Wireless Weekly, 6d. Net. Wednesday July 1st, 1925

Wireless Weekly

Vol. 6. No. 13.

A NEW AMERICAN SHORT WAVE RECEIVER

Described by PERCY W. HARRIS, M.I.R.E.

Wireless Weekly
Phone: City, 9911.

Radio Press Ltd. Bush House, STRAND W.C.2.
EDITED BY JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

£2,500 Vacancy Filled

It is with great pleasure that we are able to announce that a decision has been made in regard to the position of Chief Engineer and Director of Research to the Radio Press, Limited, the proprietors of this journal and of *Modern Wireless* and *The Wireless Constructor*. It will be recalled that, in an endeavour to obtain the most highly qualified engineer and scientist for this post, a minimum salary of £2,500 per annum was offered, which, together with further remuneration, apart from this basic fixed salary, will render the post the most highly paid staff appointment in this country.

Technicians and Publishers

The salary was so much above the average that considerable interest was aroused, as it seemed an extraordinary step that a publishing firm should launch out on a very ambitious research scheme involving very heavy financial outlay in staff, instruments, land and buildings. The reason is that we are not in the ordinary sense publishers at all. We regard ourselves as technicians, entirely independent of any commercial radio organisation, whose whole work is in studying, investigating, designing and inventing, and placing the fullest information before the wireless public. The fact that great commercial success has attended the production of periodicals and technical books, etc., has enabled us to augment our editorial staff and also to establish a great experimental, service and research department at Elstree which will ensure the further popularity of our publications, an increase in the prestige of the Radio Press, and the stability and development in this country of the radio industry, which depends so largely on a sane and progressive technical Press.

We are now, we believe, the only publishers in this country who are devoting their energies exclusively to radio technique, and this fact is in itself significant. It is true that we publish for a variety of classes; some of our publications are intended to appeal to the youngest convert, but our aim has always been to give sound and authoritative information, however simple.

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Elstree

Our new laboratories and the results of work done there, which will be published in our periodicals, will be a great step towards extending this ideal. The whole scheme is a far-seeing one, as the period of the staff agreements and building operations indicate, and the very logical progress of the company in a very specialised field justifies a confidence which has just been strikingly confirmed in regard to our new trade monthly journal, *The Wireless Dealer,* which backed by the full organisation of the Radio Press, Ltd., has been promised such support from manufacturers and the trade generally that its success is already secured.

The reiteration of the policy of this company appears to be necessary, because there are apparently some who, failing to see the carrying out of an ideal step by step, imagine there is some absurd idea of the company entering the manufacturing field at some future period!

Final Choice

The announcement of the vacancy for the new post created by the inauguration of the laboratories has resulted in applications from technical heads of Government Departments and of commercial concerns. There were exceedingly few engineers in this country eligible, but the majority filed applications, and to these the most careful consideration was given. The final choice rested on Major James Robinson, D.Sc., Ph.D., F.Inst.P., who is in charge of the radio research and design laboratories of the Royal Air Force. As the technical head of one of the Fighting Services, Dr. Robinson has had unique opportunities of exercising his brilliant scientific attainments and his administrative ability. As the chief of a large Government experimental establishment, his experience of the very latest developments (not only those of the Air Force, but of the Army and Navy) fits him peculiarly for the work to be carried out by us at Elstree.

A Distinguished Inventor

Dr. Robinson has not only achieved academic distinction (he has declined professorships at two leading Universities); he has not only great personality and administrative abilities; his qualifications do not end with the fact

Major James Robinson, D.Sc., Ph.D., F.Inst.P.

that he has reached one of the highest posts in the Government Service; he is an inventor himself—skilled in that branch of research which often results in the immediate improvement in apparatus and methods. After the war, Dr. Robinson was granted a very large sum by the Royal Commission for his valuable radio inventions. His name to many is associated with Direction Finding, a system for which bears his name and is very widely used; this, however, is only one small branch of his activities in which he specialised some seven years ago.

Practical Design Work

His work since then has been connected broadly with radio research and design, and he has devoted a great deal of time to improvements in wireless reception methods. Such work has involved not merely the development of new and better methods, but their actual incorporation into reliable apparatus. In short, his work has been concerned with practical designs as well as inventions. For obvious reasons, being in Government employ, Dr. Robinson's name is not as familiar, perhaps, as those of engineers in the commercial world, but his long association with one of the Services will enable him to bring an entirely impartial mind to bear on problems which affect the wireless trade.

In resigning from his high position, Dr. Robinson is abandoning a career in which he achieved the greatest success. It was a coincidence that at the time of his application he was offered promotion to a very high administrative post at the Air Ministry.

Director of Research

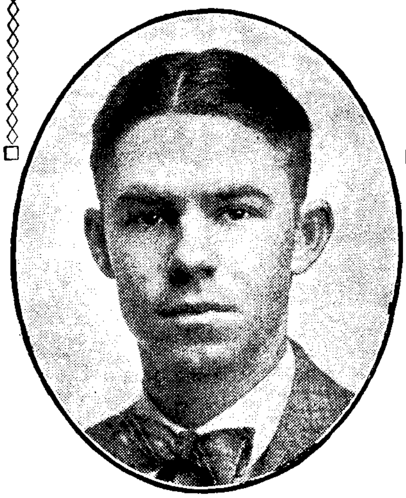
We, and our readers, are fortunate that his free choice will result in his joining the company at an early date in the capacity of Director of Research and Chief Engineer on the exact and complete terms, of course, of the original vacancy announcement, his whole-time services being retained by the company for many years to come.

MY IMPRESSIONS OF BRITISH RADIO

British and American Experimental Methods Compared

By JAMES S. MORRIS, Radio U4IO (President Atlanta Radio Club—Winner of the Reid Cup for the best station in the Southern States—representing the Southern States at the I.A.R.U., in Paris, A.R.R.L. Manager for State of Georgia).

Mr. Morris has been staying in this country since the conference in Paris, and in view of the number of British amateur transmitting stations he has visited during his stay, his comparison of British and American amateur methods makes interesting reading.



Mr. JAMES S. MORRIS

EVERYWHERE one goes the same question is asked, "How are American conditions, as compared with these you have seen in England?"

Let us consider for a moment the proposition of the situation of the broadcast listener in the States. If he has a crystal detector he must, under normal conditions, be content to listen to the station or stations within a few miles of him.

If, however, he boasts of a single-valve reaction receiver, he may have the choice of programmes of, let us say, fifty stations, if a powerful local station is not on the air at the moment.

Interference

However, with several hundred stations on the air with only a few metres difference in their waves, there is often very bad interference. One of the worst forms of this is the clash of the side bands of two stations working on nearly the same wave.

The possibility of hearing perhaps thirty to fifty stations in a single evening has created what is called among the amateurs the "DX craze."

Thus it is not uncommon for the listener-in to impatiently wait till the station's call-letters are announced and then hurriedly turn the dials in search of another station, regardless of how good the concert or lecture may be.

This "DX craze" gradually begins to wear off, and then the listener is content to go from one station to another and "park himself" on a station whose programme suits his perhaps rather fickle fancy.

Potential Experimenters

And so, after the first novelty wears off, he does one of several possible things. He either gets tired of radio, and he only listens casually every other night or so, until finally the receiver becomes covered with dust; he has gone back to his golf or bridge, and so he makes his exit. The man next door has in all likelihood also become tired of this steady listening, so he begins to build a new set of his own, to try different circuits; he comes to want to find out what really happens behind the panel and at last to wonder what the people in the books and magazines (he buys them all) mean when they talk about oscillations and regeneration, and all the funny words he'd never even heard of before. This man eventually becomes either an experimenter or else he begins to wonder at the meaning of all the queer dots and dashes. As soon as he does this he ceases to be a simple "BCL"—he is now a potential amateur.

This is undoubtedly the same in both England and America—it is true the world over.

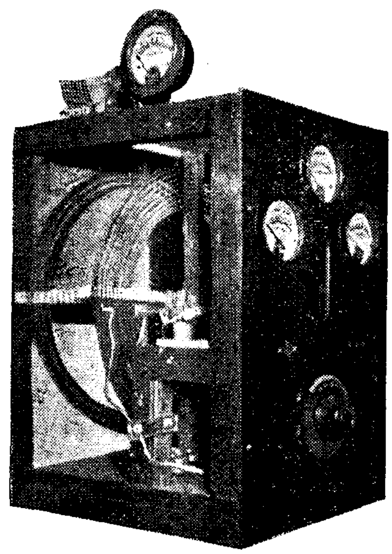
H.F. Amplification

The Americans have never gone in very strongly for radio-frequency (high frequency) amplifiers, using for the most part a regenerative detector with one or two steps of audio-frequency amplification.

The average set is perhaps more selective than the British receivers. A receiver is considered to be no good at all if the powerful local stations cannot be tuned out and others at least a thousand miles away brought in clearly.

Selectivity

With the growing popularity of the super-heterodyne and the neutrodyne, it is now quite a simple matter to tune out the locals and bring in the stations on the other side of the country,



The transmitter used by Mr. Morris.

twenty-five hundred to three thousand miles away.

Low-loss coils and condensers have found their way into the broadcast tuners and, as would be expected, have increased the selectivity and sensitivity to a marvellous extent.

Gone are the old varnish-soaked fine-wire coils wound on poor ebonite tubes, and gone is the old condenser with miserable "moulded ebonite" endplates and doubtful contacts.

