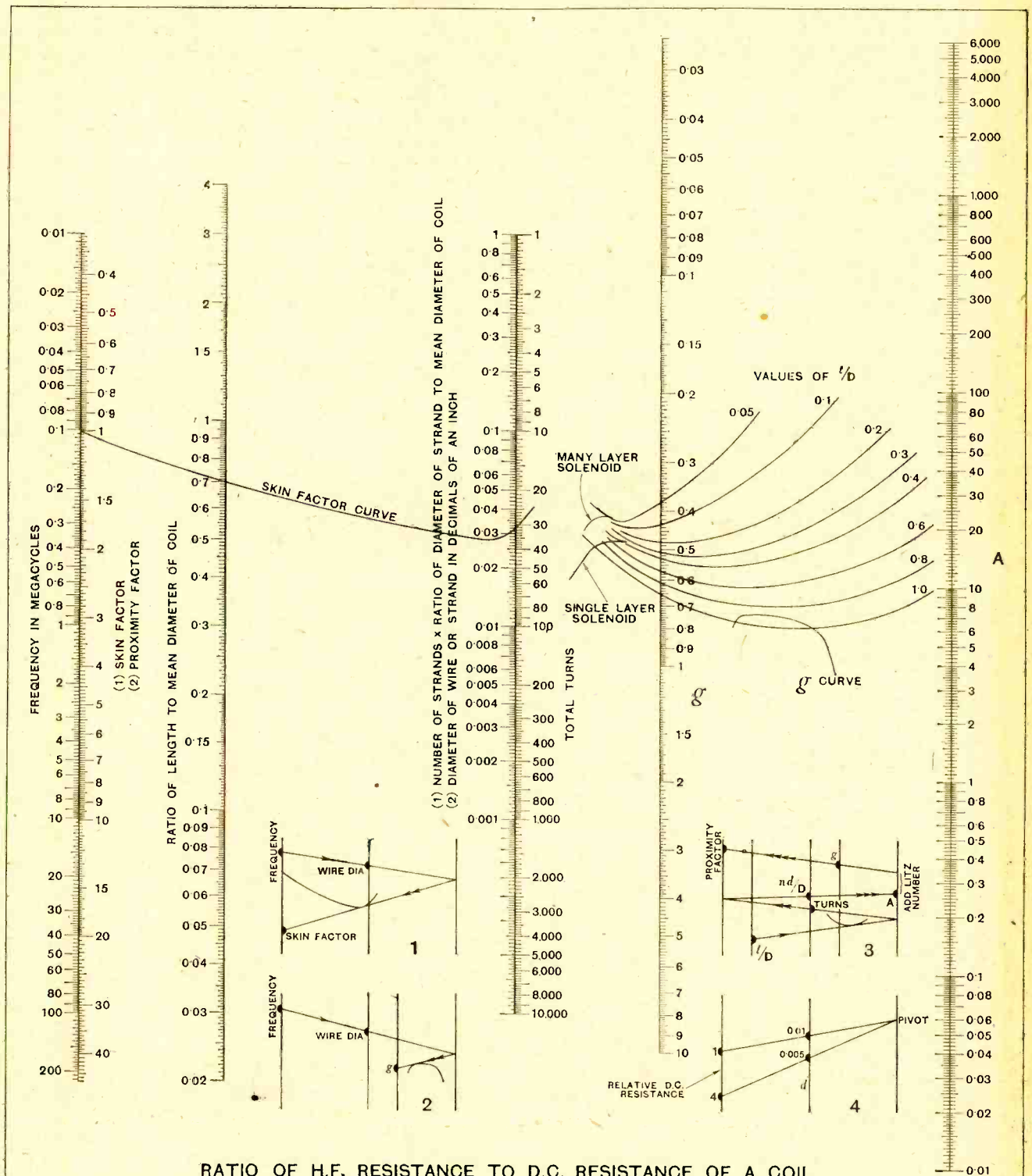
L = self-inductance = 200 microhenrys.
f = 1 megacycle.
N = number of turns = 43.5.
D = diameter of coil in inches = 4in.
d = diameter of each strand in inches = 0.00421in.
n = number of strands = 27.
l = length of coil = 2in.

The Skin Factor.

Inset 1 shows that a line must be drawn through the values of f and d and on the return journey a tangent is drawn to the curve: the skin factor is found to be 1.009.

The Value of g.

Inset 2 shows that a line must be drawn through the values f and d and on the return journey a tangent is drawn to the g curve: the value of g is found to be 0.294.



RATIO OF H.F. RESISTANCE TO D.C. RESISTANCE OF A COIL

= SKIN FACTOR + g^3(LITZ NUMBER + A)

= SKIN FACTOR + PROXIMITY FACTOR

W.W. ABAC

Nº 21.

Useful Data Charts (No. 21).—

The Proximity Factor.

Inset 3 shows that we must start from $l/D = 0.5$, along a tangent to the curve for a single-layer solenoid, then we return from right to left through $N = 43.5$ turns, then from left to right through $nd/D = 27 \times 0.00421/4 = 0.0284$, thus arriving at the value of A which will be found to be 26.6. The Litz number must now be added from the table. The nearest gauge obtainable is 27/0.0040in., and the corresponding figure for single silk covering is 18.2. Thus we have $26.6 + 18.2 = 44.8$ on the A scale, and g has already been found to be 0.294: accordingly the final line with 4 arrows leads to a proximity factor of 1.16.

THE LITZ NUMBERS.*

Number of Strands.			Gauge of Each Strand.
3.	9.	27.	
2.25	8.00	25.2	0.0076"
2.01	7.15	22.3	
1.54	5.55	17.4	No. 36
2.21	7.88	24.6	0.0060"
1.87	6.68	20.7	
1.38	4.87	15.3	No. 38
2.27	8.00	25.3	0.0048"
1.71	6.08	19.0	
1.19	4.26	13.3	No. 40
2.18	7.69	24.2	0.0040"
1.63	5.80	18.2	
1.14	4.09	12.8	No. 42
2.17	7.76	24.3	0.0032"
1.46	5.17	16.3	
0.96	3.47	10.8	No. 44

The top figure in each compartment refers to enamelled wire, the middle figure to S.S.C., and the bottom figure to D.S.C. Thus for 9/40 S.S.C., the Litz number is 6.08.

* These figures have been calculated from data kindly supplied by the London Electric Wire Co. and Smiths, Ltd.

The H.F. Resistance.

Abac 20 gives 1.06 ohms for the D.C. resistance of this coil and so, collecting all the results,

$$R_{HF} = 1.06\ [1.009 + 1.16] = 2.30 \text{ ohms.}$$

The average time required to obtain the H.F. resistance for a stranded coil, using Butterworth's chart and tables, is found to be 35 minutes: the same computation using Abacs 19, 20, and 21 requires only 5 minutes, and the chances of making errors are greatly diminished.

Stranded *v.* Solid Wire.

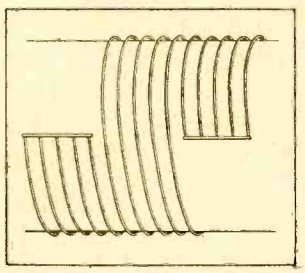
We may now try the effect of winding the same coil with different types of wire, and the following results will be obtained:—

	D.C. Resistance.	Skin Factor.	Proximity Factor.	H.F. Resistance.
Solid	0.402	3.55	3.59	2.87
9-Strand	1.57	1.03	1.07	3.30
27-Strand	1.06	1.009	1.16	2.30

The result of using 9-strand wire is to increase the H.F. resistance, but an improvement is made by using 27 strands. Indeed we cannot predict the best type of stranding, or whether stranding will be better than using solid wire; it is necessary to carry through the calculations. Mr. Butterworth has pointed out to me that this uncertainty is due to the Litz number, which represents a kind of proximity effect occurring within the cable itself. If it were not for this number, stranding would always be beneficial, and the resistance would be smaller the greater the number of strands employed.

In some cases, such as with coils for short waves, the Litz number completely swamps the term A; in such cases stranding confers no benefits.

Thus in the case of a coil of 11.4 microhenrys with 12 turns, the diameter being 3in. and the length 1.5in., and the wavelength being 60 metres, the H.F. resistance works out at 0.496 ohms when solid wire is used. With 27-strand Litz the resistance is 1.47 ohms, and on examination the Litz number is found to be 16.3 (for S.S.C.), while A is only 1.97.



To retain the advantage of stranded wire but to have a truly single-layer winding, a suggestion has been made that a coil should be wound with a tape of paralleled wires.

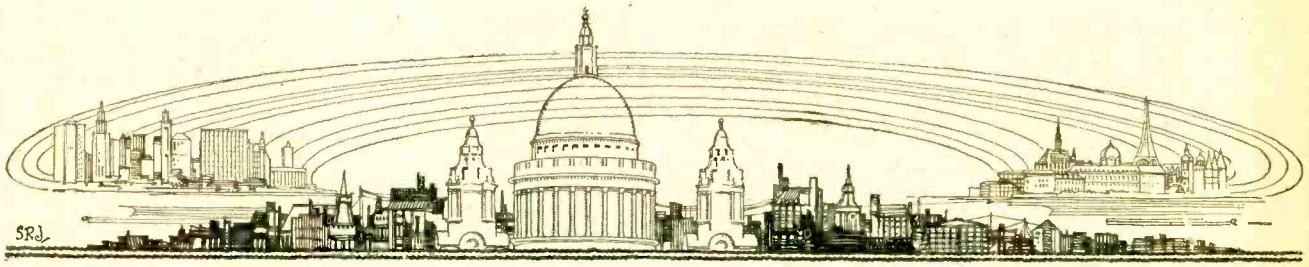
Evidently it is desirable to diminish the Litz number by increasing the distance between strands; it will be seen from the table that in any compartment the figures decrease in passing from enamelled to S.S.C. and on to D.S.C. But the decrease is not very great. A more radical method, one which was, I believe originally suggested by Mr. Stanley Ward, is to split up the solid wire, not into Litz, but into a series of adjoining wires connected in parallel and wound on like tape, as shown in the illustration. Thus the advantages of a truly single-layer winding, with uniform spacing, are regained.

Relative D.C. Resistances.

When a few gauges on each side of the theoretically best gauge are being tried to ensure that the lowest resistance is being obtained, the relative D.C. resistances may be obtained without recourse to Abac 20 by the method shown in the 4th inset. Thus, if the first gauge used has a diameter of 0.01in., draw a line through the point 1 on the frequency scale and through $d = 0.01$in. Mark the point where this line meets the right-hand scale, and using this as a pivot sweep the line through different positions. Then, when $d = 0.005$in. we read 4 on the frequency scale. Hence the frequency scale can be used to read off relative D.C. resistances.

Actual H.F. Resistance.

The H.F. resistance found by the method described in this article will be increased in practice by dielectric losses due to the material of the coil former and the wire insulation. If 10 per cent. is added to the theoretical resistance a fair approximation will be obtained to the actual value.



CURRENT TOPICS

Events of the Week in Brief Review.

PICTURE RECEPTION AT SCIENCE MUSEUM.

A "Fultograph" picture receiver has been accepted by the Science Museum, South Kensington, for demonstration purposes.

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NEW "Q" SIGNAL.

We hear that a certain Bristol amateur was searching his code sheets the other evening for the meaning of QTK. This mysterious signal emanated from a Brazilian station whose signals he had reported as "loud and clear." Asked for a translation, the Brazilian gave it: "Quit the kidding."

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AMERICA'S FREQUENCY FLYING SQUAD.

Six cars are being equipped with frequency and field strength measuring instruments by the Westinghouse Company at Springfield, Mass., their purpose being to "police" the American ether by ensuring that broadcasting stations adhere to the powers and frequencies allocated by the Federal Radio Commission. The Union International de Radiophonie might adopt similar methods in Europe, but, unfortunately, it lacks the necessary legal authority.

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GOOD FOR WIRELESS BATTERY MAKERS.

There is general rejoicing among battery manufacturers in the United States over the results of a national survey which shows that 10,000,000 American houses are still without an electric mains supply.

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BROADCAST BREAKDOWNS IN 1928.

During 1928 the Daventry Experimental station, 5GB, was in a state of "breakdown" for 0.54 per cent. of its scheduled transmission time. The B.B.C. explains that this rather high percentage was due to the fact that the station was, and still is, being used experimentally for the purpose of testing apparatus for inclusion in the new twin-wave regional transmitter at Brookman's Park.

In the case of other B.B.C. stations the average percentage breakdown per station was 0.03 per cent., representing fifty-eight minutes in the year. The lowest individual breakdown figure was that of Swansea, with only 0.01 per cent. Glasgow, with 0.11 per cent., was the longest out of action.

The Chelmsford short-wave station, 5SW, transmitted for 1,536 hours 18 minutes, with a total breakdown period of 0.91 per cent.

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SEARCH YOUR "DEN."

Readers who are about to spring-clean their workshops may come across disused apparatus which would be gladly received by the vicar of St. Jude's, Old Bethnal Green Road, London, E.2, who is starting a wireless club for poor lads. It is hoped that sufficient gear may be collected to build both a crystal and a valve set.

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SHORT WAVES FROM SCHENECTADY.

2XAF and 2XAD, the well-known short-wave transmitters at Schenectady, U.S.A., are now transmitting fairly regularly on 31.48 and 19.56 metres respectively. The former operates from 11 p.m. to 5 a.m. (G.M.T.) on Monday, (11 p.m.), Tuesday, Thursday, and Saturday. The latter works on Monday, Wednesday, Friday, and Sunday at the same hours.

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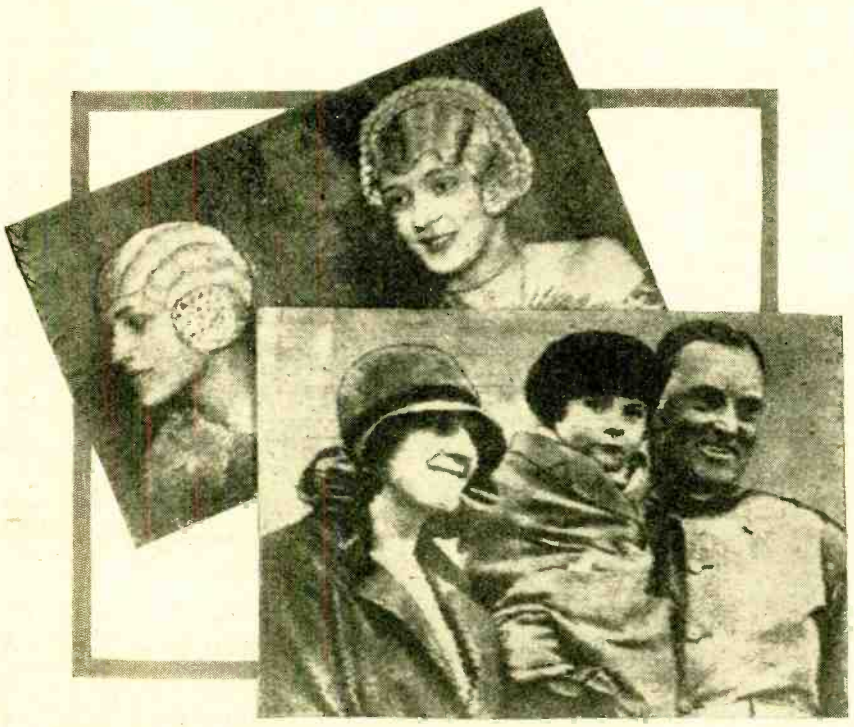
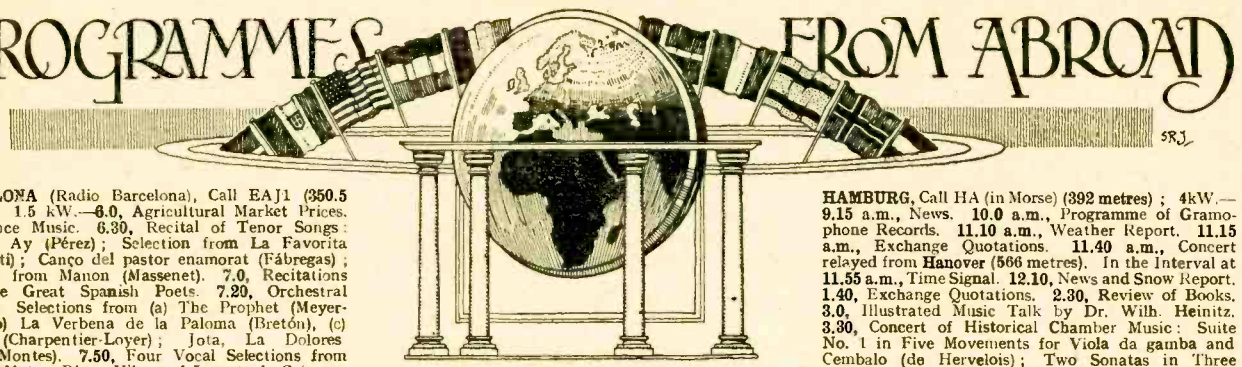
BAN ON SHIPS' SIGNALS.

In order that the Rabat (Morocco) broadcast transmissions may not suffer interference, the *Office Chérifien* of the Morocco Posts and Telegraphs Department has decreed, through the Berne International Union, that from January 1, 1929, no ship telegraphy stations are to make use of Morse transmissions on wavelengths between 300 and 450 metres during certain hours while within a radius of 250 sea miles of the African coast. Similar instructions have been given to the coast stations at Casablanca, Agadir, and Tangiers.



NEARING PERFECTION. These excellent untouched reproductions were picked up from Daventry last week by a South Coast reader using an ordinary "Fultograph" instrument.