He has learned that it is wise to take down his big aerial (there are no restrictions on size of aerials in the States), and erect in its place a shorter and lower one. By doing this he, of course, sacrifices a little volume but gains in selectivity.

Comparison

And now actually how does the American broadcast receiver compare with the British, and how do conditions compare?

The American receiver is, on the whole, probably the better of the two.

In the first place, with so many different stations transmitting in a narrow band, selectivity has become a very important factor. As a result the single circuit has long ago been cast aside as absolutely useless, and in its place has come the three-circuit regenerator with a decent coupling between the aerial and the secondary circuits.

Also it has been realised that by putting in real low-loss coils and condensers the efficiency of the tuner is increased to a remarkable extent.

Apparatus

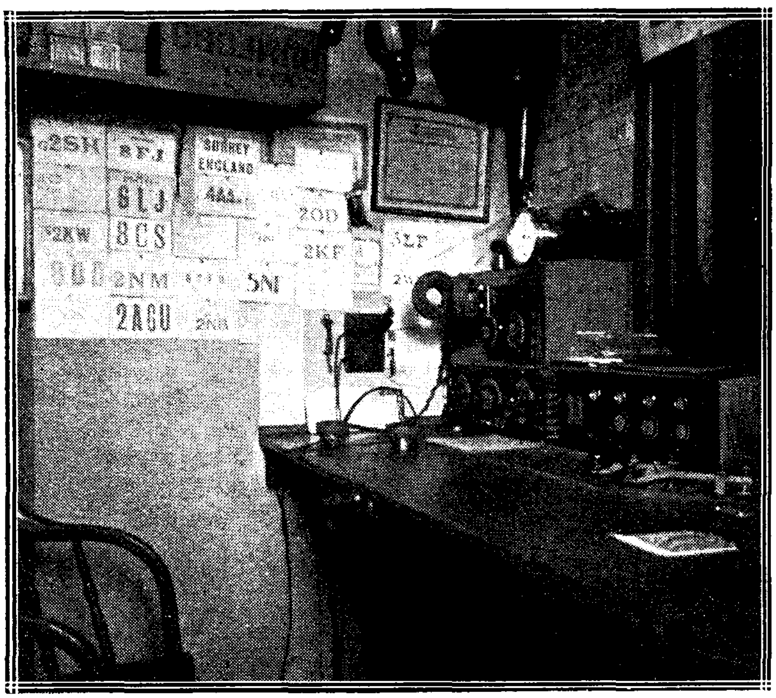
If the disciple of the fine-wire coil who believes that all this "low-loss" talk is just "talk" will give it a trial, he cannot help but notice the very marked improvement both in close tuning and volume.

On the whole, it seems that the broadcast listener in America has the best of it all round.

I think really good apparatus and parts are much more easily accessible and perhaps a trifle cheaper in cost.

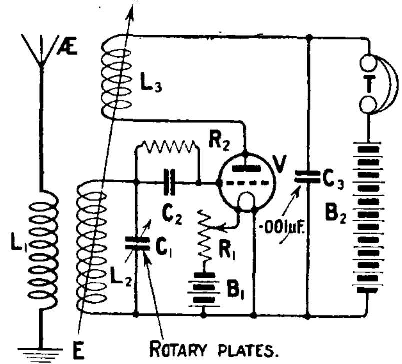
There is no licence fee to be paid, and no restrictions on sets or limitations on size or type of aerial system.

There are over five hundred different broadcasting stations, so a much greater choice is possible in type of programmes.



A general view of Mr. Morris's station. Many of the QSL cards will be easily recognised.

The manufactured receivers are also, in my opinion, better than the average British-made set. Perhaps the two reasons for this are, first, having so many stations transmitting simultaneously it is necessary for the set to be very selective—otherwise none would be sold. The second reason is, the American manufacturer has been quick to put sets on the market incorporating the new and more efficient circuits and assembled of newly designed, improved parts.



This type of circuit is very popular in America for short-wave reception.

It is very difficult to receive European broadcasting in the States on account of the five- and six-hour differences in the time. When darkness begins to set in in America the European stations are just closing down, so it is only possible to hear European stations on tests early in the morning.

Among the real amateurs there is not such a marked degree of difference.

The main differences are very similar to those of the broadcast listener.

Aerials

As to licences, although the examination for an operator's licence in the States seems more difficult there is no delay once the examination has been passed, and then, too, there are no fees of any sort to be paid.

Not so much attention has been paid over here to aerial systems as in America.

I have seen only one aerial which boasts a height of over sixty feet, and it has also been noticed that guy wires have not been broken up with insulators as well as they might be, and there has been a marked lack of those invaluable strings of insulators at the ground end of the guy. In the aerial and counterpoise themselves the "long, skinny" porcelain insulators which improved our radiating systems so much are missing, and in their place remains the fat, ball type or the egg.

There is also a great difference in valves. Our valves are of very low impedance compared with the popular types of British transmitting valves, and this may perhaps account for the non-success of some of the popular American circuits such as the three- or four-coil Meissner.

Valves

The American valves work on a much lower-rated plate voltage and draw a much higher plate current, and are more often overloaded than is customary with the British "bottles."

The transmitting circuits are very similar.

The familiar loose-coupled Hartley is perhaps the most universally used circuit of all and is the most popular in America, as it works very well on the short waves and is easily controlled and adjusted.

The most popular places for keying are in the primary of the plate transformer (nearly every station in America uses rectified A.C.) or else in the centre tap, the key being shunted with a 1 or 2 μF condenser to absorb the key clicks.

The vital importance of good insulation has been realised in both America and England, and everywhere one finds all apparatus either mounted on glass or in air, or (largely over here) on porcelain.

Receivers

Really good wavemeters for the very short waves are not nearly as much in evidence as they should be either in America or here, though the American amateurs have had the great advantage in getting accurate calibrations, thanks to the kindness of our Government and research stations who have transmitted standard frequency signals on the very short waves.

In the receivers there is not very much difference. The Americans here again have the advantage of being able to obtain good low-loss condensers. The current American practice of removing valve bases and thus eliminating the capacity of the base as well as doing away with indifferent contacts encountered in a socket does not appear to be very popular on this side, but experience has shown us that it is a big jump forward in the matter of reducing losses in the circuit. The circuits themselves are rather similar; the old loose coupler and reaction arrangement has come into its own and is here to stay. We know the simpler the better, so the superheterodyne is not popular in America as it only complicates matters and is not needed, as nearly all foreign amateurs come in well enough on a detector alone and with one stage of audio-frequency amplification, so no more is needed.

Another rather widely used scheme in the States and which has not been observed here is that of using a separate receiving aerial.

It is not only unnecessary to use a high transmitting aerial for receiving, but it brings in a greater static-interference ratio to desired signal than is the case where a very low, short single wire is used.

It sharpens up tuning to a great extent also. The two big advantages for separate receiving aerials are—first, it eliminates the great loss of a change-over switch, and, second, it permits a good break-in system to be used, as the operator is enabled to listen to the station to whom he is transmitting. Of course, it is necessary to put an extension on the back of the key and add another set of contacts which breaks the receiving circuit; thus the receiving aerial is cut off when the key is pressed only, and is connected at all other times.

Neon Tube

The one piece of British apparatus which has made the most favourable impression on the writer is—the neon tube!

This tube is far superior to any seen in America and is a decided improvement on ours, as it is much larger and much more sensitive.

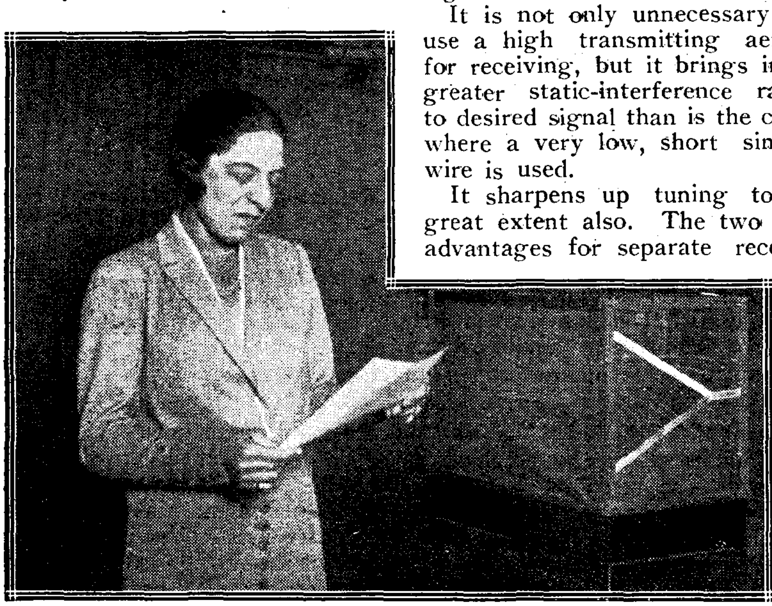
And now as to impressions of the men themselves.

Never has the writer been more royally received than by the radio men here. They have done everything possible to make things pleasant for a visiting amateur, and it has truly been appreciated.

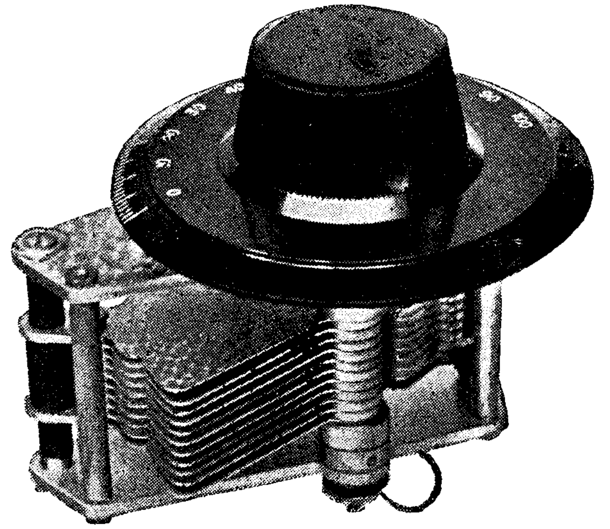
The writer has visited practically every prominent station in the Southern part of this country, and has been much impressed by the efficiency and good workmanship which predominates, and by the sound radio knowledge manifested in the operators and shown in their stations.

And so the writer leaves England with the most pleasant of recollections of his stay in this country and of her sons of radio, and linked to England by strong bonds of friendship which can never be broken.

May we meet again!



Mlle. Suzanne Lenglen broadcasting from the London station on the 22nd June.



A new type of condenser which is designed upon low-loss lines.

THE LOW-LOSS ERA

By W. K. ALFORD (2DX).

NOW that the science of radio communication is becoming middle-aged it is interesting to look back and notice how callous the wireless designer of early days was in view of the present prominence of "low-loss" construction.

It is true, however, that he was not confronted by the problems entailed by the use of waves of ultra-high frequency. A condenser was simply a device that "condensed"—a coil merely a means of obtaining a certain number of microhenries, and an ebonite panel, an inch perhaps in thickness, made an excellent and substantial mounting for the whole.

Short Waves

As time went on and the evolution of radio progressed, the use of long waves (low frequencies) for long-distance communication was the rule. This was followed by a steady and continuous development of shorter and shorter wavelengths (*i.e.*, higher and higher frequencies), until at the present time 25 metres is being used for commercial communication.

It may be truthfully said that both the term "low-loss" and the general application of its ideas were originally put forward by the enthusiastic "amateurs" of America, who, under stress of circumstances forced on them by the authorities, were compelled to investigate the lower wavelengths, firstly, the 180-metre, then the 100, and latterly 75, 45, 20 and 5 metre regions.

Low-loss Methods

It was soon discovered that the conditions controlling efficient reception (and transmission) were largely wrapped up in "low-loss" methods. These were most clearly demonstrated in nearly all the components comprising a receiver. The list of "defaulting" instruments and parts is a formidable one, and comprises :—

(1) Coils and coil mountings.
(2) Condensers (fixed and variable).
(3) Valve sockets.
(4) Valves.
(5) Ebonite panels.

Since the popularising of the "low-loss" characteristic the whole radio market has been deluged with various forms of its application, just as though the idea was an undiscovered novelty.

Valve Holders

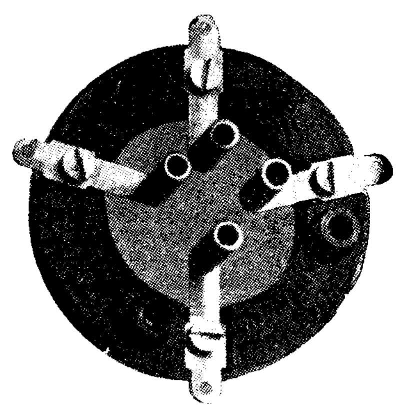
This is all to the good when carried out sensibly, but it is reaching the proverbial stage of "thrashing the dead donkey."

The whole of "radio construction" is somewhat of a paradox, especially when it comes to the point of efficiency as a function of the methods employed. For instance, everybody agrees that soldered joints should be the rule without exception throughout a wireless receiver, yet nearly everybody is content to push a valve into a socket without any thought of contact efficiency—and the grid circuit handles micro-amperes !

Condenser Design

The greatest service to radio that the "low-loss" hunt has provided is usually considered to exist in the modification to variable condenser design.

In earlier days one was quite content to judge a condenser solely by its mechanical construction and its "movement," and it is sad to see the beautiful specimens which rest on our shelves

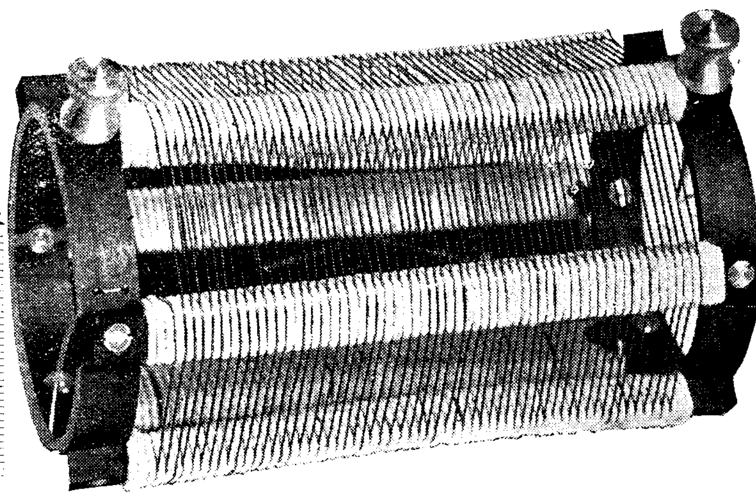


The low-loss principle has now been applied to valve holders, as this photograph shows.

as relics, being perfectly useless for present-day short-wave work.

We see a famous make of condenser using quadrantal plates interleaved with ebonite—a triumph of ingenuity in fitting an enormous capacity in a small space—a beautiful air dielectric model with enormously thick brass plates and a single bearing at least two inches in diameter, the whole surrounded by a glass receptacle which could be filled with oil to give an increased dielectric constant, yet all are

Mr. Alford, whose call sign will have been heard by many readers, has quite a long experience of short-wave work, and in this contribution he expresses his views upon the subject of "low-loss."



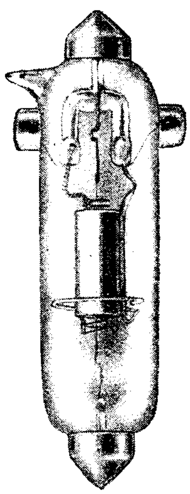
A very effective method of winding a low-loss coil. The white portion is a string binding which serves to space the turns of enamel-covered wire.

as useless as the spark sets they tuned in.

H.F. Resistance

At the present time there are very many beautiful examples of high efficiency variable condensers extant. Their efficiency can best be gathered from the fact that the older types of condensers had a high-frequency resistance as large as 7 ohms at 3 million cycles, whereas the best models to-day are as low as .5 ohm and less. These differences on the wavelengths of 20 metres and less mean roughly that a signal may be inaudible if tuned with the one and quite readable if tuned with the other.

On these short wavelengths one



The V24 and other similar valves are particularly suitable for use upon short wavelengths.

is not only interested in the electrical performance of variable condensers, but also in certain points of their mechanical design. Their movements must be light and free from "sticking," as adjustment is extremely critical and frictional contacts as distinct from direct electrical connections are to be deprecated in the extreme. The effect of frictional contacts is soon demonstrated, especially in a receiver oscillating on 20 metres, in the form of ear-splitting crashes and grinding noises.

Moving Plates

The method chiefly involved in reducing the electrical losses seems to lie in the complete and effective isolation of the fixed plates from the moving element. This is done in a variety of ways, and frequently the metal plates forming the end plates are arranged to be in electrical contact with the moving element, thus forming a very useful electrostatic screen to the fixed elements, which should always be arranged to be at the higher potential.

Coils

The question of inductance coils of high efficiency is being particularly studied at the present time, and a very close approximation to the ideal seems to lie in the air-spaced, self-supporting solenoid type of coil.

The question of the size of wire to use is a very vexed question, and although not altogether backed by technical research, one seems to gain something by the use of heavy gauges.

It is almost needless to say that the use of coil plugs and sockets is to be avoided, in spite of their convenience, unless they are of the type where the pins are well spaced and not surrounded by a heavy mantle of moulded material of doubtful composition.

An important point to remember in connection with solenoid coils is that very serious loss of efficiency is brought about by bringing the lead from the remote end back through the coil and near to the turns. The self capacity may be much increased, and capacity is the deadly enemy of oscillating currents at high frequencies when inductance is desired.

Valves

The question of "low loss" in valves lies mainly in the matter of inter-electrode and inter-lead capacities actually in the valve and socket and from general inference does not play so great a part in the conflict for efficiency as one would at first expect. Although the use of an anti-capacity valve, such as the V24 type is naturally the best practice, those whose pockets are thinly lined, and whose fingers are nimble, may prefer to remove the cap from a more standard type of valve.

If a four-pin valve is really decided on for convenience, the design of the valve holder may well be looked to, as in many types the capacity of this between the anode and grid sockets may frequently be as much as three times the inter-electrode capacity of the valve, to say nothing of actual electrical leakage through the material of which some holders are made.

The best solution in this case undoubtedly lies in the use of small valve sockets with a very small diameter threaded portion. Full clearance holes should be provided for these, and a large hole in the centre of the four when mounted.