PROGRAMMES FROM ABROAD



SATURDAY, FEBRUARY 2nd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—6.0, Agricultural Market Prices. 6.5, Dance Music. 6.30, Recital of Tenor Songs: Ay, Ay, Ay (Pérez); Selection from La Favorita (Donizetti); Canço del pastor enamorat (Fábregas); Selection from Manon (Massenet). 7.0, Recitations from the Great Spanish Poets. 7.20, Orchestral Concert: Selections from (a) The Prophet (Meyerbeer), (b) La Verbena de la Paloma (Bretón), (c) Louise (Charpentier-Loyer); Jota, La Dolores (Bretón-Montes). 7.50, Four Vocal Selections from Brahms, Matas, Pérez, Vilar and Lamote de Grignon. 8.20, Orchestral Selections (D'Ambrosio), (a) Andantino, (b) Paysanne, (c) Ronde des Lutins, (d) Tarantelle. 8.40, Sports Notes. 9.0 (approx.), Close Down.

BERGEN (365.9 metres); 1.5 kW.—5.30, Programme for Children. 6.0, Programme for Girls. 7.0, Orchestral Concert. 7.20, Georg Dahae, Talk: The History of Whale Fishing. 7.50, Topical Talk. 8.0, Concertina Recital by Trygve Dahl and Alfred Gustafsen. 8.30, Recitations by Mr. Sverre Erichsen. 9.0, Weather Report, News and Time Signal. 9.15, Dance Music. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,648.3 metres); 40 kW.—12.45, Phototelegraphy Transmission. 1.30, Programme for Children by Ursula Scherz. 2.0, Herr B. K. Graef, Talk: Elocution. 2.30, Weather Report and Exchange Quotations. 2.40, Talk for Women: How to make Fancy Dresses. 3.0, Prof. Litte, Talk: Science and Education. 3.30, Programme relayed from **Hamburg**. 4.30, Herr Falkenberg, Talk: The part of Minor Officials in Organisational Life. 5.0, Dr. Walther Pahl, Talk: Educational Travels abroad for Young Workers. 5.30, Elementary Spanish Lesson. 5.55, Dr. Konrad Eilers, Talk: The Ethical Values of Hunting. 6.20, Herr Winter, Talk: The Centenary of the Birth of Brehm. 7.0, Programme relayed from **Voxhaus**.

BERLIN (Voxhaus) (475 metres); 4 kW.—9.10 a.m., Market Prices. 9.15 a.m., Weather Report, News and Time Signal. 10.0 a.m., Programme of Gramophone Records. 10.30 a.m., Exchange Quotations. 11.55 a.m., Time Signal. 12.30, Weather Report and News. 1.0, Programme of Gramophone Records. 2.0, Exchange Quotations, Agricultural Report and Time Signal. 2.30, Dr. Paul Frank, Talk: Medical Hygiene. 3.0, Relay from the Berlin Sportpalast. 3.30, Stefan Lorant, Reading: Film Stars. 4.0, Concert from the Works of Fall; Selection from Der liebe Augustin; Soprano Solo from The Dollar Princess; Waltz from The Dollar Princess; Soprano Solo from The Rose of Stamboul; Selection from Madame Pompadour; Soprano Solo, Waltz from Jugend im Mai; Selection from Die geschiedene Frau, followed by Announcements. 5.30, Felix Stiemer, Talk: Friendship as Destiny—Goethe and Eckermann. 6.0, Willy Meyer, Talk: Outstanding Advances in Aviation during 1928 and Prospects for 1929. 6.30, Prof. Th. Litte, Talk: The Importance of a Profession in Life. 7.0, Brehm Festival Concert, on the Occasion of the Centenary of the Birth of Alfred Brehm, Natural Historian: Overture to Der Wildschütz (Lortzing); Opening Speech by Prof. Heck and Wireless Greetings to Brehm's Daughter in Renthendorf; Soprano Solos, (a) Der Vogel im Walde (Taubert), (b) Canzonetta (Loewe), (c) Frühlingsstimmen, Waltz (Joh. Strauss); Two Speeches; St. Wolfgangsee Idyll (Mozart); Address by Dr. Kleinschmidt, with Gramophone Illustrations; Symphony in D Major (Haydn), followed by Weather Report, News, Time Signal and Sports Notes. 9.30, Dancing Instruction, followed by Dance Music from the Hotel Esplanade. 11.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—4.0, Orchestral Concert. 6.29, Time Signal and Weather Report. 6.30, Programme for Young People: Selections for Children's Choir and Mouth Organ Orchestra. 7.30, Reading of Tales for the Young, in Dialect. 7.50, Orchestral Selections, Children's Melodies, and Soldier Songs. 8.45, News and Weather Report. 9.0, Orchestral Music. 9.35, Dance Music. 11.0 (approx.), Close Down.

BRESLAU (321.2 metres); 4 kW.—5.40, Herr Glien, Talk: The Economic and Cultural Relations of the Towns of the Guhrau District. 6.5, Shorthand Lesson. 6.35, Reading from his Novel, "Lessing in Breslau," by Emil Maxis. 7.0, Programme relayed from **Voxhaus**. 9.0, News and Announcements. 9.30, Programme from **Voxhaus**. 11.0 (approx.), Close Down.

BRÜNN (432 metres); 2.5 kW.—3.30, Programme for Children. 3.45, A Melodrama (Kricka). 4.15, Humorous Stories. 4.30, Mr. Charvát, Talk: Cultural Problems. 4.45, German Transmission, News, Talk and Musical Selections. 5.15, Report for Journalists by Dr. Jerábek. 6.0, Programme from **Prague**. 6.10, Talk on the following Transmission. 6.15, "The Circus Princess," Operetta (Kálmán). 9.0, Programme from **Prague**. 9.25, Dance Music.

BRUSSELS (512 metres); 1.5 kW.—5.0, Orchestral Concert from the Palace Hotel. 6.0, English Lessons. 6.45, Pianoforte Recital. 7.0, Selection of Columbia Gramophone Records. 7.30 to 11.0 (approx.), Experimental Transmission on a High Power. 7.30, "Radio-Chronique." 8.15, Programme of Famous Waltzes. 8.50, Topical Talk. 9.0, Concert by Jack Hylton and his Band from the Casino Lyrique, Brussels. 10.15, News and Esperanto Announcements. 10.20, Orchestral Concert from the Palace Hotel. 11.0 (approx.), Close Down.

BUDAPEST (555.5 metres); 20 kW.—3.15, Recital of Hungarian Songs by Margit Bodán. 4.45, Sports Results. 5.0, Variety Programme. 7.0, Violin Solos by Albertina Ferrarix and Songs by Olga Kalliwoda. 8.30, Gramophone Concert. 9.30, Tzigane Music from the Café Emke.

CRACOW (566 metres); 1.5 kW.—5.0, Programme for Children relayed from **Warsaw**. 6.0, Miscellaneous Items. 6.5, Wireless Vocal Competition. 6.56, Time Signal from the Astronomical Observatory. 7.0, News and Announcements. 7.5, Talk on the Foreign Politics of the Past Week by Mr. J. Regula. 7.30, Programme relayed from **Warsaw**. 9.0, Programme relayed from **Warsaw**. 9.30, Concert from a Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—1.30, Weather Report and Gramophone Concert. 7.20, News. 7.30, Talk. 7.45, Irish Lesson by Seamus O'Duirinne. 8.0, Selections by the Station Orchestra. 8.15, Soprano Solos by Mme. Hefferman. 8.25, Selections by the Station Orchestra. 8.45, Baritone Solos by P. J. Duffy. 9.0, Variety Selections by W. A. Manahan. 9.30, Original Sketches and Songs by John MacDonagh and Company. 10.15, Selections by the Station Orchestra. 10.30, News, Weather Report and Close Down.

FRANKFURT (421.3 metres); 4 kW.—2.55, Hints for the Housewife by Fini Pfannes. 3.35, Vocal and Orchestral Concert: Overture to Manfred (Schumann); Three Soprano Songs (Jensen), (a) O lass' dich halten, (b) Der Bote, (c) Ständchen; Serenade for String Orchestra in G Minor (Reinecke); Overture to Nachklänge von Ossian (Gade); Three Soprano Songs (Jensen), (a) Klinge, klinge mein Pandero, (b) Der Schmied, (c) In dem Schatten meiner Locken; Selections from the Serenade in A Major, Op. 16 (Brahms); In the Interval, News and Announcements. 5.10, Answers to Correspondents. 5.20, Alfred Brehm Centenary Programme: Introductory Talk; Readings from his Book on Animal Life. 6.0, Astronomical Talk by Prof. E. Sittig. 6.30, Song Recital by Richard Tauber, relayed from the Large Hall of the Saalbau, followed by Variety Programme from the Playhouse.

HAMBURG, Call HA (in Morse) (392 metres); 4kW.—9.15 a.m., News. 10.0 a.m., Programme of Gramophone Records. 11.10 a.m., Weather Report. 11.15 a.m., Exchange Quotations. 11.40 a.m., Concert relayed from **Hanover** (566 metres). In the Interval at 11.55 a.m., Time Signal. 12.10, News and Snow Report. 1.40, Exchange Quotations. 2.30, Review of Books. 3.0, Illustrated Music Talk by Dr. Wilh. Heinitz. 3.30, Concert of Historical Chamber Music: Suite No. 1 in Five Movements for Viola da gamba and Cembalo (de Hervelois); Two Sonatas in Three Movements for Viola d'amore and Cembalo (Ariosti); Cembalo Solo; Concerto for Viola da Gamba and Cembalo (Tartini); Plaisir d'amour (Padre Martini); Minuet (Millandre); Sonata in E Minor for Violin, Viola da gamba and Cembalo (Erlebach). 4.30, Request Concert. 5.30, Talk on Economics: The Position of the Worker in Co-operative Societies. 6.0, "Interview with our feathered Friends" from the Bird Fancier Karl Reich's Home, relayed from **Bremen** (273 metres). 6.55, Weather Report. 7.0, Variety Programme. 9.30, Programme Announcements, News, Sports Notes, and Snow Report. 9.50, Concert from the Café Wallhof. 10.50, North Sea and Baltic Weather and Ice Report.

HILVERSUM (1,071 metres); 5 kW.—9.40 a.m., Time Signal and Daily Service. 11.40 a.m., Police Announcements. 11.55 a.m., Concert of Trio Music. 1.40, Concert relayed from the Tuschinski Cinema, **Amsterdam**, under the direction of Mr. Max Tak, with Pierre Palla (Organ). 3.40, Italian Lesson by Mr. Giovanni Rizzini. 4.40, French Lesson by Mr. Raymond Lafont. 5.40, Time Signal. 5.41, Concert of Trio Music. 6.25, German Lesson by Mr. Edgar Grün. 7.25, Police Announcements. 7.45, Programme arranged by the Workers' Radio Association: Concert and Talk. 11.15 (approx.), Close Down.

HUIZEN (336.3 metres); 4 kW.—Transmits on 1,852 metres from 5.40 p.m. 12.10, Concert of Trio Music. 2.40, Programme for Children. 5.10, Gramophone Selections. 6.10, Talk by M. Gerisch. 6.20, Gramophone Selections. 6.30, Catholic Bulletin. 6.40, English Lesson. 7.10, Lesson in Dressmaking. 7.40, Talk by the Rev. Popelier. 8.0, Concert.

KALUNDBORG (1,153 metres); 7 kW.—Programme also for **Copenhagen** (339.8 metres).—6.30 a.m., Morning Gymnastics. 10.0 a.m., Weather Report. 10.15 a.m., Educational Talk. 2.30, Instrumental Concert. In the Intervals: Reading by Aage Brandt. 5.20, Talk by Svend Larsen. 5.50, Weather Report. 6.0, News and Exchange Quotations. 6.15, Time Signal. 6.30, David Grünbaum, Talk: Modern Foreign Authors, Arnold Bennett. 7.0, Chimes from the Town Hall. 7.2, David Grünbaum reads from "The Hound of Heaven" (Arnold Bennett). 7.30, Concert of Dance Music by the Strauss Family: Radetzky March (Joh. Strauss, Sen.); Polka (Joh. Strauss, Sen.); Selections (Joh. Strauss), (a) Waltz, Wo die Citronen blüh'n, (b) Mazurka, Weissager, (c) Quadrille on Melodies from The Gipsy Baron; Waltz, Dorschwalben aus Oesterreich (Jos. Strauss); Mazurka, Frauenherz (Jos. Strauss); Waltz, Doctrinen (E. Strauss); Gallop, Mit dampf (E. Strauss). 8.30 (approx.), News. 8.45, Concert of Light Music: March, The Boys of Tipperary (Amers); Chant sans paroles (Tchaikovsky); Selection from No, No, Nanette (Youmans); Reading; Humorous Variations in Old and New Styles on the German Folk Song "'s kommt ein Vogel geflogen" (Ochs). 9.45, Dance Music from the Industri Restaurant. 11.0, Chimes from the Town Hall. 11.15 (approx.), Close Down.

KATTOWITZ (416.1 metres); 10 kW.—3.0, Music Lesson by Prof. F. Sachse. 3.35, Children's Letter Box. 4.0, Service relayed from **Vilna** (426.7 metres). 5.0, Programme for Children. 6.0, Announcements 6.20, Talk by Prof. Simm. 7.0, Talk by Mr. K. Rutkovsky. 7.30 Programme relayed from **Warsaw**. 9.0, Weather Report and News. 9.30, Dance Music.

KAUNAS (2,000 metres); 7 kW.—3.15, Temperance Talk by Onkel Baltrus. 3.30, Recitations. 3.45, "Radio Patarejas." 4.30, Announcements. 5.0, Weather Report and News. 5.30, Agricultural Notes. 6.0, Health Talk. 6.30, Evening Entertainment.

LAHTI (1,504 metres); 35 kW.—4.0, Orchestral Selections: Heil Europa (v. Blon); Waltz from The Count of Luxembourg (Lehár); Selections from The Rose of Stamboul (Fall); Sabot Dance (Fétras).

Programmes from Abroad.

4.35, Talk. **4.57,** Time Signal, Weather Report and Press News. **5.15,** Concert: Balalaika Music (Putilin): Pizzicato from the Ballet Sylvia (Delibes); Selections (Dobrochotoff), (a) Mazurka brilliante, (b) Humoresque, (c) Russian Songs. **5.35,** Orchestral Selections: Kasperles Wochenende (Flamm); Overture to Stradella (Flotow); Wiegenlied (Kaun); Under the Star Spangled Banner (Sousa). **6.0,** Talk. **6.20,** Dance Music. In the Intervals: Recitations and Talks. **8.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres), and **Münster** (265.5 metres).—**12.5,** Orchestral Concert from the Café Corso, Dortmund: Overture to Der Waffenschmied von Worms (Lortzing); Waltz, Ganz Paris (Waldteufel); Selection from Eugen Onegin (Tchaikovsky); Fallende Blätter (Carena); Erinnerung an Capri (Becce); Slavonic Dance No. 4 (Dvorak); Suite No. 1 from The Fables of Lafontaine (Mouton); Selection from Just one Night (Stolz); Russian March (Ganne). **1.30,** Hints for the Housewife. **2.0,** Programme for Children by Els Vordemberge. **2.30,** Economic Report. **2.40,** Arthur Wurbs, Talk: The Foundations of Wireless Technique. **3.5,** Talk for Young People by Pastor Becker. **3.30,** Dr. Radtke, Talk for Women: Housing Problems of Large Cities. **3.55,** Line Wallerstein, Talk: German Artists and their Travels. **4.20,** English Lesson by Prof. F. Hase. **4.45,** Orchestral Concert: Military Symphony in G Major (Haydn); Second Part of the Haffner Serenade (Mozart), Overture to the Ballet, Men of Prometheus (Beethoven). In the Interval at **5.15,** Programme Announcements. **5.30,** Dr. Wilhelm, Talk: Religious and Intellectual Life in China. **5.50,** Morse Instruction. **6.15,** Prof. Wieruszowski, Legal Talk: Personal Rights. **6.40,** Prof. Hessen, Psychological Talk: What do we know of the Soul? **7.0,** "Prinzessin Tessa und ihre Freier"—Wireless Comedy (Rehse), followed by News, Sports Notes, Business Announcements, Orchestral Selections and Dance Music. **11.0,** Dance Music from the Apollo Theatre, Düsseldorf. **12.30 a.m.** (approx.) (Sunday), Close Down.

LEIPZIG (361.9 metres); 4 kW.—**3.0,** Chess Lesson. **3.30,** Concert by the Station Orchestra under the direction of Hilmar Weber. **4.45,** Wireless News and Talk. **5.20,** Weather Report and Time Signal. **5.30,** Programme from **Königswusterhausen. 6.0,** Prof. Georg Witkovsky, Talk: Lessing as a Philosopher. **6.30,** Dr. Fritz Kaphahn, Talk: The Sentiment of Europeanism—The Renaissance. **7.0,** Vocal and Orchestral Concert: Overture to Poet and Peasant (Suppé); Two Songs (Erwin), (a) An der Weser, an der Mosel und am Rhein, (b) Vier Worte möcht ich Dir jetzt sagen; Waltz (Strauss); Three Songs, (a) Heut' Nacht hab ich mich toll verliebt (Fresco), (b) Es gibt eine Frau, die Dich niemals vergisst (Cowler), (c) Sprich zu mir nur ein Wort (Malbot and Corren); Selections from Paganini (Lehár); Two Songs, (a) Draussen in Mauer (Arnold), (b) Ja i glaub in dem Wein muss was drinn g'wesen sein (Strucker); Selections from Der Juxbaron (Kollo); Three Songs; Selections from The Waltz Dream (Oscar Straus). **9.0,** Labour Report, News, Weather Report, Sunday Programme Announcements and Sports Notes. **9.30,** Relay of the Ball at the **Dresden** Opera House.

MADRID (Union Radio), Call EAJ7 (427 metres); 3 kW.—**7.0,** Chimes, Exchange Quotations and Programme of Dance Music. **8.0,** Talk: Inventors and Inventions. **8.25,** News and Announcements. **9.45,** Agricultural Notes and Market Prices. **10.0,** Chimes, followed by Selections from Musical Comedy from (a) La Patria Chica (Chapi), (b) El Tambor de Granaderos (Chapi); In the Interval at **12.0 Midnight** (approx.), News. **12.30 a.m.** (approx.) (Sunday), Close Down.

MILAN, Call 1MI (504.2 metres); 7 kW.—**7.30,** Time Signal and Announcements. **7.45,** Mr. G. Ardau, Talk: Industrial Review. **8.0,** Relay of an Opera from the Scala Theatre. In the Intervals: Talk on Music by G. M. Ciampelli, Reading by Angelo Soldini from "L'Innocente" (G. d'Annunzio), News and Economic Report. **10.30** (approx.), Close Down.

MOTALA (1,365 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Malmö** (229 metres), **Ostersund** (720 metres), **Sundsvall** (545.5 metres).—**4.0,** Concert of Light Music. **5.0,** Programme for Children. **5.30,** A Musical Revue relayed from **Göteborg. 6.45,** Sonata for Violin and Pianoforte No. 4 in E Minor (Mozart). **7.0,** Talk: Professions and Professional Men. **7.15,** Military Band Concert relayed from **Jönköping** (201.3 metres). **8.15,** News and Weather Report. **8.45,** Topical Talk. **9.0,** Dance Music. **11.0** (approx.), Close Down.

B 23

Saturday, February 2nd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres).—**3.0,** Orchestral Concert. **4.30,** Herr Heck, Talk: Alfred Brehm, on the occasion of his Centenary. **5.0,** Harmonium Recital by Gustav Schödel. **5.35,** Labour Market Report. **6.0,** Answers to Correspondents. **6.30,** Folk Song Recital: Das schlaue Mädchen (arr. von Othegraven); Abgeblitzt (Schumann); Upper Swabian Dance Song (Knorr); Die Auserwählte (Kienzl); Schneiders Höllenfahrt (Hausegger); Guten Abend, liebes Lieferl (Schumann); Songs (arr. Ochs), (a) Beim Tanze, (b) Schnützelputzhäusel. **7.0,** Humorous Programme. **8.30.** Vocal and Instrumental Selections of the Season's Song Hits. **9.0,** Dance Music from the Park Hotel. **9.20,** News and Close Down.

NAPLES, Call 1NA (333 metres); 1.5 kW.—**7.35,** Talk by R. Lotto. **7.30,** Wireless Notes, Announcements, News and Harbour Notes. **8.0,** Time Signal. **8.2,** A Comedy with Orchestral and Solo Interludes: Orchestral Selection, Overture to Ein Morgen, ein Mittag, ein Abend in Wien (Suppé); "Papa' Eccellenza"—Comedy in Three Acts (Rovetta); in the First Interval, 'Cello Solos, (a) Largo (Mulé); (b) Tarantella (Oliveri); in the Second Interval, Sogno (Rillone); Tarantella (Alfano). **9.30,** Review of the Week. **9.50,** News. **9.55,** Calendar and Programme Announcements. **10.0** (approx.), Close Down.

OSLO (497 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**5.0,** Programme for Children. **6.15,** Weather Report, News and Topical Talk. **6.30,** M. Erling Bergendahl, Talk: Film Art. **7.0,** Time Signal. **7.2,** Orchestral Concert: The Bridal Procession passes by (Grieg); Neapolitan Serenade (d'Ambrosio); The Rustle of Spring (Sinding); Invano (Tosti); Liebesleid-Liebesfreud (Kreisler); Selection (Olsen); Canzonetta (Godard); The Negro's Dream (Middleton); Swedish National Melodies (Gösta Berlin). **8.0,** Reading by Fridtjof Krohn. **8.30,** Weather Report, News and Topical Talk. **9.0,** Hawaiian Music. **9.30,** Dance Music by the Orpheans from the Hotel Bristol. **11.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres); 5 kW.—**5.0,** Pasdeloup Concert. **7.10,** Weather Report. **7.20,** "Le Journal Parlé." **8.50** (approx.), Close Down.

PARIS (Petit Parisien) (336 metres); 0.5 kW.—**8.45,** Gramophone Selections, Talk and News. **9.0,** Concert: Overture to Cleopatra (Mancinelli); Selection from L'Arlésienne (Bizet). **9.25,** News and Announcements. **9.30,** Symphony Concert: Selection for Violin and Orchestra, Poème (Chausson); Pièces brèves (Franck). **10.0,** News and Concert: Selection from Panurge (Planquette); Divertissement from Miarka (Georges); Finale from the Ballet Egyptienne (Luigini).

PARIS (Radio-Paris), Call CFR (1,769 metres); 15 kW.—**12.30,** Concert of Dance Music; News in the Intervals. **2.0,** Exchange Quotations and Religious Information. **3.30,** Market Prices. **3.45,** Dance Music by the Joss Ghislery Symphonians. **4.50,** Exchange Quotations and News. **6.30,** Agricultural Report and New York Exchange Rates. **6.45,** Gramophone Selections. **7.30,** Pianoforte Lesson by M. Pierre Lucas. **8.0,** M. Félix de Pathère, Talk: Laws of Social Insurance, followed by Exchange Quotations and News. **8.15,** Concert: "Le Petit Monde"; Songs; Dance Music; in the Intervals, News.

POSEN (336.3 metres); 1.5 kW.—**6.0,** Talk. **6.25,** Violin Recital by Mlle. Claire Kaulfussówna: Ave Maria (Schubert); Scherzo Tarantella (Wieniawsky); Andante from the Spanish Symphony (Lalo); Serenade (Burmester). **6.50,** Talk for Women by Mme. Sabina Swidzinska. **7.5,** Miscellaneous Items. **7.30,** Programme relayed from **Warsaw. 9.0,** Time Signal and News. **9.30,** Cabaret Concert. **11.0,** Concert arranged by the Maison Philips. **1.0 a.m.** (Sunday), Close Down.

PRAGUE (343 metres); 5 kW.—**3.30,** Popular Concert: Popular Overture (Smetana); Selection from The Barber of Bagdad (Cornelius); Prelude in D Major (Scriabine); The Invitation to the Dance (Weber); Les romantiques, Op. 167 (Lanner); Gavotte (Millöcker); The Blue Danube (Strauss). **4.30,** Educational Talk. **4.40,** Talk on Asiatic Russia. **4.50,** Agricultural Talk. **5.0,** German Transmission: News and Programme for Children. **6.0,** News and Chimes. **6.10,** Programme from **Brünn. 9.0,** Time Signal, News and Theatre Notes. **9.25,** Programme from Brünn.

ROME, Call 1RO (443.8 metres); 3 kW.—**6.50,** Topical Talk, Sports Notes, Exchange Quotations and Weather Report. **7.29,** Time Signal and Talk. **7.45,** Band Concert: March, Op. 76 (Schumann); La Schiava saracena (Mercadante); Selection from Lucrezia Borgia (Donizetti); "Il Portalettere"—One-Act Comedy (the Brothers Golz); Selections (Manente), (a) Scena zingaresca, (b) Ricordo di Cairo, (c) Symphonic March, Il Littorio; Talk, Literary and Artistic Life; Danza abruzzese (Melchiorre); Selection from Francesca da Rimini (Zandonai); Triumphal March from Cleopatra (Mancinelli). **9.50,** Topical Talk, News and Close Down.

SCHENECTADY, Call 2XAF (31.48 metres); 30 kW.—**11.27,** Time Signal and Weather Report. **11.30,** White House Coffee Programme relayed from **New York. 12.0 Midnight,** Phil Spitalny's Music relayed from **New York. 12.30 a.m.** (Sunday), Musical Programme from **Rochester. 1.0 a.m.,** National Symphony Orchestra, conducted by Walter Damrosch. **2.0 to 4.0 a.m., New York** Programme. **2.0 a.m.,** Lew White Organ Recital. **2.30 a.m.,** Programme by Mildred Hunt and Marimba Orchestra. **3.0,** Lucky Strike Programme. **4.0 a.m.,** Programme of Dance Music. **5.0** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**7.30,** Weather Report and Time Signal. **7.40,** Orchestral Concert: Overture to Tancred (Rossini); Valse de la Sérénade (Tchaikovsky); Russian Song (Smith); Romaneska (Zikoff); Ballet from Rosamunde (Schubert). **10.0,** News and Close Down.

STUTTGART (374 metres); 4 kW.—**1.0,** Programme for Children. **2.0,** Concert of Vienna Waltzes and Operetta Selections. **3.30,** Dance Music from the "Cafasö," Mannheim. **5.0,** Time Signal and Weather Report. **5.15,** Talk on the occasion of the 100th Anniversary of the Birth of Alfred Brehms, by Dr. Lehmann, relayed from **Freiburg** (577 metres). **5.45,** Lesson in Bock-keeping, by Dr. Wolf. **6.15,** Time Signal and Sports Notes. **6.30,** Herr L. Leibfried, Talk: Exchange and Cheques from the Legal Point of View. **7.0,** Concert of Chamber Music: Four Movements from the String Quartet, Op. 40 (Debussy); Four Movements from the Sonata in G Major, Op. 95, for Violin and Piano (Beethoven). **8.15,** "Der Ritter von der Humpenburg"—Comic Opera in One Act (Kormann).

TOULOUSE (Radiophonie du Midi) (383 metres); 8 kW.—**12.45,** Concert. **8.0,** Exchange Quotations and News. **8.30,** Orchestral Selections from Carmen (Bizet). **8.50,** Vocal Concert: Song from Louise (Charpentier); Air from Lakmé (Delibes); Le Père La Victoire (Ganne); Song from Mireille (Gounod); Song of the King of Thule from Faust (Gounod); Margaret's Song from Le Roi d'Ys (Lalo); Song from The Merry Widow (Lehár); The Nightingale's Song from Jeannette (Massé). **9.22,** Instrumental Selections: Mandoline Selection from Les Millions d'Arlequin (Drigo); Piccolo Polka (Damaré); Cornet Solo, La Bavarde (Sellenick); Piccolo Solo, The Nightingale (Blémant); Waltz, Aubade charmeuse (Peyronnin); Saxophone Solo, Serenade (Rachmaninoff); Hawaiian Guitar Solo, Chiquita (Wayne); Saxophone Solo, Nocturne (Chopin); Clarionet Duet, La Chanson des nids (Buot); Cembalo Solo, Waltz No. 1 (Durand). **10.0,** Dance Music. **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (520 metres); 15 kW.—**4.35,** Fairy Tales for Children of All Ages, with Lute Selections. **5.10,** Concert: Songs (Brahms); Violin Solos, (a) Romance (Svendsen), (b) Gavotte (Martini), (c) Hungarian Dance (Brahms-Joachim); Songs (Richard Strauss), (a) Cäcilie, (b) Meinem Kinde, (c) Zueignung, (d) Waldseligkeit, (e) In goldener Fülle; Pianoforte Solo, Figaro Fantasia (Liszt-Busoni). **6.0,** Richard Gerin, Talk: Bob-sleighing. **6.30,** Selections from the Works of Therese Rie-Andro, with Introductory Talk. **7.5,** Time Signal and Weather Report. **7.10,** "A Night in Venice"—Comic Opera in Three Acts (Joh. Strauss), followed by Dance Music from the Hotel Bristol, and Phototelegraphy Transmission.

WARSAW (1,385.7 metres); 10 kW.—**6.45,** News and Time Signal. **7.30,** Concert of Light Music; in the Intervals, Theatre Notes. **9.0,** Aviation Notes and Weather Report. **9.5,** News, Police Announcements and Sports Notes. **9.30,** Dance Music from the Oaza Restaurant. **10.30** (approx.), Close Down.

ZÜRICH (489 metres); 1 kW.—**6.17,** Variety Programme. **9.0,** Weather Report and News. **9.10,** Gramophone Selections of Dance Music.

Programmes from Abroad.—

ALGIERS, Call PTT (353 metres); 1 kW.—12.30, Orchestral Concert, rendered by the Station Orchestra under the direction of C. Cerlini (Flautist): Overture to Robin Hood (C. M. v. Weber).

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—11.0 a.m., Cathedral Chimes Relay. 11.5 a.m., Meteorological Report for Europe and Spain, followed by Notes on the Conditions of Aviation Routes. 1.30, Musical Selections by the Iberia Trio; in the Interval, Gramophone Records. 2.45 to 5.30, No Transmission. 5.30, Opening Signal, followed by Partial Opera Relay from the Gran Teatro del Liceo; in the Interval: Stock Exchange Quotations and Agricultural Market Prices. 8.0 to 8.20, Weekly Bulletin from the San Isidro Institute of Agriculture. 8.20, Concert of Orchestral Music: Rhythms of Spain, Dances and Songs (S. Raurich), rendered by the Station Orchestra. 8.40, Sports Results. 9.0 (approx.), Close Down.

BERGEN (365.9 metres); 1.5 kW.—9.30 a.m., Relay of Morning Service. 11.30 a.m., Weather Conditions and Forecast, followed by General News Bulletin. 7.0, Orchestral Concert. 7.50, Topical Talk. 8.0, Dumky Trio, Op. 90, for Pianoforte and Strings (A. Dvorak), rendered by Jim Johannesson (Violinist), Karl Johannessen ('Cellist) and Mrs. Signe Bonneire (Pianist). 9.0, Weather Conditions and Forecast, Late News and Announcements and Time Signal. 9.15, Dance Music Programme. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,648.3 metres); 40 kW.—7.55 a.m., Relay of Chimes from the Potsdam Garrison Church. 9.0 a.m., Morning Festival of Sacred Music and Sermon from **Voxhaus**, followed by Relay of Chimes from Berlin Cathedral. 10.30 a.m., Morning Concert of Orchestral Music, relayed from **Voxhaus**. 12.45, Experimental Transmission of Pictures. 1.30 to 2.25, Three Talks on Agricultural Topics, relayed from **Voxhaus**. 2.30, Reading of Fairy Tales. 3.0, Talk. 3.30, Selections of Light Music. 5.0, Talk on a Topical Question. 6.0, Talk. 7.0, Musical or Dramatic Programme, followed by General News Bulletin and Programme of Dance Music. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475 metres); 4 kW.—7.55 a.m., Chimes, relayed from Potsdam Garrison Church. 8.0 a.m., Sacred Morning Festival of Vocal and Instrumental Music with Address in the Interval, followed by the Chimes from Berlin Cathedral. 10.30 a.m., Concert of Light Music. 1.0, Elementary Lesson in Morse by Hans W. Priwin. 1.30 to 2.25, Programme of Lectures for Agriculturalists. 1.30, News and Practical Notes for the Farmer. 1.45, A Review of Market Prices and Weather Conditions of the Previous Week. 1.55, Talk on Farming Topics. 2.30, Reading of Fairy Tales for Children. 3.0, Talk. 3.30, Concert of Light Music. 7.0 (approx.), Musical or Dramatic Programme, followed by Weather Report and Forecast, General News Bulletin, Time Signal and Sports Intelligence. 9.30, Selections of Dance Music. 11.30 (approx.), Close Down.

BÉZIERS (211 metres); 0.6 kW.—6.0 to 7.0, Concert Programme, arranged by "La Radio-Agricole française." 8.45, Selections of Popular Music on the Pathé and Pathé-Art Gramophone Records, arranged by the Maison-Relin Minoles at Béziers. 10.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—9.30 a.m. to 10.30 a.m., Protestant Sermon. 12.0 Noon, Time Signal and Weather Conditions and Forecast. 12.5, Popular Concert. 6.29, Time Signal and Weather Conditions and Forecast and Football Results. 7.30, Relay from Basle on 1,010 metres: First Performance of "Das Wiedersehen," Wireless Play in One Act, by Arnold Schmidt. 8.45, Sports Notes, News and Announcements and Meteorological Report. 9.0, Popular Concert, rendered by the Kursaal Orchestra. 9.35 (approx.), Close Down.

BRÜNN (432 metres); 2.5 kW.—4.30, Lecture for Workers from **Prague**. 5.0, News and Musical Programme for German Listeners. 5.30, Sports Notes, relayed from **Prague**. 9.20, Concert Programme, relayed from **Prague**. 10.30 (approx.), Close Down.

BRUSSELS (512 metres); 1.5 kW.—5.0, Musical Selections by the Orchestra of the Armenonville Tea Room. 6.0, Children's Entertainment, organised by the Children's Theatre, under the management of M. Léon Leroy. 6.30, Musical Programme. 7.30, "Journal parlé de Radio Belgique." 8.15 (approx.), Concert or Opera, followed by General News Bulletin from the Evening Press. 11.0 (approx.), Close Down.

SUNDAY, FEBRUARY 3rd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BUDAPEST (555.5 metres); 20 kW.—8.0 a.m., News and Announcements and Beauty Hints for Women. 9.0 a.m., Relay of Divine Service and Address. 2.30, Agricultural Talk. 3.15, Educational Programme of the Wireless Lyceum consisting of Lectures and Musical Recitals.

COLOGNE (263.2 metres); 4 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Langenberg** (462.2 metres), and **Münster** (265.5 metres).—6.45 a.m., Lesson in Self Defence by Dr. Ludwig Bach. 7.5 a.m., Lesson in German Shorthand by Hans Molitor. 7.25, a.m., Esperanto Instruction by Alfred Dormanns. 7.45 a.m. to 7.55 a.m., Review in Esperanto by Alfred Dormanns of Programmes of the Week. 8.0 a.m., Relay of Chimes. 8.5 a.m., Catholic Recital of Vocal and Instrumental Music, with Address. 12.0 Noon, Concert of Orchestral Music. 1.30, Talk. 3.30, Vocal Recital by the Dülken Quartet. 5.0, Talk by Doctor Harnisch: "How Animals find their Way." 7.15 (approx.), Relay of an Opera or Play, followed by General News Bulletin, Sports Notes and Popular Musical Selections and Programme of Dance Music. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—8.30, Concert of Vocal and Instrumental Musical Selections. 11.0, National Anthem and Weather Conditions and Forecast. 11.15 (approx.), Close Down.