Ebonite

The further points of importance with regard to "low-loss" construction, apart from wiring, lie in the use of good quality ebonite or other insulating material used in the mounting of the components. Polished ebonite is a snare and a delusion, as in many cases it possesses a surface coating of conductive material, although the varieties now available, which have been matted first and then polished, using the correct mediums, have better properties of excluding moisture.

Finally, no definite standard of efficiency can possibly be set, and the whole idea of making everything "low-loss" is to get the very utmost out of a given receiver, and at the present time the extended use of short wavelengths has focussed everybody's attention on the matter, possibly because the points of increase in efficiency are so strikingly demonstrated. □

Interference Between Broadcasting Stations.

LISTENERS to broadcast telephony programmes in all European countries will follow with interest a Conference convened by the Office International de Radiophonie, to take place at Geneva on July 6 and 7. Invitations have been sent from Geneva to the leading technical experts of every broadcasting organisation in Europe, whether that organisation is actually engaged in broadcasting or making plans for commencing operations next autumn.

Interference

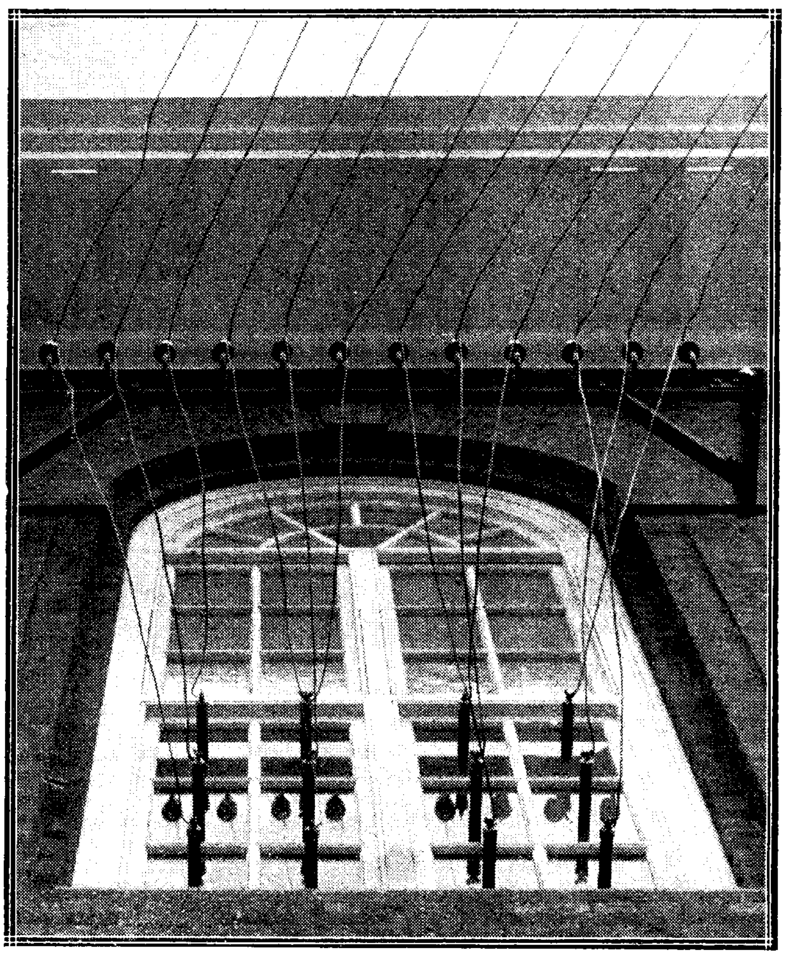
The prime object of this Conference is to secure mutual agreement upon a system whereby the existing European stations, and the several projected or actually in course of erection, can operate at their highest possible efficiency without any risk of mutual interference and consequent disappointment to listeners. This will not be possible if the present policy is pursued any farther.

A memorandum on the subject, together with a proposal for future working, has recently been forwarded to the Office International at Geneva by Capt. Eckersley, chief engineer of the British Broadcasting Co. This has been circulated throughout Europe, and will be a basis for discussion.

Other points of a technical yet highly interesting character, also intimately associated with the international development of broadcasting, will be discussed by the experts during their stay at Geneva.

In order that the recommendations of this Conference may be put into practice without delay it has been timed to precede the July Council meetings of the Union Internationale de Radiophonie, also to be held at Geneva, on July 8 and 9. The recommendations of the Engineers' Conference will be the first non-routine item on the Council's agenda.

THE RUGBY STATION.

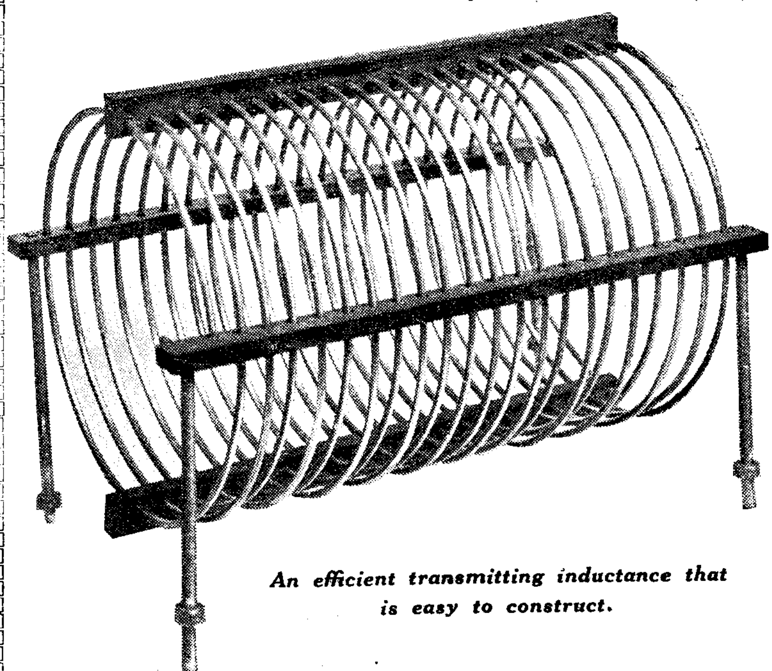


The aerial lead-in at the Hillmorton Station, Rugby.

Some Experiences with the Hartley Transmitting Circuit

By C. P. ALLINSON (6YF).

An article which transmitting readers will find of practical value while those readers who anticipate taking out transmitting licences will find in this contribution many valuable hints which otherwise only experience would teach them.



An efficient transmitting inductance that is easy to construct.

THE Hartley transmitting circuit first gained popularity in the United States, and for a quite considerable period very little else was used. And though it did not catch on in England for some while to nearly the same extent as in the United States, it is now largely used. One of the reasons for this slow popularity is that it sometimes will not work too well with an ordinary earth, but rather requires a counterpoise earth if the best results are to be obtained. The question of valve impedance is also important.

Preliminary Trials

This was borne out by the first few experiments carried out with this circuit by the writer. Using a simple form of the direct-coupled circuit shown in Fig. 2, the transmitter could be made to oscillate easily enough so long as the aerial was disconnected. As soon as the aerial was connected to the set, however, it promptly went out of oscillation, and no adjustment of the anode, grid and filament taps could coax it into oscillation again. It must be borne in mind, however, that the earth was probably one having an extremely high resistance, for the lead was about thirty feet long, going along the floor and a landing to the rising water-main in the cistern loft. This was the nearest earth connection available, the operating room being at the top of the house.

The next step prior to putting up a counterpoise earth was therefore to try loose coupling, and the circuit shown in Fig. 1 was tried. With this it was found possible to keep the transmitter oscillating when the aerial circuit was in tune, provided the coupling was fairly loose. Tightening the coupling to any appreciable extent at once put the set out of oscillation. It was then decided to put up a counterpoise without delay. This consisted of four wires spread fan-wise about six feet above the ground, a long insulated lead going up the side of the house to the transmitter. The aerial used was a six-wire cage on 14-in. hoops about 50 ft. long. Stranded enamelled copper wire was used, and it was well insulated at each end.

On switching on the transmitter a much larger aerial current was at once obtained, and seeing that things were now going satisfactorily it was decided to do everything to improve the set's efficiency.

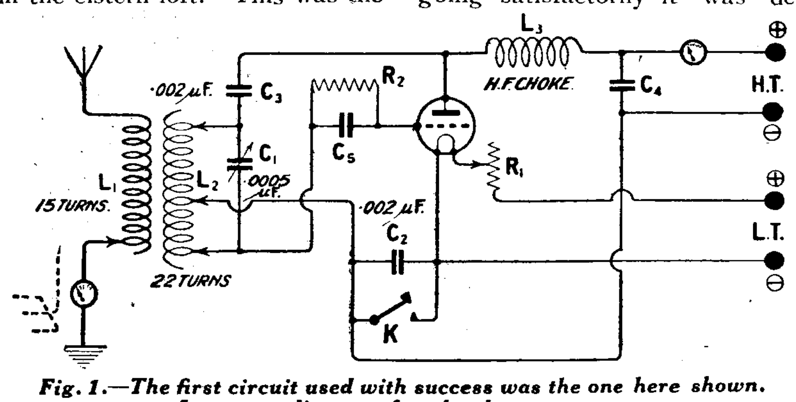


Fig. 1.—The first circuit used with success was the one here shown. Loose coupling was found to be necessary.