CRACOW (536 metres); 1.5 kW.—9.15 a.m. to 10.45 a.m., Relay of Divine Service from a Cathedral. 10.56 a.m., Carillon, relayed from the Church of Notre Dame, followed by Time Signal and Weather Report and Forecast. 11.10 a.m., Concert of Orchestral Music by the **Warsaw** Philharmonic Orchestra. 1.0 and 1.20, Talks for Agriculturalists. 1.40, Agricultural Chronicle by Dr. St. Wasniewski. 2.0, Weather Report and Forecast. 2.15, Afternoon Concert by the **Warsaw** Philharmonic Orchestra. 6.0, Miscellaneous Items. 6.20, Talk. 6.56, Time Signal from the Observatory. 7.0, Fanfare, relayed from the Church of Notre Dame, followed by Sports Notes and Results. 7.30, **Podhale** Programme, Musical Selections, Talks, and Recitations: Mountain Music and Choir; Funeral March; The Burial of Janosik. 9.0, Programme from **Warsaw**. 9.30, Musical Programme from the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—8.30, Concert Programme, relayed from **Cork**: Vocal and Instrumental Items. 11.0, National Anthem and Meteorological Report. 11.15 (approx.), Close Down.

HUIZEN (336.3 metres); 4 kW.—Transmits from 6.40 on 1,852 metres.—8.5 a.m., Church Service and Sermon. 12.10, Musical Selections by the Station Trio. 1.10, Talk. 1.40, Talk. 5.20, Relay (on 1,852 metres) of Service from a Church in **Bussum**: Sermon by Doctor H. A. Wiersinga on the 13th and 14th verses of the Seventh Chapter of the Gospel according to St. Matthew. 10.25, Epilogue by the Choir, conducted by Mr. Jos. H. Pickkers. 10.40 (approx.), Close Down.

HAMBURG, Call HA (in Morse) (392 metres); 4 kW.—Programme relayed by **Bremen** (273 metres), **Hanover** (566 metres), and **Kiel** (250 metres).—7.20 a.m., Time Signal. 7.25 a.m., Weather Report and Forecast, followed by General News Bulletin. 7.40 a.m., Talk on Contemporary Industrial Questions. 8.0 a.m., Weekly Legal Review. 8.15 a.m., Morning Recital. 10.0 a.m., Talk. 11.55 a.m., The Nauen International Time Signal. 12.5 (for **Hamburg** and **Kiel**), Concert by the Station Orchestra. 12.5 (for **Bremen**), Musical Selections by the Station Orchestra. 12.5 (for **Hanover**), Concert of Gramophone Selections. 1.0, Programme for Children by Funkheinzelmann. 6.0, Talk. 6.30, Sports Talk. 6.40, Sports Notes. 6.55, Weather Report and Forecast. 7.0, Musical or Dramatic Programme. 10.50 (for **Hamburg**, **Bremen** and **Kiel**), North Sea and Baltic Weather Report and Forecast. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—11.40 a.m., Talk by Mr. S. Davidson: "How to Play Chess." 12.10, Musical Programme by the Station Trio. 1.40, Musical Selections by the Indian Hawaiian Band. 7.40, Time Signal. 7.42, Latest News and Announcements; Weather Report and Forecast. 7.50, Musical Programme. 10.40 (approx.), Close Down.

KALUNDBORG (1,153 metres); 7 kW.—Programme also for **Copenhagen** (339.8 metres).—9.0 a.m., Divine Service with Sermon from a Church in **Copenhagen**. 10.30 a.m., to 10.40 a.m. (**Kalundborg** only): Weather Report and Forecast from the **Copenhagen** Meteorological Institute. 2.30, Afternoon Concert by the Station Orchestra conducted by Otto Fessel. 5.50 (**Kalundborg** only): Weather Report and Forecast from the **Copenhagen** Meteorological Institute. 6.0, Press News and Announcements. 6.15, Time Signal. 6.30, Talk. 7.0, Relay of Chimes from **Copenhagen** Town Hall. 7.2, "Et Eventyr i Rosenborg Have": Vaudeville by J. L. Heiberg, Music by C. E. F. Weyse. 10.0, Dance Music Selections by the Palace Hotel Orchestra conducted by Teddy Petersen. In the interval at 11.0, Chimes relayed from the Town Hall at **Copenhagen**. 11.30 (approx.), Close Down.

KATTOWITZ (416.1 metres); 10 kW.—11.15 a.m., Popular Concert by the Station Quartet. 1.0, Talk. 1.20 and 1.40, Two Talks on Agricultural Subjects. 2.0, Weather Report and Forecast. 2.15, Symphony Music by the **Warsaw** Philharmonic Orchestra, conducted by B. Szulc and M. Fliederbaum (Violinist): Symphony in D Minor (César Franck). 4.30 to 5.0, No Transmission. 6.0, Various Announcements. 6.20, Talk. 6.56, Time Signal. 7.0, Talk. 9.0, Weather Report and Forecast, Press Communications and Sports Results. 9.30, Dance Music. 10.30 (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—2.30, Programme for Children of Fairy Tales and Musical Items. 3.0, Programme for Young People. 3.30, Medical Lecture by Doctor Jurgelionis. 4.0, Talk on Economics and the Life of the People by J. Ardiekas. 5.0, Weather Report and Forecast and Press News and Announcements. 5.5, Programme for **Vilna**. Talks in the Lithuanian and Jewish Languages. 6.10 (approx.), Talk for Women by O. Masiotiene. 6.30, Musical Programme.

KÖNIGSBERG (280.4 metres); 4 kW.—Programme relayed by **Danzig** (456 metres).—8.0 a.m. (**Königsberg** only): Sacred Recital of Choral and Instrumental Music. Address in the interval. 10.0 a.m. (**Königsberg** only): Weather Conditions and Forecast. 10.50 a.m., Musical Recital. 11.55 a.m., The Nauen International Time Signal, followed by Weather Conditions and Forecast. 12.0 Noon, Musical Selections by the Scheffler Orchestra relayed from the Central Hotel. 1.0, Chess Talk by P. S. Leonhardt. 2.0, Spanish Lesson for Beginners by Kurt Metze. 9.5, Evening Concert rendered by the Station Orchestra, conducted by Erich Seidler with the collaboration of Alexander Nicolaievitch Tcherepnine: Concerto in C Minor for Pianoforte and Orchestra (Tcherepnine). The Composer at the Piano. Followed by News and Announcements, Sports Notes and Musical Selections. 11.30 (approx.), Close Down.

LAHTI (1,504 metres); 35 kW.—Programme also for **Helsingfors** (374 metres).—8.0 a.m., Relay of Divine Service in the Finnish Language. 9.50 a.m., Press Bulletin and Communications. 10.5 a.m., Musical Programme. 10.50 a.m. (approx.), Weather Report and Forecast and Time Signal. 11.0 a.m., Divine Service Relay in the Swedish Language. 4.57, Time Signal and Weather Conditions and Forecast. 5.10, Historical Lecture. 5.40, Musical Programme. 7.5, "Lieutenant Merenheimo's Dream": Play (Capt. E. Huttunen). 7.45, General News Bulletin in the Finnish and Swedish Languages. 8.30 (approx.), Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres and **Münster** (265.5 metres).—6.45 a.m., Lesson in Self Defence by Dr. Ludwig Bach. 7.5 a.m., Lesson in German Shorthand by Hans Molitor. 7.25 a.m., Lesson in Esperanto by Alfred Dormanns. 7.45 a.m. to 7.55 a.m., Review in Esperanto of the Forthcoming Programmes by Alfred Dormanns. 8.0 a.m., Relay of Church Bells. 8.5 a.m., Catholic Morning Recital of Sacred Music with Address. 12.0 Noon, Orchestral Concert. 1.30, Talk. 3.30, Selections by the Dülken Vocal Quartet. 5.0, Talk by Doctor Harnisch: "How do Animals find their Way." 7.15 (approx.), Musical or Dramatic Programme, Selections of Popular Dance Music conducted by Eysoldt. 11.0 (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—Programme relayed by **Dresden** (276 metres).—7.30 a.m., Recital of Organ Music. 8.0 a.m., Morning Musical Festival. 10.0 a.m., Talk. 10.30 a.m., Talk. 11.0 a.m., Musical Programme. 12.0 Noon, International Time Signal from **Nauen**. 12.2 and 12.30, Agricultural Talks. 5.30, Talk. 6.0, Talk. 6.30, Musical Programme rendered by the Orchestra of the First Battalion of the Tenth Infantry Regiment: Selections from "Eugene Onegine": Opera (Tchaikovsky). 9.0, Late News and Announcements and Sports Notes. 9.30, Programme of Dance Music relayed from **Berlin**. 11.30 (approx.), Close Down.

Programmes from Abroad.—

LYONS (Radio Lyon) (291 metres) ; 1.5 kW.—7.30, The Radio Lyon " Journal Parlé " including General News Bulletin. Press Review, Theatrical Notes and Communications. 8.0, Concert Programme rendered by Madame Ducharne (Pianist), M. Camand (Violinist), and M. Testanière ('Cellist) : Selections from " Les Mousquetaires au Couvent " (Varney). 10.0 (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (427 metres) ; 3 kW.—Programme relayed by Salamanca (EAJ22) (405 metres).—2.0, Relay of Chimes and Time Signal. 2.5, Musical Selections by the Station Orchestra. 3.30 to 7.0, No Transmission. 7.0, Relay of Chimes. 7.5, Programme of Dance Music. 8.0, Talk and Reading : Celebrated Travels, Selections from Exciting Accounts of Famous Voyages. 8.30 to 10.0, No Transmission. 10.0, Chimes Relay and Time Signal. 10.5, Concert of Popular Music : Flamenco Songs rendered by " Niño de la Micaela " accompanied on the Guitar by Vicente Fernandez. 12.0 Midnight, Dance Music Programme from the Alkazar by the Palermo Orchestra. 12.30 a.m., (approx.) (Monday), Close Down.

MILAN, MI (504.2 metres) ; 7 kW.—9.0 a.m., Opening Signal and English Lesson. 9.30 a.m. to 10.30 a.m. (approx.), Sacred Concert of Vocal and Instrumental Music. 11.30 a.m., Time Signal. 11.32 a.m., Musical Selections by the Station Quartet. 3.0, Opening Signal and a Varied Musical Programme by the Station Quintet. 4.15, Selections by the Tzigane Orchestra relayed from the Fiaschetteria Toscana. 5.0 to 6.55, No Transmission. 6.55, Opening Signal. 7.0, Press News and Announcements. 7.15, Talk. 7.25, Sports News and Results. 7.30, Time Signal. 7.35, Relay of " Le Villi " : Opera (Giacomo Puccini). In the Intervals : Talk : " Town and Country," Sports Notes and General News and Announcements. 10.30 (approx.), Close Down.

MOTALA (1,365 metres) ; 30 kW.—Programme also for Stockholm (438 metres), Boden (1,200 metres), Göteborg (346.8 metres), Malmö(229 metres), Oster-sund (720 metres), and Sundsvall (545.5 metres).—10.0 a.m., Divine Service relayed from a Church in Stockholm. 4.0, Programme for Children. 4.55, Chimes relayed from Stockholm Town Hall. 5.0, Divine Service Relay. 6.5, Dramatic Programme. 7.15, Concert of Chamber Music. 8.15, News and Announcements and Weather Conditions and Forecast. 8.40, Concert of Orchestral Music. 10.0 (approx.), Close Down.

MUNICH (536.7 metres) ; 4 kW.—Programme relayed by Augsburg (566 metres), Kaiserslautern (273 metres), and Nuremberg (240 metres).—9.0 a.m., Catholic Morning Festival with Address. 10.0 a.m., Relay of Chimes from the Town Hall. 11.0 a.m., Concert of Chamber Music from Nuremberg. 12.0, Time Signal, Weather Report and Forecast and Review of Forthcoming Programmes. 5.0, Talk. 5.30, Musical Recital. 7.5 (approx.), Popular Concert. 9.20, General News Bulletin. 11.0 (approx.), Close Down.

NAPLES, Call 1NA (333 metres) ; 1.5 kW.—8.30 a.m., French Lesson by Professor Etienne Verdier. 9.0 a.m., Concert of Sacred Music. 3.45, Programme for Children. 4.0, Recital by the Violoncellist, Arnold Foeldsesy : First Performance in Italy of The Oriental Suite (Hugo Becker), (a) Schayzki.—Turkish Song (b) Kotschok—Turkish Dance, (c) Mattinata, (d) Aszraela. 4.30, Time Signal. 7.30, News and Announcements. 7.55, Communications from the Naples Harbour Authorities. 8.0, Time Signal 8.2, Programme of Operatic Music by the Station Orchestra and Soloists. 9.0, Sports Results. 9.50, Calendar and Notes on Forthcoming Programmes. 10.0 (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres) ; 5 kW.—7.56 a.m., Time Signal on 32.5 metres. 9.26, a.m., Time Signal on 1,488 metres. 5.0, Pasdeloup Concert Relay. 7.10 to 7.20, Weather Report and Forecast. 7.20, " Le Journal Parlé," Police Memoirs and Sports Results, etc. 7.56, Time Signal on 32.5 metres. 8.0, Concert, Orchestral Selection : Les Bucoliques (André Dulaurens) ; (a) Les plaintes ; (b) Nymphes au bain ; (c) Le pâtre ; (d) Danse des lutins ; (e) Faunes et Sylvains ; (f) Ronde. 8.50, Silent Night. 10.26, Time Signal on 1,488 metres.

PARIS (Petit Parisien) (336 metres) : 0.5 kW.—8.45, New Gramophone Records. 8.50, Talk. 8.55, News and Announcements from the Press. 9.0, Concert of Orchestral Music with the Assistance of Soloists from the Opéra and Opéra-comique. 9.25, General News Bulletin. 9.30, Symphony Concert, conducted by Professor Estyle of the Paris Conservatoire. 10.0, Late News and Announcements. 10.15, Orchestral Concert, March from " The Prophet " (Meyerbeer). 11.0 (approx.), Close Down.

PARIS (Radio Paris), Call CFR (1,769 metres) ; 15 kW.—8.0 a.m., News and Press Review. 8.30 a.m., Physical Culture Lesson by Doctor Diffre. 12.0 Noon, Religious Talk, followed by Recital of Instrumental and Choral Religious Music. 12.30, News and Announcements. 12.45, Concert of Light Music by the Albert Locatelli Orchestra, with interludes by Bilboquet. 4.30, Latest Gramophone Records, arranged by " L'Industrie Musicale." Late News and Announcements in the Interval. 6.30, Agricultural Report. 6.45, Pathé Gramophone Selections. 7.30 General News Bulletin. 7.45, Guignol Radio Paris " La Farce de Maitre Pathelin "—Parody (Duranty) 8.30, Café Concert. Music Hall Radio Paris. In the intervals, Late News and Announcements, Evening Press Review and Notices. 10.30 (approx.), Close Down.

Sunday, February 3rd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

POSEN (336.3 metres) ; 1.5 kW.—9.15 a.m. to 10.45 a.m., Divine Service, relayed from Posen Cathedral. 11.0 a.m., Time Signal. 11.15 a.m. and 11.30 a.m., Two Talks for Agriculturalists. 11.55 a.m., Address for Peasant Women. 2.15, Relay of Symphony Concert from Warsaw. 4.30 (approx.), Topical Talk by Mr. Winiewicz. 4.50, Programme for Children. 5.20, Musical Recital. 6.0, Bulletin of the Catholic Association of Polish Youth. 6.20, Relay of Talk from Warsaw. 6.45, Talk. 7.5, Miscellaneous Items. 7.30, Concert Programme. 8.15, Recital of Vocal and Instrumental Music, rendered by Mme. Sophie Fedyezkovska (Soprano), Mme. Nazieja Padlevska (Pianist), and Professor Fr. Lukasiewicz (Accompanist). 9.0, Time Signal. 9.5, Sports News. 9.20, Wireless Dancing Class, conducted by Mr. Starski. 9.40, Selections of Dance Music. 11.0 (approx.), Close Down.

PRAGUE (343 metres) ; 5 kW.—12.15, Lecture on a Sociological Topic. 3.30, Selections of Light Music. 4.30, Lecture for Workers. 5.0, News Bulletin and Concert for German Listeners. 5.30, Sports Notes. 9.0, Time Signal and General News Bulletin. 9.20, Concert Selections. 10.30 (approx.), Close Down.

RABAT, Call PTT (416 metres) ; 2 kW.—12.30 to 2.0, Concert by the Radio-Maroc Orchestra. 4.0 to 5.0, Selections of Band Music. 8.15, " Le Journal Parlé," News and Announcements. 8.30, Orchestral Selections. In the interval, at 9.30, Sports Notes and Results by M. Barrier. 10.30, Modern Dance Music Programme from the " Chaumière de Rabat." 11.0 (approx.), Close Down.

ROME, Call 1RO (443.8 metres) ; 3 kW.—8.30 a.m., Opening Signal, followed by German Lesson. 9.0 a.m., Sacred Concert of Vocal and Instrumental Music. 12.0 Noon, Opening Signal. 12.5 to 1.0, Musical Selections by the Station Trio. 1.0 to 4.0, No Transmission. 4.0, Opening Signal. 4.5 to 5.30, Concert of Light Music. 6.50, General News Bulletin and Press Communications. 7.10 (approx.), Talk for Agriculturalists. 7.15, Sports Notes and General Announcements. 7.29, Time Signal. 7.31, Wireless Journal. 7.45, Musical Programme, followed by performance of " The Secret of Susanne "—Lyrical Comedy in One Act (Herman Wolf-Ferrari). In the interval : Reading. 9.50, General News Bulletin. 10.0 (approx.), Close Down.

SCHENECTADY, Call 2XAD (19.56 metres) ; 30 kW.—3.30, Divine Service relayed from the Emmanuel Baptist Church. 6.30, Programme by the Peerless Reproducers from New York. 8.30, Concert of Organ Music by Elmer A. Tidmarsh relayed from the Union College Memorial Chapel. 9.0, Address for Men by Doctor Parkes Cadman from New York. 10.30, Selections of Violin Music by Arcadie Birkenholz relayed from New York. 11.0, Stetson Parade Programme and the American Legion Band relayed from Boston, Mass. 11.30, The Acousticon Programme from New York. 12.0 Midnight, Old Company's Programme consisting of Vocal Selections by Reginald Werrenrath (Baritone) relayed from New York. 12.30 a.m. (Monday), Relay of Capitol Theatre Programme from New York. 2.0 a.m., Lecture on " Our Government " by David Lawrence, Editor of " The United States Daily " from Washington D.C. 2.15 a.m., Atwater Kent Programme from New York. 3.15 a.m., Correct Time. 3.16 a.m., National Light Opera Company Programme relayed from New York 4.15 a.m., Experimental Television Transmission 4.30 a.m. (approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (369.9 metres) ; 2 kW.—2.0 to 3.0, Programme of Dance Music by the Seville Wireless Orchestra followed by New Gramophone Records. 9.30, Concert of Vocal and Instrumental Music. 11.0, Flamenco Songs and Dance Music. Selections by the Station Orchestra. 11.30 (approx.), Close Down.

STAMBOUL (1,200 metres) ; 5 kW.—3.30, Orchestral Concert. 4.30, Stock Exchange Report and Grain Market Prices. 5.15, Concert of Turkish Music. 7.30, Weather Report and Forecast and Time Signal. 7.40, Concert Programme of Orchestral Music. 9.0, Late News and Announcements. 9.30 (approx.), Close Down.

STUTTGART (374 metres) ; 4 kW.—Programme relayed by Freiburg (577 metres).—1.0, Entertainment for Children. 2.0, Talk or Reading. 2.30, Musical Programme. 7.0 (approx.), Concert, Opera or Play followed by Late News and Announcements and Sports Notes. 10.30 (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (383 metres) ; 8 kW.—12.45, Musical Selections. 1.0, Time Signal followed by Concert Programme. 1.45, General News Bulletin supplied by Le Télégramme, L'Express and Le Midi Socialiste. 8.0, Parisian Exchange Quotations and Grain Market Prices. 8.15 (approx.), News and Announcements from the Parisian Press. 8.30, Concert Programme. 9.0, Concert arranged by the Association des commerçants radio-électriciens du Midi : Selections from " Lohengrin " (R. Wagner), (a) The Legend of the Grail, (b) Love Duet, (c) Oh ! My Swan ! At 9.0, in the interval, Time Signal. 10.15, News and Announcements from North Africa and Late News Bulletin. 10.30 (approx.), Close Down.

VIENNA (520 metres) ; 15 kW. — Programme relayed by Graz (354.2 metres), Innsbruck (455.9 metres), Klagenfurt (455.9 metres), and Linz (250 metres).—10.0 a.m., Musical Programme. 7.5 " Der G'wissenswurm " : Play (Ludwig Anzengruber) produced by Hermann Wawra, followed by Selections of Modern Dance Music and Experimental Picture Transmission. 10.30 (approx.), Close Down.

VILNA (426.7 metres) ; 1.5 kW.—9.15 a.m. to 10.45 a.m., Divine Service relayed from a Cathedral. 10.56 a.m., to 4.30, Programme from Warsaw. 10.56 a.m., Time Signal and Relay of Carillon from the Church of Notre Dame at Cracow. 11.5 a.m., Aviation Routes Conditions and Meteorological Report. 11.10 a.m., Concert of Symphony Music by the Warsaw Philharmonic Orchestra conducted by J. Oziminski : Concerto for Violin and Viola with Orchestral Accompaniment rendered by Professor Jean Dvorakovski and L. Dvorakovski. 1.0 to 2.0, Three Agricultural Talks. 2.15, Symphony Concert of the Warsaw Philharmonic Orchestra. 6.45, News and Announcements followed by Time Signal. 7.30 to 10.30, Programme from Warsaw. 7.30, Concert. 9.0, Aviation Routes Bulletin and Weather Conditions and Forecast. 9.5, General Intelligence supplied by the Polish Telegraph Agency. 9.20, Police Announcements and Sports News. 9.30, Selections of Dance Music relayed from the " Oaza " Restaurant, Warsaw. 10.30 (approx.), Close Down.

WARSAW (1,385.7 metres) ; 10 kW.—9.15 a.m. to 10.45 a.m., Divine Service relayed from a Cathedral. 10.55 a.m., Time Signal. 11.0 a.m., Relay of Fanfare from the Church of Notre Dame, Cracow. 11.5 a.m., Notes on Aviation Route Conditions and Meteorological Report. 11.10 a.m., Concert of Classical Music arranged by the Department for Education and Culture of the Magistracy of Warsaw. 1.0 to 2.0, Three Agricultural Talks. 2.0, Weather Report and Forecast. 2.15, Selections of Symphony Music by the Warsaw Philharmonic Orchestra. 4.30, Talk. 4.55, Talk. 5.20, Popular Concert. 6.0, Miscellaneous Items. 6.20, Talk : " In the Land of the Sphinx and the Pyramids." 6.45, News and Communications. 6.56, Time Signal. 7.0, Programme of Intellectual Amusements. 7.30, Evening Concert relayed from Cracow. 9.0, Aviation Routes Conditions and Weather Intelligence and Forecast. 9.5, General News Bulletin from the Polish Telegraph Agency. 9.20, Police Announcements and Sports Notes. 9.30, Programme of Dance Music relayed from the " Oaza " Restaurant. 10.30 (approx.), Close Down.

ZAGREB (308.3 metres) ; 0.7 kW.—10.30 a.m., Orchestral Concert. 4.0, Dance Music Programme. 5.30, Travel Talk. 6.45, Talk. 7.35, Recital of Violin Music by Albertina Ferrari. 8.50, Late News and Announcements and Weather Report and Forecast. 10.0 (approx.), Close Down.

ZÜRICH (489 metres) ; 1 kW.—10.0 a.m., Concert by the Station Orchestra. 3.0, Musical Selections from the Carlton Elite Hotel by the Castellano Orchestra. 6.30, Time Signal. 6.33, Protestant Address. 7.0, Musical Programme. 7.30, Recital of Violoncello Music by Fritz Hengartner : Soloist from the Tonhalle Orchestra with Otto Strauss at the Piano. 9.0, General News Bulletin and Information supplied by the Neue Züricher Zeitung. 9.40 (approx.), Close Down.

BROADCAST RECEIVERS

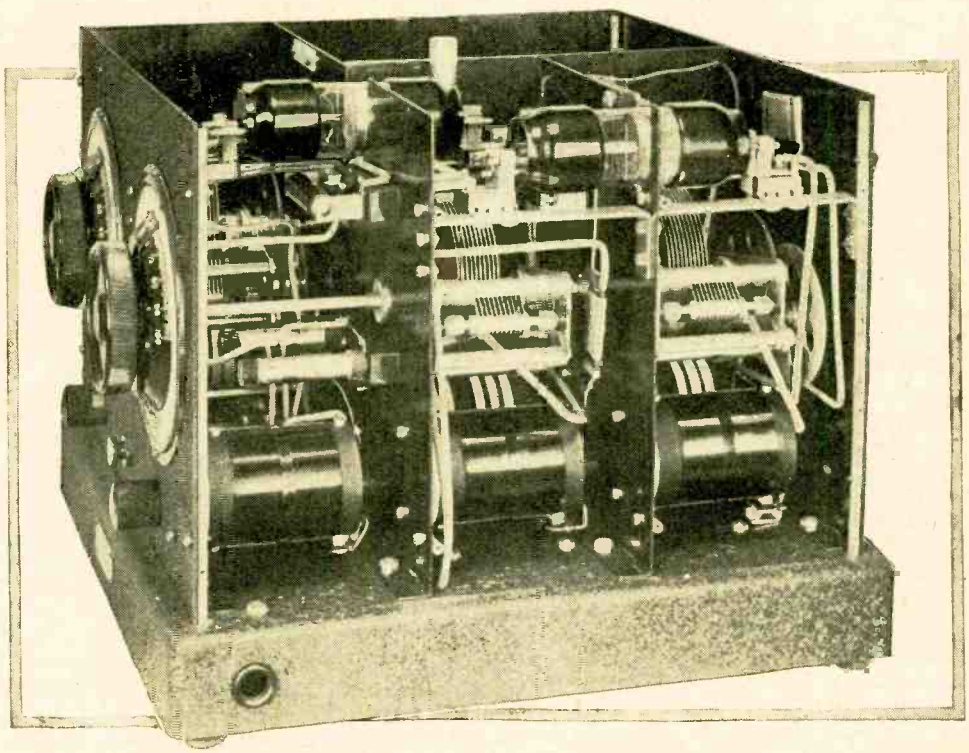
GECOPHONE WORLD WIDE

A Sensitive Long-Distance Receiver, Employing Two H.F. Stages with Screen Grid Valves.

OF the many new receivers of advanced design which made their début at the Radio Exhibition, none has stimulated more interest than the "World Wide 4," made by the General Electric Co., Ltd. The compact and workmanlike appearance and the promise of high performance suggested by its title were the principal topics of discussion. Having now had the receiver under observation for several weeks we can say with confidence that in the matter of sensitivity, the receiver is appropriately named.

The overall sensitivity is mainly due to the use of two stages of H.F. amplification with screen grid valves. Many manufacturers rely on a high degree of L.F. amplification following a sensitive leaky grid detector in order to obtain satisfactory volume from distant stations; they are satisfied if the H.F. stage or stages bring in just sufficient signal strength to stimulate the detector into action. In the "World Wide 4" no single valve is devoted entirely to L.F. amplification, and the only amplification given to audio frequencies is obtained from the step-up of the 4 : 1 transformer, the amplification incidental to the process of rectification and the comparatively small amplification factor of the power output valve. It is reasonable to infer from this that the high-frequency valves are responsible for the greater part of the overall amplification of the set, that the input to the anode-bend detector must be large and that it is therefore functioning under the most favourable conditions.

The policy of relying on the H.F. valves for most of the amplification is, from this point of view, good, but it introduces its own peculiar difficulties and cannot in practice be pursued to its logical conclusion. A high degree of H.F. amplification tends to give undue preponderance to the extraneous noises comprehensively



Side panel removed to show interior of aerial circuit and tuned-anode compartments.

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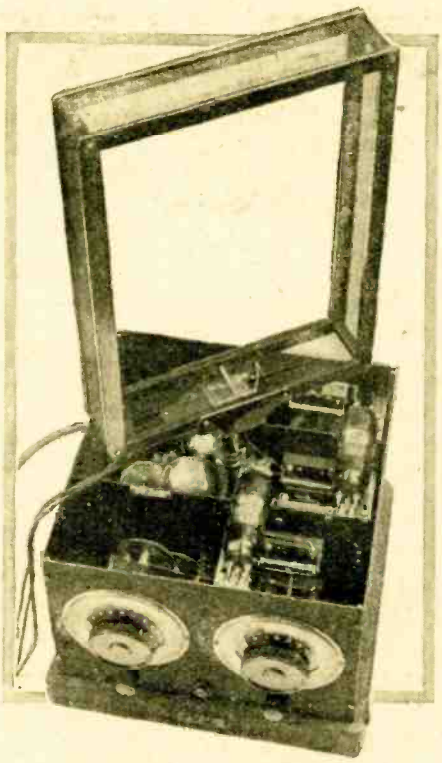
Broadcast Receivers.—

described as "mush." Further, it is difficult to obtain a sufficiently high amplification per stage without sacrificing selectivity. The designers of the "World Wide 4" have adjusted the compromise between amplification and selectivity to a nicety, and the "mush," although bad on an outdoor aerial on long waves, is entirely eliminated by the use of a frame.

The controls of the set are ideal. There is no reaction and only two tuning dials are necessary, one for the aerial circuit and the other for the coupled H.F. circuit condensers. The simultaneous operation of two tuning dials is an easy matter. However, when a third dial is added, unless its function is of an entirely subsidiary character, the control of the set becomes a little difficult for the layman. To dispense with reaction and concentrate on H.F. amplification was a wise decision on the part of the designers. The volume control is a rheostat regulating the filament temperature of the H.F. valves, and the knob operating this component is balanced on the right by a wave change switch. In the centre is a jack switch for breaking both the H.T. and L.T. circuits.



Plan view with lid removed showing mounting of frame aerial.

Compact Assembly.

At Olympia, everyone was favourably impressed by the layout and general appearance of the set. The crystalline enamelled metal cabinet measures only 12in. × 12in. × 9in., and the compact arrangement of the components in the various screening compartments with the two double-ended screen grid valves in accessible positions near the top suggests soundness and efficiency. The detachable lid is held down by a single knurled nut which screws on to a ¼in. brass post rigidly mounted on one of the screening partitions. The base of the Gecophone frame aerial is threaded to fit this screw and rotates immediately above the centre of the cabinet—a particularly neat arrangement. The only fault to be found in the layout relates to the accessibility of the aerial, earth and frame connections. These are made to terminal panels mounted inside the hollow base, and it is necessary to turn the set on its side and unscrew the metal bottom before the leads can be changed. Of course, if it is decided to receive only on the frame or alternatively on an outside aerial system, the connections are permanent and need only be made once, but in such a versatile set it is an advantage to be able to change rapidly from one type of aerial to the other; each system has its peculiar advantages and, to realise the full possibilities of the set, both should be used. A system of plugs and sockets would meet the situation.

There is a noticeable difference between the behaviour of the set on long and on short waves. In the particular receiver tested the H.F. circuits were functioning much nearer the oscillation point on long waves than on short. On one or two occasions the set did actually oscillate in the long-wave band, and the filament rheostat had to be turned down slightly for stable working. It is quite legitimate to make use of inherent reaction effects in this way, provided they are under control; it is, in fact, now accepted as one of the basic principles of design when using screen grid valves for H.F. amplification. On the short-wave band, however, there was no trace of self-oscillation and, if anything, the set was over-stabilised.

As a consequence there was more amplification on long waves than could be usefully employed on an outdoor aerial. Unless the volume control was turned well down, "mush" was rather overpowering and distant stations like Königswusterhausen, Boden and Warsaw had to be toned down after the manner of 5XX. When the frame aerial was put into use, however, the signal strength from the same stations still gave full loud speaker volume and the "mush" receded to a negligible level. On short waves there was no "mush" with an outdoor aerial and the amplification was just sufficient to give full loud speaker volume on the principal European stations. With the short-wave frame, only 2LO and 5GB could be received at full loud speaker strength in London. A few German stations were just audible, but it would not be fair to log them as stations received.

Range and Selectivity.

To extract the best from this receiver, therefore, an outdoor aerial should be used on short waves, and a frame on long. Under these conditions station after station can be picked up with ease and certainty. After dark all the long-wave stations on the list came in at good strength. The selectivity is such that Zeesen (Königswusterhausen) can be received between 5XX and Radio Paris without a trace of interference from either of these stations. The short-wave performance on an outdoor aerial is equally good, and one can tune-in most of the European stations at will. At a distance of 1¾ miles the interference from 2LO spreads about 15 degrees on either side of its true dial setting at resonance which indicates good selectivity having regard to the high overall amplification.

The quality of reproduction judged from an absolute standpoint, is reasonably good; for a sensitive long-distance receiver it is very good. A P625A valve is specified for the output stage, and will handle more volume than is normally required.

Broadcast Receivers.—

In our opinion a P625 would have been more than adequate for this stage, and would have the advantage of increasing L.F. amplification and reducing the drain on the H.T. batteries. The total H.T. current taken by the set is over 30 mA. when using a P625A under the conditions specified by the makers. This is rather a heavy current for dry cells, even of the "super-capacity" type. With a P625 in the output stage the current would not exceed 20 mA.

Returning to the question of quality, it goes without saying that best results are obtained from the local and high-powered stations. There are two ways of reducing the volume from these stations to a reasonable level, (1) detuning both dials, one to the left and the other to the right of resonance, (2) dimming the filaments of the H.F. valves, i.e., manipulating the "volume control." In practice we found that the best quality was obtained when the reduction of volume was shared equally between these two methods.

The circuit is straightforward and deviates little from standard practice. The screen grid valves are coupled by the tuned-anode method with long-wave and short-wave coils in series. A separate tuning condenser is mounted with the aerial coils in a compartment running parallel with the front panel. Two smaller compartments are allocated to the tuned-anode circuits and their condensers are ganged, with a semi-variable balancing condenser across one circuit to compensate for any slight differences of capacity incidental to manufacture. The ebonite spindle of the wave-change control operates contacts in each compartment which short-circuit the long-wave coils when not in use.

Both H.F. valves are biased to 1½ volts negative through 2 megohm leaks, a stopping condenser being inserted in series with the grid of the first valve to prevent short-circuiting of battery through the aerial coils. The H.T. feed to the anodes of these valves is passed through a series resistance to prevent coupling with the remainder of the circuit, but the screen-grid potential is obtained direct from the battery by means of a separate tapping. It is interesting to note that the by-pass condensers for the anode and screen grid feeds consist of two separate condensers in parallel; this has the effect of reducing the H.F. resistance. The by-pass condensers are all mounted underneath the set in the hollow base.

The price of the "World Wide 4," inclusive of valves and royalty, is £23 10s.—with H.T., L.T. and grid bias batteries, £28. Two frame aerials for long and short waves cost £3 14s. complete with connectors.

To conclude, we would say that the "World Wide 4" is a receiver which fully justifies its title. When working from an outdoor aerial on short wave-lengths and a frame on long, the amplification is sufficient to bring in at loud speaker volume all stations whose signal strength is greater than the level of extraneous noise due to atmospherics. On long waves there is more amplification than can be usefully employed, and on short waves the amplification is adequate, provided an outdoor aerial is used.

Club News.

Spreading the Good News.

The Swindon and District Radio Society has considerably increased its attendances in consequence of a tour round the town by a van equipped with loud speakers from which announcements were made regarding forthcoming meetings and the advantages of joining the Society. The first meeting of the new year was a "Short-wave Night," some of the members bringing their home-made short-wave receivers. At the last meeting a demonstration of resistance capacity coupled amplifiers working on mains units was given by Mr. A. Dalton Pope, who also made a comparative test on moving coil loud speakers and the Amplion "Lion."