The Inductance

The first step was to construct a good low-loss inductance, and the one that is now in use is shown in the photograph. It consists of 22 turns of No. 10 bare copper wire wound into a helix about 6 in. in diameter, threaded through four pieces of ebonite, which act as spacers and supports. The turns are spaced ½ in. apart, and the completed coil is a little over 10 in. long. Two of the ebonite spacers carry two lengths of screwed brass rod, one at each end. By means of these the coil is fixed to a light baseboard, which is held in position in the transmitter by means of a couple of clips. By making up various coils in this manner they can easily be substituted one for the other, and this enables the highest efficiency to be obtained by comparing results obtained with different coils.

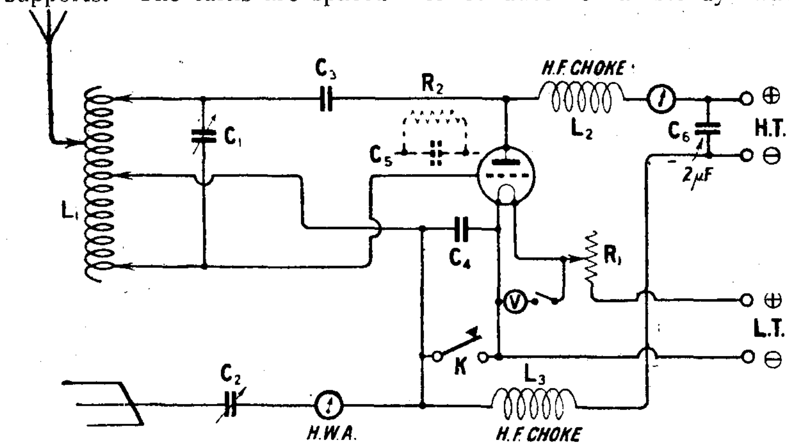
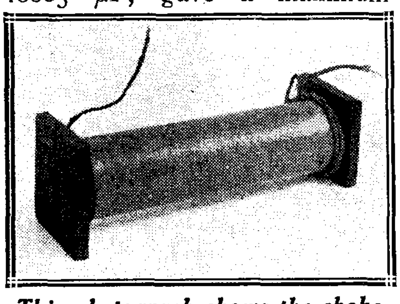


Fig. 2.—The transmitter now in use employs the above circuit. L3 needs to be only 50-60 turns.

This coil, in conjunction with a tuning capacity of approximately .0005 μF, gave a maximum wavelength just short of 200 metres, and if it is desired to work on this wavelength three or four more turns would be required.



This photograph shows the choke used in the H.T. positive lead.

Shunt Feed

Connections are made to the inductance by means of spring clips, and for loose coupling a similar coil may be used in the aerial circuit or else a flat pancake coil. The latter allows a fairly close coupling to be obtained, although it is best to work with as loose a coupling as possible, as this is more likely to conduce to a steady wave without swinging or "quacking." This last word refers to that curious effect obtained when the key is depressed, resulting in a slight change of wavelength after it has been pressed for a moment. This results in the beat note at the receiver changing its pitch after the beginning of each signal, be it a dot or a dash. The word "quacking" describes this symptom very well, and once it has been heard the description strikes one as being very apt.

As shunt feed was used it was necessary to have a really good choke in the positive high-tension lead, and that shown in the photograph is one-half of the static leak that is connected across the aerial and earth terminals of the old Marconi multiple tuners. A suitable choke can be made by winding 250 or 300 turns of 36-gauge d.s.c. copper wire on a 2-in. former. Two pieces of flex are soldered to the ends of the windings and tied round tightly, so as to prevent any chance of their breaking. Provision was made for a grid condenser and leak to be used. As the power used, however, was generally well below 10 watts, no advantage was found in using these, except when an old Cossor receiving valve was used for transmission. The grid condenser and leak were then found to give a very slight improvement.

After one or two improvements had been made to the layout of the transmitter and positive connection made to the moving spindle of the shunt variable condenser (shown at C1 in both Figs. 1 and 2), the set was again connected up and tried out. The procedure followed in adjusting the loose-coupled set may be of interest. The aerial coil L1 was moved as far as possible from the closed transmitting inductance L2 with all the turns included. The grid and anode clips were connected to opposite ends of L2 and the filament tap to the centre of the inductance. The valve was then turned on and the key depressed. The tuning inductance was then touched with the finger and the plate milliameter watched. A rise in plate current showed that the set was oscillating. Note that this test is only suitable when low powers with shunt feed are being used. An alternative test is with the valve turned out to depress the key and then slowly turn on the valve. Watch the milliammeter, and the current will be seen gradually to increase up to a certain point and then

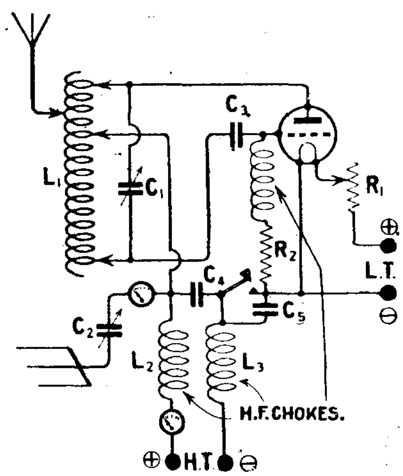


Fig. 3. — This shows series feed. C4 should be a condenser of at least 1 μF capacity.

suddenly drop back. This occurs when the transmitter goes into oscillation. C1 was then adjusted till the largest reading was obtained on the aerial ammeter. The coupling between L1 and L2 was then tightened, and the process repeated till a point was found where two readings on the condenser C1 gave a large rise in aerial current. This showed that the coupling was too tight, with the result that a single sharplytuned wave was not being emitted. The coupling was therefore loosened again till a single resonance point only was obtained. The filament tap was next moved a turn at a time, retuning, after each adjustment, on C1 till the point was found where the largest aerial current was registered.

Spring Clip Connections

The use of clips for making connections to the inductances made it very easy to change circuits, and a test was therefore carried out one night, comparing loose against tight coupling, for it was now found possible to employ tight coupling without the set going out of oscillation. The report was greatly in favour of tight coupling and the circuit finally used is that shown in Fig. 2. L1 is the 22-turn inductance, C1 a variable condenser of about .0005 μF capacity. A series condenser in the counterpoise lead of .0005 μF was used, and was found to be fairly critical in adjustment, needing a vernier to get maximum aerial current. C3, the stopping condenser in the anode tap, is a .002 μF fixed condenser. A condenser of the same capacity was connected across the key as shown at C4, and it should be noted here that the keying method shown is less likely to give rise to key clicks, and produces less sparking at the contacts than the more usual method of putting the key direct in one of the H.T. leads. The grid condenser and leak were not always used, but when employed the values used were .001 μF and 10,000 ohms respectively.

Different valves require different grid-leaks, and the value also depends on the power being used.

Results Obtained

With this set an aerial current of .25 amps. was obtained, with an input of 15 to 20 milliamps. at 240 volts; it would therefore seem to be fairly efficient.

The Fig. 2 circuit required a fair amount of time to adjust, as there are three interdependent variables and also one adjustment that affects aerial current and reacts on the other adjustments at the same time. A little patience, however, soon shows the best settings for various wavelengths.

Tuning is carried out by varying the two condensers C1 and C2, as once the best position for the aerial tap is found it can be left set over a fairly wide wavelength range.

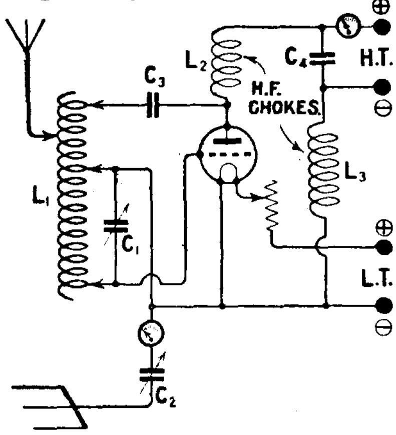


Fig. 4.—A variation of the Hartley circuit, suitable for short waves.

The Aerial Tap

One point to be noticed is that in the diagram the aerial tap is shown between the filament and anode taps, but for the shorter wavelengths it is better to place it between the filament and grid taps. A curious effect noticed in conjunction with this was in connection with a wavemeter. This consisted of a coil tuned by a condenser coupled to the transmitting inductance. When the wavemeter circuit was in tune with the transmitter, a drop in aerial current resulted. With the aerial tap at the anode end of the coil this drop could be obtained when the wavemeter was a foot from the transmitter inductance; when, however, the aerial tap was at the grid end of the coil the wavemeter had to be coupled tightly to the coil before any drop was registered.

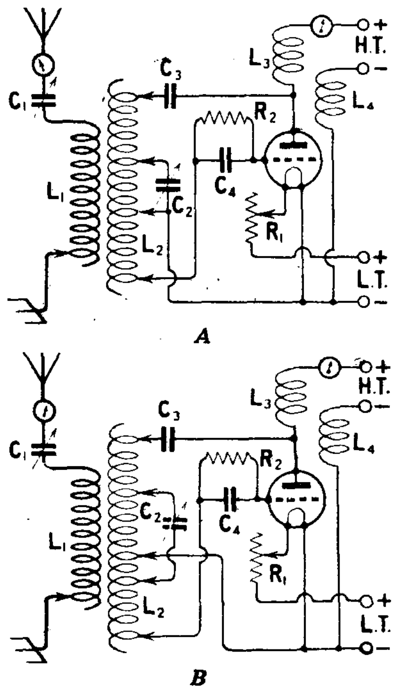


Fig. 5.—Further variations which are well worth trying out.

Some variations of the Hartley circuit are shown in Figs. 3, 4, and 5. Fig. 3 shows the use of series feed instead of shunt, and in this case it is advisable to use a grid condenser with a leak going to L.T. negative.* In the Fig. 4 circuit only that portion of the inductance between the grid and filament taps is tuned, and this method is particularly advisable for wavelengths below 100 metres. With this, little difficulty was experienced in getting the set to oscillate with only five turns of inductance in circuit.

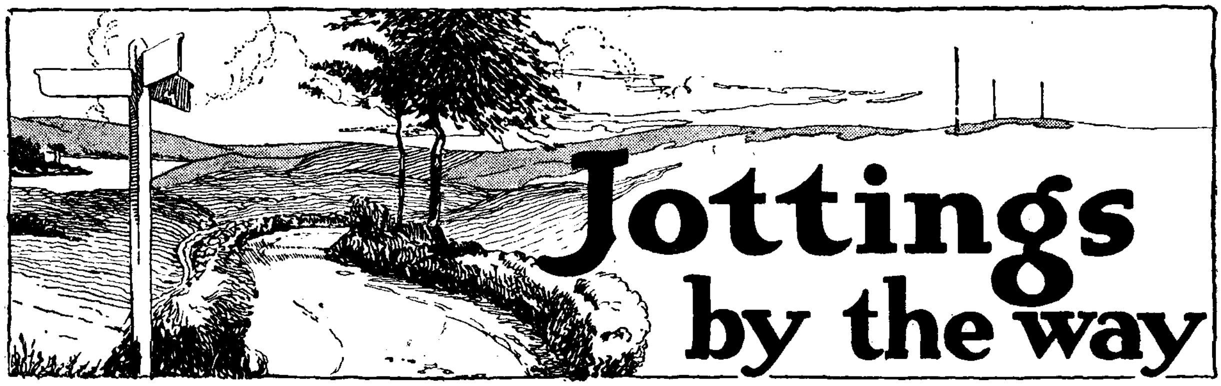
For Short Wave Work

Yet another system is shown in Fig. 5A. This is a loose-coupled circuit with the series condenser in the aerial lead instead of the counterpoise. The chief difference, however, is the fourth tap connected to the filament tap by a variable condenser, which usually has a value of about .0005 μF. This and the variation of it shown in Fig. 5B, are popular circuits in the States. For short waves all shunt tuning capacities are omitted, tuning being done by varying the number of turns in circuit. The series aerial condenser is, of course, retained.

Conclusion

In general the Hartley circuit is a favourite with beginners in transmitting, as it is one of the simplest circuits to get going, while excellent results are to be obtained. As with all transmitters, the best is only got out of it with a great deal of experimental work, and though increased aerial current is not necessarily an indication of increased radiation, it is pleasing to see the needle of the aerial ammeter creep upwards as the result of little alterations here and small improvements there.

* It should be remembered that with this circuit the inductance L1 is at high potential. Care must be exercised not to touch it when the key is down or a severe shock may result.



Jottings by the way

Base Aspersions

I WAS very much intrigued by a paragraph that I came across in one of the daily papers. It ran like this: "'The advent of wireless has greatly increased petty pilfering by the public from the railways,' said a prominent railway official yesterday. 'The public seems always to have looked on railways as fair game, but now the quantity of small screws daily removed from fixtures in the interior of our carriages is astonishing. The smaller the screw

Though they make excellent razor strops they serve no useful wireless purpose.

the more attractive it seems. The natural conclusion is that the makers of home-made wireless sets are responsible.'" What I like about the paragraph is this last sentence: the *natural* conclusion, mark you! It just shows what a terrible set of fellows we wireless people are when we really start in. I for one most indignantly deny that I am responsible for removing even the smallest of screws from the carriages on the railway which connects Little Puddleton with the Metropolis. Railways are, of course, notoriously behind the times, and that which I patronise uses screws which are not of the B.A. standard sizes. In view of the paragraph in question I have written immediately to the chairman and the general manager and lots of other prominent officials to request that all their fixtures shall in future be secured with 4 B.A.s.

Badly Catered for

Of course, if the railways really had the interests of the great public at heart they would make many improvements in their carriage fittings. What I mean is that there is really very little at present in the railway carriage that you can use. Breadsnapp did, I believe, remove the hot water radiator from beneath the seat and uses it as an earth plate, whilst Gubbsworthy constructed in his wireless den from a couple of carriage seats, a rest lounge for use on nights when he was sitting up for America. But on the whole there is very little useful loot to be obtained from the average compartment. How much brighter and better life would be for all of us if a little sympathetic attention were paid by the authorities to this matter of fittings. As it is, to turn on the heating business you have a horrid little knob affair, rather like a bed key, which is no manner of use. Why should not a condenser dial carefully graduated be substituted for this eyesore? Windows are pulled up and let down by hideous leather straps which, though they may make excellent razor strops, can serve no purely wireless purpose. How much better it would be if they were replaced with neatly plaited sets of flexible leads garnished at their lower ends with various coloured wander plugs instead of tassels or fringes.

Suggestions

Again, what is the use of a communication cord? I have always longed to pull one, though five pounds seemed rather too much to pay for the pleasure of doing so. However, whilst travelling in Germany after the war, I observed that the penalty of one hundred marks still stood, and as marks were cheap, I confess that I did have two pen'orth at the then rate of exchange. If you do pull a communication cord they have to stop the train before they can find out what you want, and then, if you merely ask for the right time or for a match, they

If you ask the time or for a match they are quite rude about it.

are quite rude about it. Would it not be a great deal better from the point of view of both the wireless enthusiast and the general traveller to fit up little telephones in compartments, so that one could communicate at will with the guard? I am sure that a guard's life must be a very dull one with never a soul to speak to, and I know that the microphones and receivers would come in very handy for constructional purposes. Railway companies are always complaining that they do not get sufficient passengers. I am showing them, I think, a way of very greatly increasing their sales of tickets, and though I make no charge for suggestions, I should esteem it a graceful compliment if my own company were to send me a free pass for life over its lines as a small mark of its appreciation and its gratitude.

Those Posters

If and when my suggestions are adopted, we shall no longer see the absurd sort of posters that now decorate railway stations. You know the kind of thing I mean, or, if you do not, you can easily find it at your own station to-morrow morning whilst you are waiting for the 8.50, having missed the 8.2 by a razor cut, a lost collar stud and two and two-fifths seconds. The sun is shining brilliantly upon a picture which is both landscape and seascape. The sea is such a dark blue that you feel that if you bathed in it you would emerge like an ancient Briton wearing his spring suiting of woad. Though there is not a breath of wind, as you can see by the state of things ashore, dozens of sailing boats are speeding madly over the surface of the water in all directions. Half the populace is engaged in running rapidly upon the sands in bathing costumes with its arms raised high and the toothiest of smiles upon its collective faces. The other half is engaged upon one and the same small piece of ground in playing cricket, golf, polo, tennis, croquet, and hop-scotch. Though the sun is not visible, you can see that it is shining by the brilliance of the colours. At the fortunate place depicted one gathers from the way in which the shadows fall that it shines from all directions at one and the same time. All that kind of thing will be banished from the railway stations once the companies wake up to the great idea of attracting the wireless public.

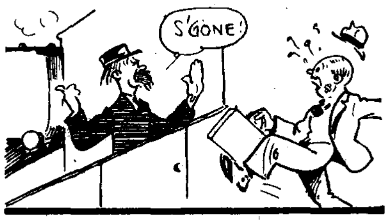
The Poster of the Future

I think that a simple poster worded something like this would work wonders :—

" NORTH, SOUTH, EAST AND WEST RAILWAY.

" TRAVEL BY N.S.E.W.

" The most comfortable and convenient rolling stock in the world. Why are our lights so steady? The voltmeter and ammeter fitted in each compartment will show you. You can adjust the strength of the light to suit your own eyes by means of the 20-stud selector switch. Every compartment fitted with loud-speaker for the reception of broadcast programmes. Our communication cords do not break; they are made of the best 7/22 phosphor bronze cable. There is no fear of electric shocks in our carriages, since all seats are insulated by panels of half-inch ebonite. Carriage windows are fireproof, being made of the best ruby mica. 4 B.A. screws used throughout. A screwdriver will be found in each compartment.



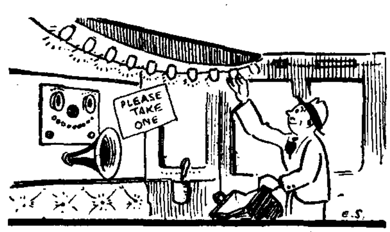
Having missed the 8.2 by a razor cut, you may read the posters.

" TRAVEL BY THE N.S.E.W.

" THE WIRELESS WAY."