Hon. Secretary, Mr. M. Hill, Windyridge, Okus, Swindon.

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A Debate on Bass Notes.

"Open discussion is good for the soul" according to the South Croydon and District Radio Society, which started the new year with a record attendance of members on Jan 8th, to take part in open debate on a number of controversial subjects. The keenest discussion centred on the reproduction of bass notes in the modern wireless set. There were many divergent views on the merits of the coil-driven loud speaker, several members contending that this device accentuated the bass notes to the detriment of the treble.

The Society is pursuing its campaign for new members, and all wireless enthusiasts in the district are invited to send a card of enquiry to the Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

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Thermionic Voltmeters.

Moullin thermionic voltmeters were dealt with in a lecture given recently before the Muswell Hill and District Radio Society by Mr. F. L. Best, A.M.I.E.E., of the Cambridge Scientific Instrument Co. These precision instruments, of which there is a range of models for different purposes, depend for their action upon the change in anode current resulting from the application of the voltage which it is desired to measure. Alternating voltages of radio frequency may readily be determined. The lecturer showed the extreme accuracy of the readings which can be obtained with this type of instrument, and pointed out its great advantage, namely, that it does not appreciably load the circuit into which it is introduced—a fault to which many voltmeters are subject.

The Society has arranged an interesting programme, and new members are welcomed. Hon. Secretary, Mr. G. Scott Sessions, 29, Grasmere Rd., Muswell Hill, N.10.

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Push-pull Amplification.

Push-pull amplification was dealt with in an interesting manner by Mr. Garside, of Messrs. Ferranti, Ltd., at a recent meeting of the Golders Green and Hendon Radio Society. The lecturer demonstrated with part of the public address equipment used at the Manchester Exhibition, the loud speaker being a large Celestion model C.24. The demonstration set consisted of one stage of screened grid H.F., detector and two stages of push-pull amplification. Four PX650 B.T.H. valves were in the output stage. Needless to say, this arrangement was capable of enormous volume, but it should be added that the quality was in no way inferior.

The Society welcomes enquiries from prospective members who are interested in wireless or who require advice regarding their sets. The Society does not neglect the social side, dances being held at regular intervals. The next dance will be held to-morrow, Thursday, Jan. 31st. All enquiries should be addressed to the Hon. Secretary, Lt.-Col H. Ashley Scarlett, D.S.O., 60, Pattison Road, N.W.2

A Radio-Gramophone Concert.

The Bec Radio Society (Balham) has prepared an interesting syllabus covering the next few months. All wireless enthusiasts in the district will be warmly welcomed at any of the meetings, and should apply for particulars of membership to the Hon. Secretary, Mr. A. L. Odell, 171, Tranmere Rd., S.W.18. The Society recently held a radio-gramophone concert, using an H.M.V. automatic gramophone supplemented by a Brown pick-up, amplifier and moving-coil loud speaker.

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Southend Radio Exhibition.

Over 4,000 people visited the recent exhibition of the Southend Radio Society. Local radio dealers responded nobly to the Society's invitation to exhibit, all available space being taken.

Some handsomely finished receivers were to be seen in the amateur section, where any bona fide amateur constructor could enter his handiwork. The silver championship cup offered for the exhibit showing exceptional merit was won this year by Mr. H. H. Burrows, chairman of the Society, with a screened-grid three-valve receiver. The circuit and layout showed originality, the workmanship being of an exceptional high order. First prizes were awarded to the following in the various sections: Set by High School Boys, S. R. Wilkins; Set by Elementary School Boys, R. Thorn; Short-wave sets, Mr. R. Denham; Three-valve sets, Mr. J. Morrell; Four-valve sets, Mr. J. Morrell; Loud Speakers—specials: Messrs. J. G. Ward, A. Knipe, E. W. Lockhart, J. Morrell, C. Guard; Eliminators, Mr. E. W. Lockhart; Wavemeters, Mr. A. Knipe; H.F. Chokes, Mr. H. H. Burrows Potential Dividers, Mr. D. Bishop; Various Units (unclassified), Mr. D. Bishop; Cabinets, Mr. J. Morrell; Transmitters, Mr. R. C. Horsnell.

During the afternoon and evening, Mr. F. H. Haynes, of "The Wireless World," in co-operation with Wireless Pictures, Ltd., demonstrated the Fultograph method of picture transmission and reception.

Designing, Fitting, and Making the Shunts.

By A. L. M. SOWERBY, M.Sc.

(*Continued from page 90 of last week's issue.*)

FROM what has already been said in the first part of this article it will be realised that we must be prepared to connect range-extending resistances both in parallel and in series with the meter, for reading currents and voltages respectively. The exact arrangements adopted for fitting these resistances must depend partly on the personal taste of the user, and partly on the individual peculiarities of the meter that is to be employed. There are, however, some points that are applicable to all cases and to which attention may be drawn here.

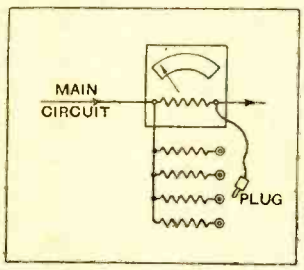

Fig. 6.—A possible, but very dangerous, mode of arranging for interchangeability of the shunts.

First, it must not be forgotten that the resistances of some of the shunts, especially those for the higher current ranges, will be quite low, so that any small variations of resistance that may occur through such causes as bad contacts and the like must only be suffered to arise at comparatively safe points in the circuit. An example of thoroughly bad design is shown, as an awful warning, in Fig. 6, where the meter is connected in circuit by two terminals and the shunts are connected to separate sockets so that by moving a plug any desired shunt can be brought into use. Suppose the plug becomes dirty or ceases, through old age, to spring out sufficiently well to make good contact with its socket. Even if the contact resistance developed here is only $\frac{1}{100}$th of an ohm, it will make a very appreciable difference to the total resistance connected across the meter terminals for the higher ranges, where the resistance of the shunt may be only $\frac{1}{4}$ ohm. This variation will lead to an error of about 4 per cent., while if the contact resistance at the plug rises to $\frac{1}{10}$th ohm the error will be some 40 per cent., the meter reading 1.4 amps., when 1.0 amp. is really flowing.

Such a design leads to the further danger that one may thoughtlessly change over from one range to another when the current is flowing, when the meter will be momentarily unshunted and the whole current will therefore pass through it. Unless the meter is fitted with a fuse this will probably entail the purchase of a new meter and the repetition of all the work of shunt-making.

Avoiding Pitfalls with Shunts.

Compare the arrangement shown in Fig. 7 with that just discussed; here the current is applied direct to the shunt and the meter is connected in circuit by the plug. In this case if the plug is removed the meter is disconnected so that the danger of burning out the meter is completely avoided. Suppose now a contact resistance of $\frac{1}{100}$th ohm develops through corrosion of the plug. This extra resistance is no longer in series with

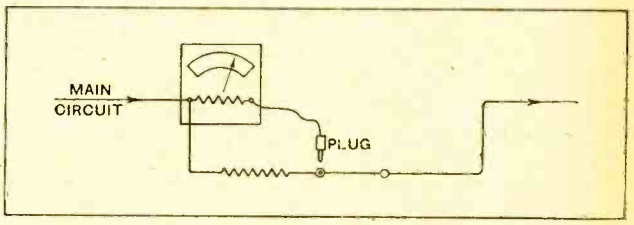

Fig. 7.—This shows the only safe way of employing plug-and-socket connections for joining the meter to the shunt.

the shunt, but only with the meter. If, as is about usual, the meter has a resistance of 50 ohms, the total resistance of meter *plus* bad contact will be augmented to 50.01 ohms—a variation of $\frac{1}{50}$th of 1 per cent. Even $\frac{1}{10}$th ohm contact resistance will only introduce an error of $\frac{1}{5}$th of 1 per cent. into the reading—which is considerably less alarming than the 40 per cent. error introduced *by the same resistance* into the arrangement of Fig. 6.

From this the general rule emerges; the shunt must

One Meter Many Purposes.—

be connected directly in the main circuit by a positive connection, and the meter must then be connected across the shunt. In practice, this makes the use of a plug-and-socket arrangement for range changing inconvenient, for each shunt must have its own terminal for connection into the main circuit. If this is done, the meter can then be plugged on to the shunt in use, as in Fig. 8, which is simply a development of Fig. 7, to cover a number of ranges.

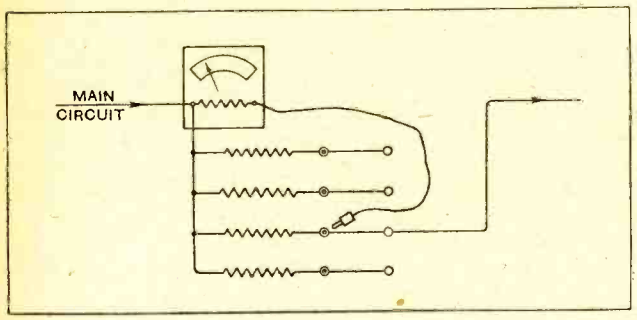

Fig. 8.—A development of Fig. 7, to cover a number of ranges. This is sound, but inconvenient.

This leads, unfortunately, to an awkward arrangement in which range changing involves first moving the main connection from one terminal to another, and then moving the meter plug to the corresponding new socket —two operations in all. If it is desired to build up meter and shunts into a self-contained unit, however, this is the only disposition of the connections that should be adopted, and a design, satisfactory in all things but the need for shifting two connections for changing the range, may be based upon Fig. 8.

The Series Resistances.

The writer has adopted for his own purposes another method, which calls for less constructional work, in which the shunts are mounted up as loose components (see Fig. 9) which can be clipped upon the terminals of the meter as required. In this case it is essential that the terminals for connection into the main circuit should be upon the shunt itself, so that any contact resistance that may make its appearance at the junction of meter and shunt shall be in the meter circuit only, as was the case with Fig. 7.

Having thus disposed of the mechanical details of connecting the shunts, let us consider the series resistances used for voltage measurements. Here, since the connection is a series one, and the resistance of the whole circuit is very high, the presence of contact resistances of the order of a fraction of an ohm, or even of several ohms, can be entirely neglected by comparison. Even a complete disconnection would result in nothing more disastrous than a complete failure of the meter to read anything at all until the fault is rectified.

If the self-contained unit is wanted, the resistances can therefore be arranged for connection by means of a plug and a series of sockets, as shown in Fig. 10, without danger of inaccuracies. If separate clip-on resistances are preferred, a third terminal, connected to nothing (T_3 of Fig. 11), may be fitted to the meter, so that the series resistances may be clipped on, as though they were shunts, to terminals T_2 and T_3. A third possibility is that the resistances may be mounted on a separate unit and connected in series with the meter as required. This opens the way to a much greater ease of construction, for the space available for the resistances on a separate unit may be made as great as desired, so that the annoyance of handling very fine resistance wire, necessary if the clip-on mode of fitting is chosen, can be avoided. Further, it becomes possible to use commercial wire-wound anode resistances in this rôle, provided that some means is found of adjusting the meter reading to the correct value. This, while it runs up the cost of the equipment, lightens the work so enormously that the extra expenditure will be considered well worth while by most people.

Constructional Details.

It is not, of course, possible to give constructional details that will be applicable to all meters or to all tastes, but it may be of assistance to many to give details of the mechanical construction of shunt and resistance carriers for one case. It will be seen that carriers of the same dimensions can be used for any meter if it is first mounted up and connected to three terminals spaced as in the example given. Again, the electrical details (resistances of shunts and so forth) will be different for different meters, but it is thought that it will be helpful if the actual calculations for a particular case are given, together with the accuracy attained, so far as the writer's other instruments were capable of assessing it, with each of the shunts.

The meter used as a basis for the work was an Elliot voltmeter of range 0-25 volts, and therefore was, as it stood, unsuitable for converting into a multi-range instrument. It was accordingly opened up, and the series resistance which it contained was removed, thereby converting it into an uncalibrated milliammeter of unknown internal resistance. Measurement of its internal resistance gave the value 44.7 ohms, and it was noticed that the series resistance that had been employed to convert it into a voltmeter had the figure "2420" scratched upon it. On checking, this proved to be its resistance in ohms, so that the total resistance of meter and series resistance together was 2464.7 ohms. At 1 volt this resistance will pass 0.4057 milliamp., so that as a milliammeter the "volts" on the scale must be multiplied by this figure to obtain the current flowing. Full-scale deflection was thus 10.14 milliamps.

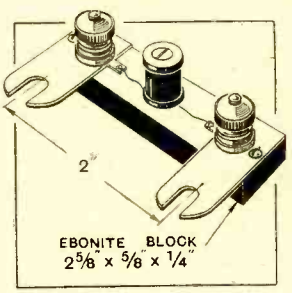

Fig. 9.—A shunt specifically designed for the meter illustrated in the text last week. By altering the dimensions it could be made suitable for any meter.

The original terminal strip of the meter, which carried two terminals only, was replaced by a new one with three, connected as shown in Fig. 11, the meter being joined to T_1 and T_2 in such a sense that T_1 was the

One Meter Many Purposes.—

negative terminal, while T_3 was a dummy for carrying series resistances for the lower voltage ranges. The three terminals were in a straight line, with 2in. between each one and the next.

A series resistance was then made up; the value was chosen so that 2 volts would give nearly full-scale deflection on the meter. Since $R = \frac{V}{I}$, and V is to be 2 volts and I about 10 mA., the nearest round number is $\frac{2}{0.010} = 200$ ohms. A resistance of about this value was wound up, with soldering tags as its end connections, so that variations in the exact point of connection

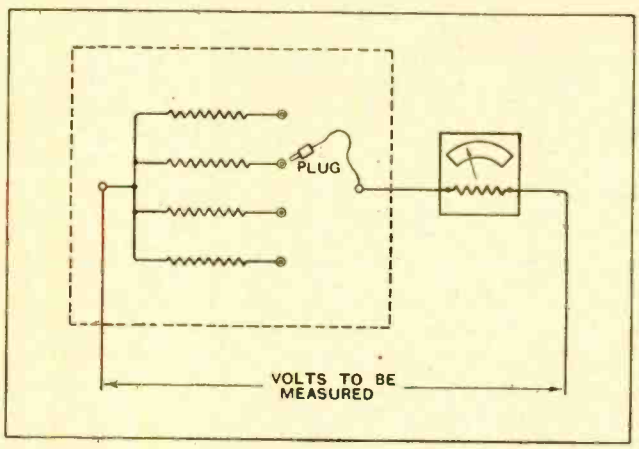

Fig. 10.—No danger arises through using plugs and sockets for alternative *voltage* ranges. If desired, a separate voltage range box, as suggested by the dotted lines, may be made up with connections as shown.

to the wire could not occur. The value of this resistance was adjusted accurately to 200 ohms with the aid of other instruments that were available.

Cleaning the Connections with Acid.

The writer was then in possession of the calibrated meter of known internal resistance and a standard resistance of known value, which represent the equipment that has been suggested as the starting-point for the making up of shunts and series resistances by the method recommended. The other instruments were then put away, and the task was started in earnest.

First some shunt carriers were made up to the dimensions shown in the illustration. The metal clips used were old crystal detector parts, and were carefully cleaned before use by a rapid dip into concentrated nitric acid, followed by a good rinse under the tap. The bobbins were of ebonite, and may be obtained from the Grafton Electric Co., Grafton Street, Tottenham Court Road, London, W.1. One of these shunt carriers, with two terminals, will be required for each current range to be covered; each voltage range, unless an external resistance is to be used, will need a carrier with a single terminal.

The first task undertaken was the conversion of the meter, which, it will be remembered, has a 0-25 scale, into a voltmeter reading to 2.5 volts. An accumulator cell was joined in series with the meter and the 200-ohm resistance, and the deflection noted. It was 21.57, so that the current flowing was $21.57 \times 0.405 = 8.752$ mA. The total resistance in circuit was 244.7 ohms, so that the voltage of the cell was $244.7 \times 0.008752 = 2.141$ volts.

For a current of about 10 mA. on $2\frac{1}{2}$ volts the resistance required is $\frac{2.5}{0.010} = 250$ ohms; reference to the wire table shows that 6 yards of 42-gauge Eureka wire will have rather more than this resistance. This length of wire was therefore measured out roughly, doubled in half, and the two ends put through tiny holes drilled in one end of one of the ebonite bobbins. The wire was then wound on to the bobbin so that the loop in the middle of the wire was on the outside of the winding. The bobbin was mounted on a carrier with but one terminal, and the free ends of the wire soldered to two soldering tags held by the fixing bolts of the metal clips.

Final Checking of Resistances.

The mounted resistance was then slipped over terminals T_2 and T_3 and the terminal on the series resistance was connected to the positive terminal of the cell, and T_1 to the negative. The meter indicated about 1.8 volts, thus showing that the resistance was too high in value. A short length of the doubled wire was unwound from the bobbin, cut, and the free ends soldered together again. The deflection of the meter was now greater than before, but still not great enough. The shortening process was continued, making more and more cautious cuts each time, until the meter read exactly the 2.14 volts required. The wire was then protected from damage by winding over it some insulating tape of appropriate width to slip between the flanges of the bobbin. On checking against another instrument the discrepancy between the two was found to be about 0.5 per cent., so far as it was possible to read so small a difference.

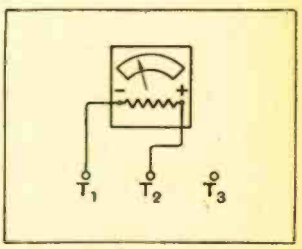

Fig. 11.—Connections of meter to terminals adopted in the instrument photographed in the first instalment of this article.