Not Yet

I am afraid it will be some time before the first railway sees fit to put into practice the suggestions that I have made, but believe me it is merely a matter of time. These things are bound to happen before so very much water has flowed beneath our bridges. And then, of course, there is the question of useful notices in compartments. This is a matter which must receive serious attention from the railway companies. Poddleby tells me that he has been able to use one notice by making a slight alteration with the help of a paint brush. He has a stand affair for his inductance coils which now bears the legend, " This rack must be used for eight articles only." The conversion of " light " into " eight " is simple, though it shows praiseworthy ingenuity on Poddleby's part to have adapted his little trophy so skilfully. Gubbsworthy, too, exhibits in his wireless room a notice that it is dangerous to leap out of the window; not many of us have wireless dens on the fifth floor as he has. One notice that I have found of use myself is that dealing with the heat regulator, which says " max." at one point and " min." at another. This does very well for rheostats, and it will be better still when the railways have seen fit to reduce it considerably in size. At present it makes rather a clumsy addition to one's set. Electric railways might usefully hang up the notice, " Danger 5,000,000 volts." The only electrical sign that I have found at all useful, so far, is the cross part of Charing + and King's +; most of the hyphens used are far too skimpy to act as decent minuses.



Travel " The Wireless Way " on the N.S.E.W. Railway.

But there is one reform that I do want to see brought in right speedily. Though there are still a few gas-lit compartments knocking about (I use the word advisedly), electric lighting is rapidly becoming universal on our railway systems. Now, since bright emitter valves give a brilliant light, why use lamps? Valves will do the work just as well, and there is not the slightest reason why these should not be employed; in fact, so far as I can see, there is every reason why they should. If my railway company would only substitute dull emitters for its present bulbs I would undertake to forgo the reading of my evening paper as I journeyed homewards and not to send a single line of complaint on that score to headquarters.

WIRELESS WAYFARER.

Reaction Refinements for Broadcast Reception

By STANLEY G. RATTEE, M.I.R.E., Staff Editor.

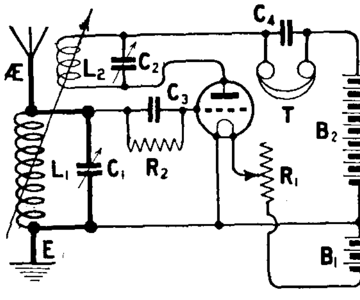


Fig. 1.—The condenser C2 gives fine control of reaction.

Readers will already be familiar with the difficulties experienced in tuning-in distant stations on small valve sets. Several methods of obtaining the necessary fine control over magnetic reaction are here described, so that simple additions to an existing receiver will enable it to be operated in its most sensitive condition with finer control and without such tedious adjustments.

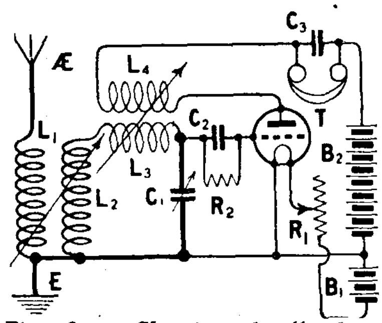


Fig. 2.— Showing the "split-secondary" system.

THOSE readers who have attempted the reception of long-distance telephony, as, for instance, the more distant of the B.B.C. stations, will agree with me that unless a multi-stage high-frequency arrangement is included in the receiver, the element of success is dependent largely upon the fine adjustment of reaction. In the case of many receivers this adjustment is only possible by weakening coupling after the circuit has been made to oscillate, whereas the correct procedure should be to bring the receiver up to the desired point without causing the set to oscillate either by accident or intention.

Reaction Difficulties

In considering these remarks it must be understood that the form of reaction discussed is the magnetic type, in that the capacity method, apart from the Reinartz method, is little used in this country.

For the successful reception of long-distance stations some arrangement is needed whereby the receiver may be adjusted easily to its most sensitive condition, meaning that the reaction effect may be increased up to the oscillating condition without quite reaching it, and it is proposed in this article to describe some of the methods whereby this fine control is made possible. The difficulties met with in obtaining fine control are mainly concerned with alterations of aerial tuning, for most readers will have noticed the fact that any variation between the coup-

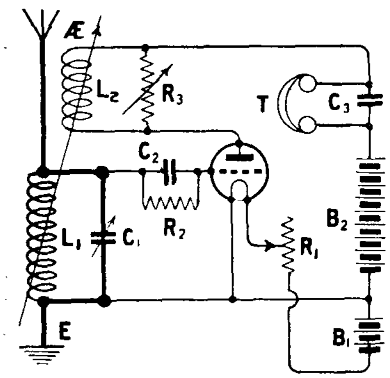


Fig. 3.—A method similar to that of Fig. 1, resistance being substituted for capacity.

ling of the reaction and aerial coils, or aerial and secondary coils in the case of loose-coupled circuits, necessitates a further adjustment upon the tuning condenser. Similarly, in those receivers employing tuned anode reaction, variation of the reaction coupling affects the anode tuning condenser.

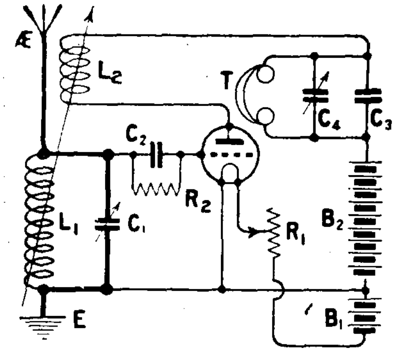


Fig. 4.—A variable condenser across the telephones gives excellent reaction control.

There are upon the market many types of plug-in coil-holders which permit both a rough and fine movement of the swinging coil, and though these would at first appear to solve the difficulty, the disadvantage resulting from the variation of coupling and the consequent necessity of retuning is still present, and for that reason coil holders of this or any other type will not form a subject for discussion in the present article, which is intended as a consideration of purely electrical methods of control.

The operator of a small valve receiver feels the need of a reaction control similar to that given by the well-known Reinartz circuit, and particularly does this need make itself felt when long-distance reception is attempted; consequently the arrangements whereby such a condition may be arrived at should prove of interest.

An Easy Method

One of the simplest methods for giving a fine reaction control is to shunt the reaction coil with a variable condenser in the manner shown in Fig. 1. With this arrangement the coil L1 is the normal size used for the particular wavelength required, whilst the reaction coil L2 will usually be one size smaller than that normally employed. The variable condenser C2 is one of the usual types, a capacity of .0001 μF being suitable. To operate this circuit, set C2 to its

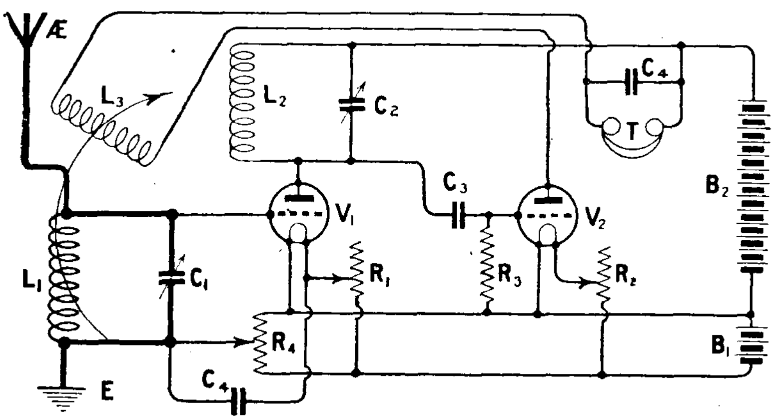


Fig. 5.—Suitable adjustment of R4 (potentiometer) applies the correct grid potential to the first valve to provide stable oscillation control.

zero reading, after which the performance is precisely the same as that obtaining with a similar arrangement but without the condenser C2. When the reaction coupling is set to a safe maximum without oscillating, the final adjustment may be made by slowly turning the condenser C2 towards its maximum value, which will then allow the set to be brought up to its most sensitive condition more easily than would be the case by varying the reaction coupling, and, further, the adjustment of the aerial tuning condenser C1 will not be upset very much.

The Fig. 3 circuit is similar to that just referred to, with the difference that instead of using the C2 condenser to obtain the fine control required, we now have a variable resistance across the reaction coil. The operation of an arrangement such as this is precisely the same as with the Fig. 1 circuit, excepting that the final reaction adjustments are made by varying the resistance R3. With this circuit the coil L1 is again as used normally, while the reaction coil L2 will also be of normal size. The resistance R3 may quite conveniently be one of the variable anode resistances now on the market, working at a resistance value of anything between 70,000 and 100,000 ohms.

" Split-Secondary " Tuning

Another circuit which single-valve enthusiasts will find attractive is that given in Fig. 2, known as the " split-secondary " arrangement. It will be seen that semi-aperiodic aerial coupling is employed, while the secondary circuit is split into two halves, one being used for coupling to the aerial coil and the other for coupling with the reaction coil. In this method the adjustments for aerial coupling and reaction are practically independent and permit an exceedingly fine degree of selectivity to be obtained in addition to a good control of reaction, the only difficulty being the choice of coils for the secondary circuit, a choice which is not altogether easy with some makes.

Tuning with this arrangement is best accomplished by first placing L1 fairly closely coupled to L2, with L3 and L4 widely separated, and then tuning with the variable condenser C1 (.0005 μF). If no signals are heard, vary the coupling between L1 and L2 and tune with the condenser C1 simultaneously. With signals received and the optimum coupling adjusted, the coupling between L3 and L4 should be tightened until the most sensitive condition of the receiver is arrived at; then retune upon the condenser C1. The most practical manner in which split - secondary tuning may be used is by means of two ordinary two-way coil-holders, using one for L1 and L2 and the other for L3 and L4, whilst the coils for this arrangement are as follows :—

For wavelengths between 250-500 metres : the aerial coil L1 is best found by experiment, as its size will depend upon local aerial conditions and should be either a No. 25, 30 or 35. For L2 coils No. 35 or 50, while for L3 No. 35 or 25 should be tried. For the reaction coil L4 a No. 35 or 50 will be found quite suitable.