Encouraged by this, the making of shunts was next attempted. For the meter being used, the first shunt made up was one that "corrected" the scale, i.e., one which would make each scale division 1 milliamp., giving a range to 25 mA. Since originally 1/0.406 division represented 1 milliamp., this shunt had to multiply the range by 1/0.406 or 2,465, and the resistance required was therefore $\frac{1}{2.465 - 1} = \frac{1}{1.465} =$ 0.682 times the resistance of the meter; $0.68 \times 44.7 =$ 30.6 ohms, so that, by reference to the wire table given last week, $3\frac{1}{2}$ yards of 34-gauge Eureka wire was measured off, giving a resistance a little higher than that required.

(To be concluded.)

A Review of Manufacturers' Recent Products.

OLDHAM H.T. UNITS.

Some interesting changes have been made in the construction of the high-tension accumulator units made by this firm since last we reviewed their products[1]. It will be recalled that each cell was attached to neighbouring ones by bitumen sealing compound, which virtually resulted in a continuous surface, and, if this became moistened by acid spray, there was the possibility of leakage taking place.

The latest development consists of air spacing each cell by moulding small studs on the outside of each container, thereby reducing the possibility of leakage to a minimum. This is known as the "Isola System," and is to be adopted in all their

Oldham 10-volt unit with air spaced cells.

units from now onwards. The method hitherto adopted for sealing and interconnecting the plates between cells will be retained, but the price has been reduced. The large capacity type LH TL, which has a capacity of 5,500 milliampere hours, is now 7s. 3d.

The makers are Messrs. Oldham and Sons. Ltd., Denton, Manchester.

[1] *The Wireless World*, July 4th, 1928, p. 20.

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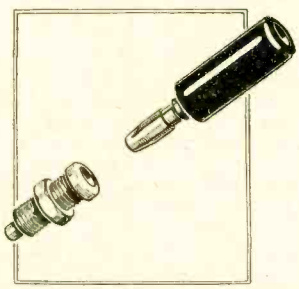
"CLIX" POWER PLUG AND SOCKET.

These have been designed specially for heavy duty battery eliminators, chargers or similar use, and are virtually big



Clix power plug and socket.

brothers to the standard size wander plug and socket. The socket, which is provided with a $\frac{3}{16}$in. hole, fits practically flush with the panel and requires a $\frac{1}{4}$in. diameter hole for fixing.

The plug is of the familiar "banana" pattern, which ensures a more certain contact than the split-pin type, and, moreover, does not require constant adjustment. A polished Erinoid sleeve covers the top of the plug, and the method of attaching the wire is the same as in other plugs of the same make. Lateral grooves are cut in the metal with a hole for anchoring the lead, and when the sleeve is screwed home it grips the wire firmly, making a good electrical connection.

A further addition to the Clix range is a large size spade terminal intended primarily for finishing off L.T. leads to the accumulator. The contacting surfaces are lead coated to prevent the acid attacking the metal.

The price of the power plug and socket is 4½d., and the spade terminals 2d. each. Both are supplied in either black or red, and the makers are Lectro-Linx, Ltd., 254, Vauxhall Bridge Road, London, S.W.1.

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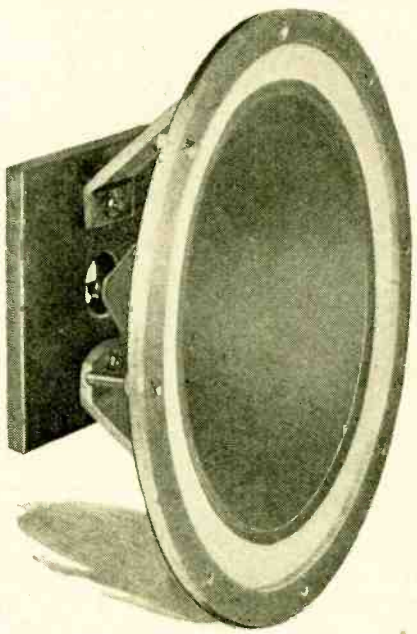
ZAMPA FLOATING CONE.

This consists of a cone, six inches in diameter, mounted on supple leather clamped between two aluminium rings.



"Zampa" cone for reed or balanced armature units.

The general construction closely follows moving coil practice, though in this case

provision has been made for attachment to a reed-driven or balanced armature loud speaker unit. The aluminium chassis can be fixed either to a baffle board or in a cabinet of suitable dimensions.

A small spring chuck provides a simple yet rigid fixing for the driving spindle of the unit, and also holds in position two cone-shaped washers, the particular function of which is to strengthen the apex of the cone and enable it to withstand the driving action of the unit. The cone is constructed from specially prepared material, which in appearance somewhat resembles stout brown paper, but is of a much finer texture. It is light in weight, and is claimed to be immune to atmospheric changes.

The makers are the Mic Wireless Co., Market Street, Wellingborough, and the price is 12s. 6d.

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CENTRALAB PRODUCTS.

Centralab wireless accessories are manufactured by the Central Radio Laboratories, Milwaukee, Wis., U.S.A., and distributed in this country by the Rothermel Corporation, Ltd., 24-26, Maddox Street, London, W.1. Wide use is made of bakelite mouldings, and many of the components exhibit that mechanical ingenuity for which our friends across the seas are noted. Among the components reviewed is a heavy duty potentiometer with a maximum resistance of 10,000 ohms. The resistance element

Centralab 10,000 ohms wire-wound potentiometer and filament rheostat for single hole fixing.

is of the wire-wound type, and accordingly admirably suited for use in battery eliminators or other similar circuits where the current flowing is too high for the average graphite type to carry. The particular specimen tested showed a maximum value of 10,400 ohms. It is provided with three contact lugs, one at each end of the resistance and one for the slider, so that the device can be used either as a potentiometer or as a variable high resistance. The wire is wound on a strip of asbestos 1in. wide bent in circular form, this being protected by a metal cup-shaped cover 1⅝in. in diameter. The large area of the winding enables rapid radiation of heat, and all resistances in this range are rated to dissipate 15 watts. This type of high-resistance potentiometer is made with various resistance values, ranging from 2,000 to 50,000 ohms, and all are wire wound.

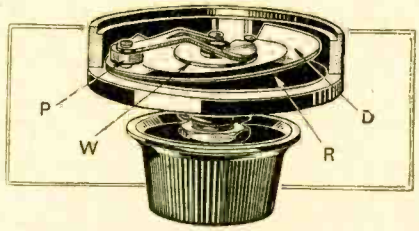
It is often very convenient to control the volume of output by means of a high resistance in a part of the circuit not passing D.C. currents, and in these cases

Two types of Centralab volume control.

the Centralab graphite-strip type is admirably suitable. Resistances of this type are made in values ranging from 200 ohms up to 500,000 ohms, and are provided with three terminals for use as a potentiometer if required. The principal point of interest in connection with these components is that the moving contact does not rub directly on the resistance element, but travels over a disc-shaped spring which is pressed into contact with the track by the moving arm. The spindle and the contact arm are insulated from both the resistance and the spring disc, thereby enabling the component to be mounted direct on a metal panel without first bushing the fixing holes with insulating material.

The sectional drawing will help to explain the construction of this device. P is the moving arm provided with a small insulating stud; D the spring disc; W an insulating washer; and R the resistance element.

The 250,000 and 500,000 ohms accessories are termed modulators, and in these the resistance does not change in direct proportion to the movement of the control knob. The resistance is not constant per unit length, but it is so graded as to give a bigger change in value per unit length at one end. The aim of the designers has been to evolve a device which gives smooth and even control of volume, so that it is advisable



Method of varying the resistance in Centralab volume controls is shown clearly in this sectional drawing.

when fitting these components to find by trial and error the correct way round to connect the terminals at each end of the resistance element.

Before leaving the subject of volume control mention must be made of the Modu-plug which is a combined loud speaker, or telephone plug and volume control. This is inserted in the jack on the set, if one is provided, and the telephones attached to the spring clips under the moulded cover on the volume control. For use in cases where terminals are provided in place of a jack, this device can be supplied with cords in place of the plug. The sample illustrated and reviewed was the latter type, and measurements showed the resistance to be in the order of 50,000 ohms. This comprises a graphite track, and the method of varying the resistance in the circuit is the same as that adopted in the larger sized volume control and modulators described above, only in this case the physical dimensions are much smaller.

A wide range of filament rheostats is included also in this firm's products. The particular model illustrated is the 6-ohm type, but others are available ranging from 0.5 to 500 ohms.

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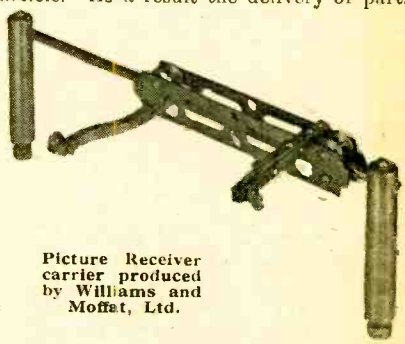
CARRIER FOR PICTURE RECEIVER.

In accordance with established practice the design details of the various component parts specified for *The Wireless World* Picture Receiver were not broadcast to the manufacturing trade prior to the publication of the constructional article. As a result the delivery of parts



Picture Receiver carrier produced by Williams and Moffat, Ltd.

must necessarily be slow. The situation as to supplying parts has been rendered all the more difficult by the demand being unexpectedly large.

Components are now coming to hand, and the accompanying illustration shows the carrier as produced by Williams and Moffat, Ltd., Ladypool Road, Sparkbrook, Birmingham.

For convenience of manufacture certain details of construction have been modified though the leading dimensions exactly agree with those given. An excellent feature is the provision of ball race mountings for the pulley wheels, giving a slow traverse without side play. The platinum point of the stylus is carried in an ebonite block, tension being applied by a spring bronze leaf. Construction is robust, while careful scrutiny reveals that this component can be recommended as entirely suitable for inclusion when building the Picture Receiver.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Brussels Plan in Practice.—French Visitors.—Wireless "Sabotage."

Reviewing the New Wavelengths.

Despite the confusion in the Continental ether which the *Plan de Bruxelles* has done little to alleviate, the B.B.C. engineers at Keston are not dissatisfied with the results of the scheme over here. A careful check has now been made on the conditions experienced by each of the B.B.C. stations, and it has been found that interference is less noticeable than before the change.

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Interference from Small Fry.

5XX is still suffering from interference by Lahti. The heterodyne on 2LO, to which I referred last week, has not yet disappeared, but the B.B.C. is inclined to absolve Graz, which was the station originally blamed. The offender is believed to be one of those smaller Continental stations which have never quite mastered the intricacies of the Brussels wavemeter.

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Three Lucky Stations.

5GB and Glasgow are both slightly heterodyned, but Belfast, Plymouth, and Cardiff, the three luckiest of all, are able to report "all clear."

On the other hand, Newcastle has gained nothing by its giddy drop to 243.9 metres. Nuremberg is a nightly offender on this wavelength, and the B.B.C. engineers accuse it, not of heterodyning, but of producing a "wipe out" effect!

Aberdeen would be quite happy if Zagreb would close down or make an appreciable change in its wavelength.

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On the Common Wavelength.

The stations working on the common wavelength of 288.5 metres—Bournemouth, Bradford and Edinburgh—are much more comfortable than they were a week ago, when a slight "wobble" on Bournemouth's part was producing very unpleasant results in the north.

Manchester is being heterodyned by a C.W. station which has not been identified. Fortunately its signals are weak.

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Sir Thomas Beecham.

It would not surprise many who know Sir Thomas Beecham if his forthcoming liaison with the B.B.C. in the development of a National Symphony Orchestra were to produce some electrification of the atmosphere at Savoy Hill. The direction of the musical side of B.B.C. activities is a jealously guarded prerogative, but eminent conductors have been known to tilt at prerogatives and sometimes to upset them.

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More Music Hall Broadcasts.

The fact that the B.B.C. has come to terms with Sir Oswald Stoll is yet another indication of an inevitable change of attitude on the part of the music halls. Certain variety interests, including the Gulliver group, have still to recognise that broadcasting, in small doses, can increase box-office receipts, but the "conversion" of Sir Oswald Stoll can be counted a signal victory for the microphone.

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That De-rating "Debate."

If there are to be any more broadcast "debates" of the kind staged last week, many listeners will be turning their attention to silkworm culture or some other comparatively lively pastime. The organisers of the De-rating debate erred in placing each speaker in solitary confinement, the outcome of this policy being to turn the affair into a succession of fearfully and wonderfully made talks in which the sparkle of real debate was almost entirely absent.

No doubt thousands of listeners were quite eager to hear the *pros* and *cons* of de-rating from the mouths of experts, but the B.B.C. choose a faulty method of presentation.

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French Amateurs to Visit London.

The people of Lille possess one of the best broadcasting stations owned by the French Post Office. They take a keen interest in wireless, and the local Radio Club is organising a "study" trip to London for the purpose of learning the "latest" that is to be seen and heard in the British metropolis.

Both the Daventry stations will be visited, and the "Lillois" will be officially welcomed by representatives of the B.B.C. The trip will take place in the early days of spring.

Publicity for British Goods.

This visit offers a good opportunity to the wireless trade to acquaint French amateurs with the latest types of British apparatus. The French are greatly interested in British wireless developments, but their chances of studying our gear are few and far between.

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A Squabble in Toulouse.

Not all French listeners are so fortunate as those of Lille. In the south-west the wireless public are helpless spectators of a perpetual squabble between the privately owned stations and the Post Office.

The latest battle has been waged over the operatic transmissions from the Capitole Théâtre at Toulouse. The well-known station Radio Toulouse, wished to rebroadcast the performances, but was refused a landline by the Post Office, which owns the rival station of Toulouse PTT. Thereupon Radio Toulouse installed its own short-wave transmitter on the theatre roof.

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Interference.

On the first night of the transmissions the results were so good that listeners imagined that a landline was being used instead of a wireless link. On the second night, however, the transmission was turned into a farce by a series of oscillation howls which persisted throughout the performance. Exactly the same thing occurred on the successive nights, until Radio Toulouse was compelled to announce the temporary stoppage of the relays owing to interference from a secret transmitter in the neighbourhood.

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Wireless "Sabotage."

All this happened in the middle of January, and the fight still goes on. Radio Toulouse issues the broadest hints concerning the ownership of the station guilty of this "sabotage," and the Post Office enters the arena with the declaration that the short-wave "post" in the theatre is illegal. Radio Toulouse refuses to dismantle it, and is now gaining the support, not only of the radio clubs in the district, but of the local authorities and the Press.

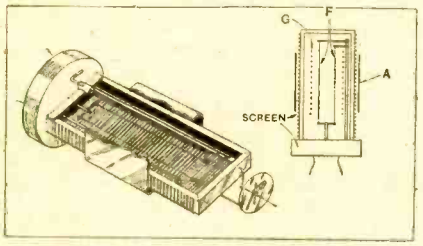
B

Marconi and Osram S.215 Valve.

THE S.215 is a two-volt screened-grid valve fitted with a four-pin base of familiar design for mounting in the standard type valve-holder. The filament and grid pins occupy the same relative positions as in the three-electrode valve, this being the only similarity, as the pin which is usually the anode connection is, in this case, the termination of the screened-grid; the anode being taken to a small bakelite shrouded terminal attached to the top of the glass bulb.

The electrodes are robust and rigidly mounted, but nevertheless care should be exercised in handling the valve, as an accidental jar may slightly displace them and cause an internal short-circuit.

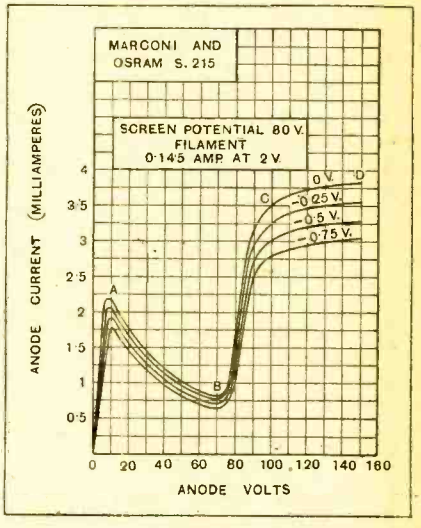
The filament F actually consists of two filaments connected in parallel and supported at both ends; the inner or central grid G surrounds the filament and has a relatively close mesh. The screen, which resembles a very closely wound grid, is supported by a metal frame mounted on a flanged base extending well below the top of the "pinch." The anode A is rectangular in shape and is joined to the top terminal by means of an inverted "U"-shaped wire, to the centre of which is joined a short straight connector. A small disc of mica mounted on this lead shields the top terminal and the glass in the immediate vicinity and prevents the metal from depositing in this area when the magnesium is flashed.



Electrode construction in the Marconi Osram S.215 Valve.

The reason for fitting a screen between the grid and anode in valves of this type is to reduce the capacity between these two electrodes to the smallest practical value, but the advantage gained by this will be less marked unless precautions are taken to reduce to a minimum electrostatic coupling external to the valve between the leads and circuits associated with these electrodes. It is, therefore, usual to screen these circuits, and to make this screening as complete as practical considerations allow the valve should be inserted through a hole in the external screen and positioned so that this falls in line with the flanged base of the screened-grid inside the valve. As the "getter" does not extend much below this, its position can be readily determined.

The valve characteristic curves with which the reader is most familiar, namely, anode current grid-volts relationship, convey very little useful information in the case of valves of the screen-grid type, so it is customary to show the characteristics of these by the relationship between anode-volts and anode-current with certain fixed values of grid bias. It will be noticed that between the points A and B, when the anode-voltage is less than the screen potential, the valve has a marked negative resistance. The part of the curve with which we are most concerned when the valve is employed for H.F. amplification is that portion between the points C and D. The curves show a gradual rise from the horizontal indicating a high A.C. resistance. The average values between 100 and 150 volts H.T. were found to be A.C. resistance 196,000 ohms., and the amplification factor 190. These figures are quite good, the A.C. resistance being slightly lower than the makers' rating, and the amplification factor higher. The mutual conductance of the specimen tested was 0.97 mA per volt, as compared with 0.85 mA per volt given by the makers.



Average values between 100 and 150 volts H.T. A.C. resistance 196,000 ohms., amplification factor 190, mutual conductance 0.97 mA/volt.

The screen potential was kept fixed at 80 volts. Careful tests failed to reveal any trace of reversed grid current, showing that the valve is dead hard.

LETTERS TO THE EDITOR.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

PICTURE RECEPTION.

Sir,—In operating our Fultograph we experienced a degree of difficulty in laying the sensitised paper on the cylinder really evenly and tightly, so we take this opportunity of giving you an idea of ours, as we anticipate that it will be of service to your readers, whom, we imagine, will also be troubled as we were.

Procure from any stationer one of the small metal U-shaped paper clips, of the variety used for holding odd invoices together, and with it grip the extreme edge of the paper before immersion. After wetting, the paper is laid on blotting to partially dry. Still with the clip in position, the paper is laid on the Fultograph cylinder. No difficulty will now be experienced in holding the paper taut, while bringing the cross-piece into position, as one hand is used for each job. An additional tip is to mark one side of the clip and always see that this is put to the smooth side of the paper in the first instance.

Galashiels. RADIO & ELECTRIC SERVICES, LTD.,
BRYAN GROOM, Manager.

TELEVISION.

Sir,—As a wireless man of many years' experience, associated far more with the practical than with the theoretical aspects of the art, I am constantly coming up against letters of the tenor of that written by Mr. C. R. Cosens in your issue of January 16th. He deals at considerable length upon the subject of television, but, with all due respect, the only statement that is conclusively proved is his *personal* opinion that there is no entertainment value in television as we know it at present.

I have met several people during my extensive ramifications over the last three months or so who also have that personal opinion, but conversely I have met *scores* of others who consider the art as being quite ripe for home consumption just as it is, and are most anxious to instal a receiver immediately the necessary transmitting station or stations are in commission. It is always understood that transmissions should take place at reasonable hours and with sufficient power.

I do not know whether Mr. Cosens has been associated with radio for as many years as myself, rather more than twenty, but even with four or five years' experience it is very noticeable how often practice does *not* coincide with theory, and some astounding results have often been obtained, giving a complete reversal of what one was lead to expect from a theoretical viewpoint.

However, after a keen investigation it is obvious that there is an enormous section of the public waiting for "live" pictures of the present dimensions, and if critics would only get the "Dot" idea out of their heads and concentrate upon intensity modulation, not forgetting to eliminate relatively large areas with no change in frequency, they would realise that ten kilocycles in 3,000 k.c. is quite a practical proposition. This *does* pan out in practice! H. A. HANKEY.

London, W.6.

Sir,—As one who believes that television has a future at least equal to that of radiotelephony, I read the letter of Mr. C. R. Cosens in the issue of *The Wireless World* dated January 16th, 1929, with much interest.

As long as practical methods of transmission and reception involve the principle of "image scanning," the problem of side-band width will have to be considered. In the series of papers published in the "Bell System Technical Journal" (October, 1927), describing the efforts of a very large and powerful American company to demonstrate television, this subject was fully considered as applied to both line and radio transmission channels, and the authors came to substantially the same conclusions as Mr. Cosens. This apparently insuperable difficulty present with all advocated systems, including cathode-ray scanning, would appear insoluble when using practicable carrier frequencies, but in two articles in "Television" by J. Robinson a somewhat different light is thrown on the problem.

This author shows in a plausible manner, basing his arguments on the transmission of strips of varying density rather than of individual dots, that the transmission at least of the human face would be entirely embraced by any existing short-wave telephony band.

It has been announced that transmissions are now being made regularly on 200 metres using the Baird system, and while the writer has received at loud-speaker strength the accompanying telephony on 250 metres, he has yet to suffer the annoyance of having these signals wiped out by the "colossal" wave-band of the television signals, which seems to bear out the arguments put forward by Robinson. I am not yet in possession of the fundamental quantity, viz., the ratio height of image/strip width, of the above experimental transmissions (have any of your readers this value available?), and consequently have so far been unsuccessful in reproducing the images. Personally, I was agreeably surprised at the quality of the reception at the recent demonstrations at the "Wireless Exhibition" at Olympia, in which really recognisable, and above all "living" pictures were shown, which showed only the slightest traces of flicker and in which vertical strips, at any rate, could not be detected. As for eye strain I found it negligible in the official demonstrations, though I cannot say the same in the case of my own home-made television receiver.

I am eagerly anticipating the time, which doubtless will soon arrive, when the B.B.C. will transmit television signals, and when *The Wireless World* adds to its already unrivalled reputation by publishing authoritative articles on the reception of these signals. BERNARD J. GIBBS.

Teddington.

Sir,—The two letters on television which affect to reply to my recent note to you call for comment.

The first letter from the Woking correspondent states: "When Mr. Moseley and his friends can produce television images comparable in size, quality, and cost with the pictures given by the Fultograph there will be time to grouse about 'unfair discrimination.'"

It is very evident that your correspondent knows nothing about television. There is, of course, no comparison between "still" pictures which are at present being broadcast and the moving, living image which the public has not yet had the opportunity of seeing. Nevertheless, it is not only possible to televise a picture of equal size and cost to that given in "still" pictures, but of far better quality, and *instantaneously*. This, indeed, was the opinion of two well-known M.P.s who saw a picture thus televised, after having seen the slow, "still" picture process.

I advise Mr. Part to enquire first before rushing into print.

The letter of your second correspondent, Mr. Cosens, comes under a different category. He has, apparently, gone to the same trouble as have other theorists in raising airy obstacles before demolishing them. He appears to be labouring under the impression, as so many other genuine critics, that the reasons why certain technicians of the B.B.C. turned down television were set out in technical form. This was not the case. No conditions were made, apart from one of secrecy—which was not kept—nor were any reasons for the decision communicated to the Baird Company. Indeed, since the technical side of the matter was not raised before, during, or after the test, one is justified in assuming that it is merely on what they saw from *the receiving end* that the representatives of the B.B.C. gave an adverse decision. Since then, however, many eminent men and women have been given an opportunity of witnessing the actual accomplishments of television, and they have more or less unanimously come to the conclusion that this big invention is being held up without real cause, and that this country is losing an opportunity of maintaining its lead in a science for which all the world is clamouring. Surely it

is not too much to ask that the world should be permitted to decide whether it wants television or not. No convincing reason has been given why such an opportunity was offered in the case of "still" pictures and withheld in the case of television.

We have seen that the public has not exhibited over-eagerness in the case of "still" pictures, but, at any rate, the Fultograph people cannot complain that they have not had facilities given them.

I have yet to hear an unbiased critic defend the action of the great monopoly in endeavouring to stifle a private scientific enterprise.

SYDNEY A. MOSELEY.

London, E.C.4.

Sir,—Mr. Cosens has fulfilled a public service in so clearly setting out in your correspondence columns the facts concerning the possibilities of radio television. It must not be forgotten that the Baird Company has made most explicit claims concerning the successful performance of their apparatus right from the start of their enterprise, and now that the argument concerning the problems of picture analysis has bought into prominence a serious difficulty, vague suggestions are thrown out regarding "frequency modulation" and "strip analysis." I ask that all readers of radio experience should carefully read the article by J. Robinson in the current issue of *Television*. The arguments and suggestions contained therein reveal clearly that a new system of picture analysis and radio modulation is essential or, in other words, that without some such development television is a failure. If Dr. Robinson has invented a device which provides a means of overcoming what have appeared to be insurmountable difficulties I trust that he will see fit to convert it into practical form. If his proposals are associated with the construction of practical apparatus, it is to be hoped that he will do one of two things. Get on with the job or, alternatively, make his work the subject of a paper to be read before the Institution of Electrical Engineers.

Prolonged argument as to the feasibility of radio television shows conclusively the existence of serious difficulties. One might contrast the claims made for television with the achievements in the field of picture telegraphy and the success of the Fultograph. From the onset the Fultograph people have given radio demonstrations on all occasions, while we still await an actual radio demonstration of television, however crude, before, say, those responsible writers in our radio journals who will undoubtedly hail television as a new enterprise possessing unbounded possibilities.

It was stated in *The Wireless World* that the demonstrations given at Olympia last September were conducted between wire-connected stations, thus eliminating the real problems of television—modulation and synchronisation. That the public as well as the radio journals have no prejudice is indicated by the recent activity in picture reception, about which there is no doubt concerning technical details in view of the considerable activity among manufacturers. A boom in picture reception seems to be evident. Radio enthusiasts have given no more initial attention to picture reception than to television, yet of these two new developments the one is unanimously endorsed while the other is with almost equal unanimity neglected. That the judgment of the technical experts of the B.B.C. should be in keeping with this point of view is only further evidence that the Baird system presents special problems when applied to radio transmission, though in view of the weight of general opinion the decision of the B.B.C. need scarcely be added in arriving at a clear judgment in the television situation of to-day. Our leading radio journals and societies have adopted a similar attitude, while it is significant to note that the council and supporters of the Television Society have not sprung from among the leaders of radio interests.

Instead of further debating the possibilities of practical television, let us bear in mind that a single successful demonstration would be convincing. Let us remember also that this controversy could never have arisen had the sceptics been answered with technical argument and had the comments and challenges been combated.

A. MOIR.

SMALL POWER TRANSFORMERS.

Sir,—In reading through your recent articles on small-power transformer construction it occurred to me that it frequently happens that an amateur has a transformer core of sorts, which he has picked up cheaply and which he would like to utilise. At the same time I had a case brought to my notice where a transmitting amateur—following the advice in earlier articles in *The Wireless World*—took the empirical value of between 3 and 4 turns per volt and built his windings around an existing set of stampings, the cross-section area of which was much too small—the transformer having high iron losses as a result.

The chart (attached) should therefore be useful to amateur designers, as it gives them the number of turns per volt for a variety of small core sizes, and for flux densities covering hoop-iron or the best grades of iron.

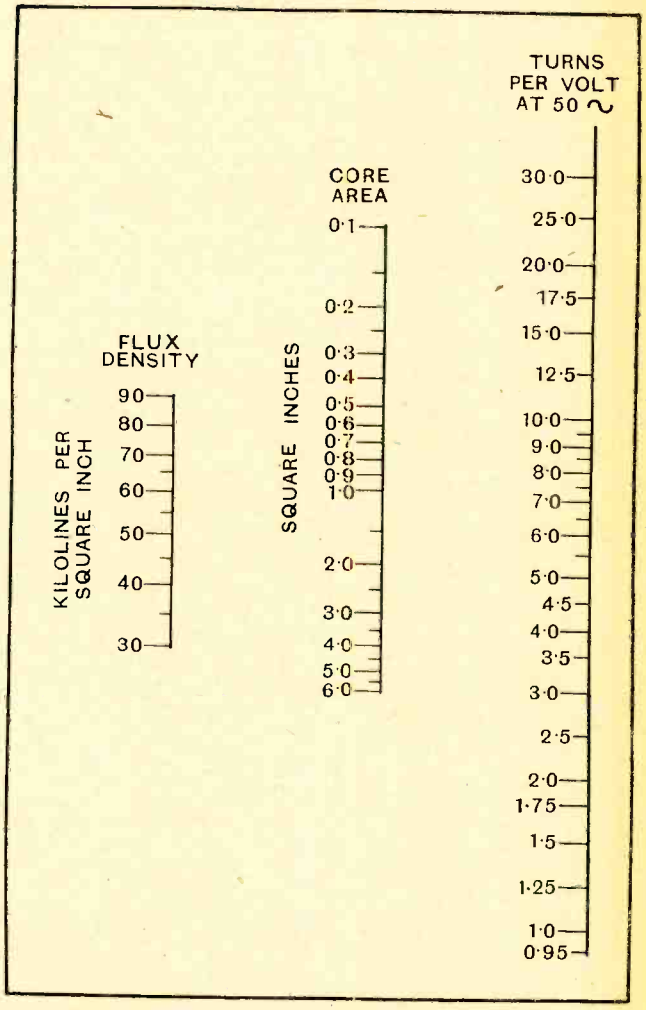


Chart showing number of turns per volt for various core sizes and Flux Densities.

A similar chart appeared in "Q.S.T." some time ago, but as it was worked out for 60 cycles and 25 cycles, it was not very helpful. It has, therefore, been recast to show values for the usual 50-cycle A.C. in use at home.

It is, of course, derived from the formula

$$\frac{n}{E} = \frac{10^8}{4.44 \times B \times A \times l}$$

Rawalpindi, India. C. T. HUGHES, Capt., A.M.I.E.E.

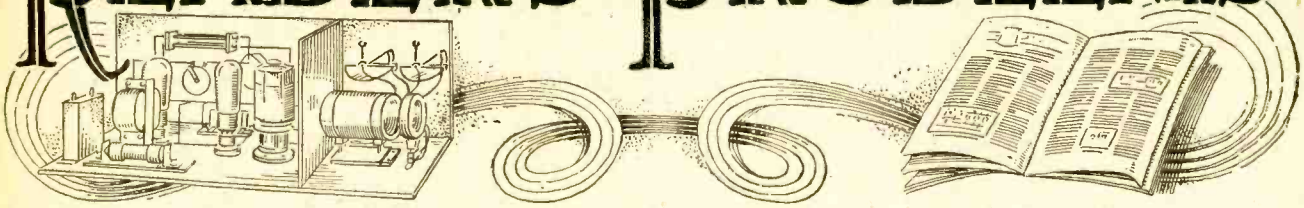
A NAME FOR BROADCAST HOUSE.

Sir,—I suggest that "Fleming House" would be a suitable name. Without Professor Fleming's invention of the valve the house would not have been required.

F. PINK.

Southsea.

READERS' PROBLEMS



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Grid Bias Troubles.

My four-valve receiver (H.F.-Det.-2L.F.) does not give good quality, and I suppose this is due to the fact that it will not take grid bias. Can you tell me why this should be? D. W. S.

We are not quite clear as to the effect produced when you attempt to apply grid bias—which is always necessary in a modern L.F. amplifier. If the connection of the bias battery results in a weakening of signals and possibly a deterioration of quality, we can only think that the H.T. voltage applied to the plates—or, at any rate, to the plate of the output valve—is very much less than it should be. If this is so, the negative voltage on the grid may almost completely stop the flow of any anode current, and signals will be both weak and distorted. We advise you to check your voltages, and if you have, or can obtain, a milliammeter, to see if the valves are passing their normal current.

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Eliminating Power Circuit Interference.

In an article published by you some time ago, it was stated that the use of a frame aerial with a centre tapping connected to earth is helpful in reducing interference from near-by electrical apparatus and circuits. I have tried this arrangement with promising results, but have encountered a difficulty; perhaps you can suggest a way out?

I think I am right in assuming that when the centre-tapped frame is followed by a detector valve which takes energy from it (as a grid circuit rectifier), there is no loss of signal strength in using this arrangement; indeed, my experimental work confirms this. When I use the centre-tapped frame across the grid circuit of the first valve of my two-stage H.F. amplifier, there is a considerable falling-off—due, I take it, to the fact that only a part of the signal voltage developed is applied to the grid circuit. Is there a way of connecting the "centre earthed" frame in such a way that there is no loss in intensity? J. C. McM.

We suggest that you should use the arrangement shown in Fig. 1. This consists, as you will see, of a frame aerial with the winding broken at the centre point and a coupling coil of a few turns inserted at the break. The centre point of this coil is earthed. A variable coupling is desirable, but after a good average position has been found there will be no need for subsequent adjustment, and the relative positions of the two coils may then be fixed.

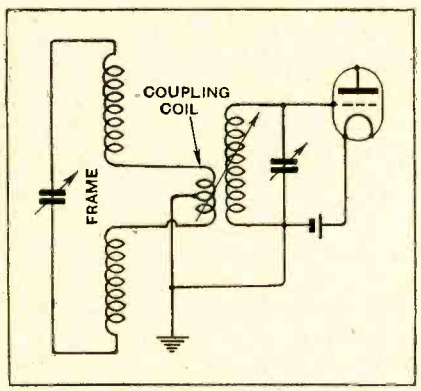

Fig. 1.—A magnetically coupled frame aerial circuit.

From the fact that you have apparently obtained fair results with your "two-H.F." set with an ordinary frame, we assume that practically complete screening is already included. This will be almost essential with the arrangement we suggest.

In order to compensate for the increased inductance of the frame, result ing from the insertion of the extra coil, it may be necessary to remove a turn or two from its winding.

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Power or Lighting Mains.

Will it make any difference if I connect my trickle charger to a power supply point (240 volts 10 amps.)? Up to the present I have been joining it to a lamp-socket connected to the ordinary household supply (240 volts 5 amps.) T. J. P.

As long as the voltage is the same in both cases, it is quite immaterial as to which point your charger is connected. The rating in amperes applies only to the maximum current which may be taken with safety through these two sources of supply, and has no bearing on the amount of energy consumed by your instrument.

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Anode Resistance and By-pass Capacity.

In the "Readers' Problems" section of your issue for January 16th, you suggest to "B. R. N." that the addition of an anode by-pass condenser of 0.0003 will tend to introduce some attenuation of the higher audible frequencies. Now, I am using a larger condenser than that mentioned (0.0005 mfd.), but must admit that I cannot detect any lack of brilliance. Values are: valve impedance, 12,000 ohms; anode resistance, 50,000 ohms; and as stated, by-pass condenser, 0.0005 mfd. Do you recommend me to reduce this capacity? V. G. P.

The reader to whose letter you refer was assumed in our reply to him to be using a very high value of anode coupling resistance, and under these conditions the effect of a large by-pass condenser can be harmful. Due to the fact that you yourself are using a comparatively low resistance, your by-pass condenser will not be responsible for any very considerable reduction in proportional amplification at frequencies up to, say, 3,000 cycles, but perhaps it would be better to reduce it to 0.0003 mfd. A good deal depends on the actual impedance of the valve under working conditions: it will presumably be working as a bottom bend detector, and so the figure you give may be considerably exceeded.

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.