For the longer-wave stations, such as Chelmsford and Radio Paris, L1 should be a No. 150, L2 a No. 200, L3 a No. 50, and L4 a No. 200.

Very Fine Control

Perhaps the finest possible adjustment of reaction is obtained in the manner shown in Fig. 4, in which a variable condenser C4 is connected across the telephones in parallel with another condenser C3, this latter being fixed. This arrangement of condensers permits the variable condenser to be of smaller value than would be the case were the C3 condenser omitted.

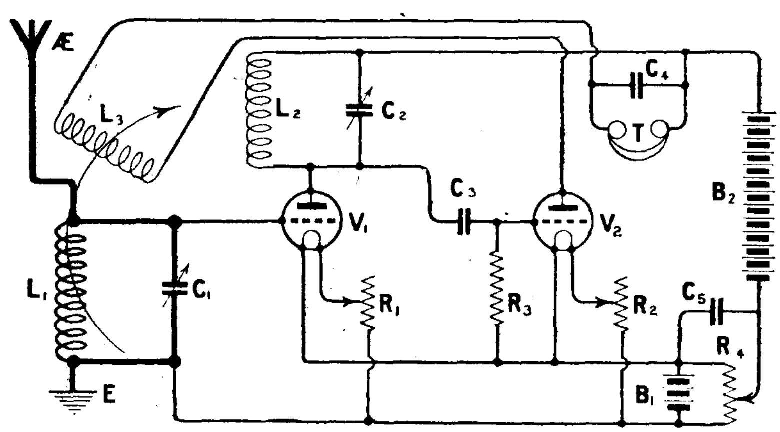


Fig. 6.—A circuit similar to that of Fig. 5. Here the potentiometer gives a variation of the anode potential.

Actually the value of C_3 may be .0005 μF, while C_4 may quite conveniently be .0003 or .0005 μF. This arrangement is probably the nearest approach to that control given by the Reinartz circuit that the writer has heard of, and is to be strongly recommended to the long-distance enthusiast. The operation of the circuit, together with coil values, are exactly the same as if the C_4 condenser were of the fixed type, and when the reaction coupling has been set to an optimum value with the C_4 condenser set at 90 deg., variation of this latter reading will cause the circuit to creep up to or away from the oscillation point, according to which way the condenser is turned, without disturbing the aerial tuning adjustments.

Two-Valve Circuits

In considering circuits in which the detector valve is preceded by a high-frequency amplifier, the most suitable means of controlling reaction is that employing a potentiometer, and in Fig. 5, which shows a very common two-valve circuit of this type, the potentiometer R_4 will give the desired effect.

Coil sizes with this arrangement are such as would be normally used with this circuit, and the potentiometer is set to a position where the receiver will not oscillate when the aerial and anode circuits are brought into tune with each other, the reaction coil being widely separated from the aerial coil. In this condition the ordinary operation of tuning and reaction setting is proceeded with until the desired signals are received, when a slight variation of the potentiometer adjustment, either one way or the other according to results, will just bring about that fine and delicate adjustment which it is impossible to obtain with the reaction coil alone without affecting the aerial tuning. The value of C_4 may be .001 or .002 μF.

An Alternative Method

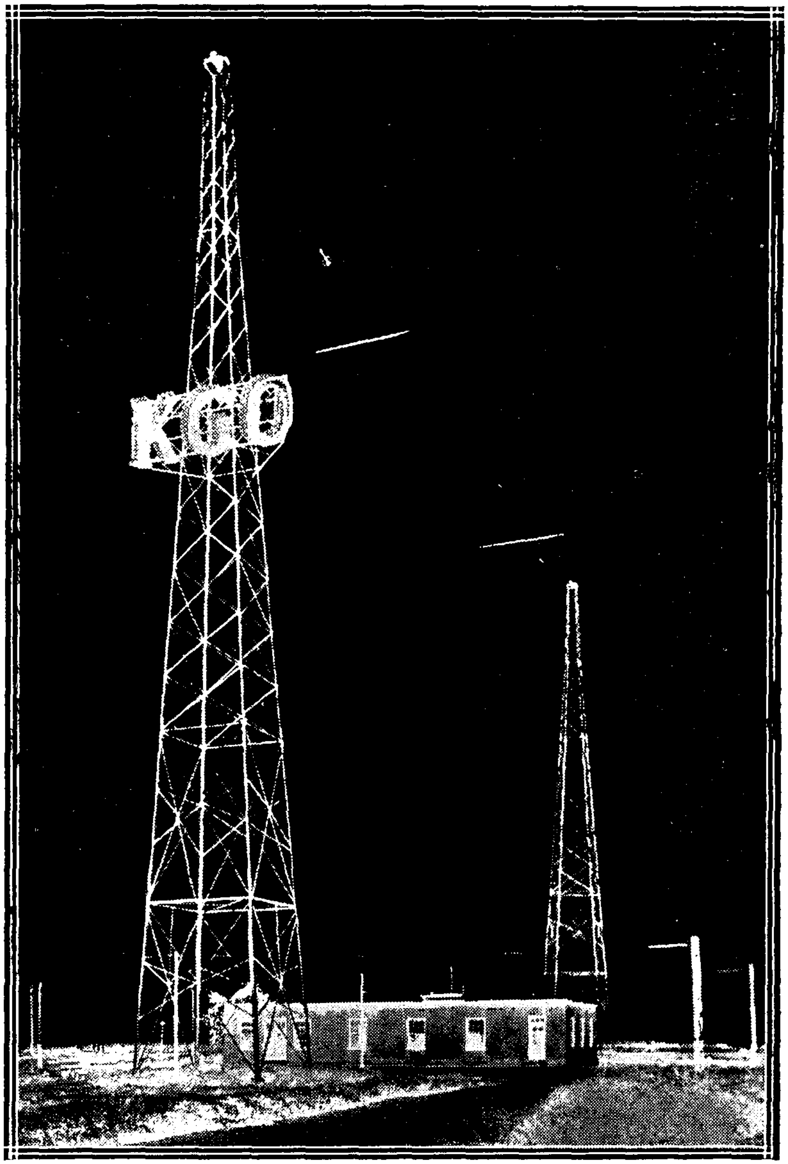
A further method which should recommend itself to readers is that given in Fig. 6, which again shows a two-valve circuit with the first valve acting as a high-frequency amplifier. Here the potentiometer is again involved, but in this instance the slider, instead of being connected to the grid of the first valve, is connected to the H.T. negative.

The operation of the circuit, coil values, and so on are again the same as normal, and after the set has been adjusted to give the best results, with the potentiometer slider moved to its mid point, that fine control of reaction which it is desired to get is given by moving the slider of the potentiometer one way or the other.

The manner in which this fine control is brought about is in the variation of anode voltage given by the position of the potentiometer slider; for instance, with the slider at the negative end the value of anode voltage is the value of the H.T. battery, whereas with the slider of the potentiometer at the positive end, then the anode voltage is that of the H.T. battery plus that of the L.T. battery, and it is this small variation in total voltage which makes possible the fine control given by this arrangement. The value of C_5 may be .001 or .002 μF.

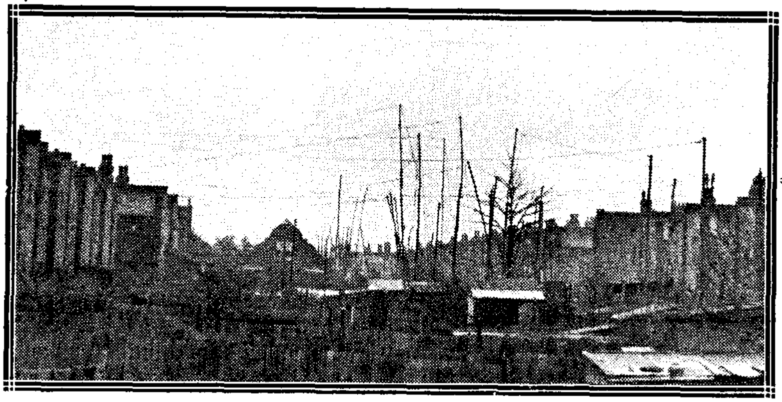
Conclusion

In conclusion it should be understood that in the circuits illustrated the values of aerial tuning condensers, grid condensers, leaks, etc., are taken to be of normal value, and for that reason are not mentioned.



The masts at KGO, Oakland, California, are illuminated at night and present a striking contrast against the night darkness.

Freak Reception and Neighbouring Aerials



By D. J. S. HARTT, B.Sc.

Some conclusions resulting from experiments on the effect on reception of various aerials in close proximity.

ONE often hears of instances of reception, sometimes of fairly distant stations, under conditions which normally would render such reception difficult if not impossible. Only recently, for instance, the author heard of a case where most of the B.B.C. stations had, on occasions, been received quite well on a very poor indoor aerial and not too good an earth connection, using quite a modest one-valve set. Quite apart from the variations of signal strength and the change in general reception conditions from time to time, there are other factors which have a bearing on the question of "freak" reception, particularly when such reception is carried out at a spot where there may be several aerials erected in close proximity to one another.

"Casual" Aerials

Again, eliminating the possibilities of radiation from a neighbouring aerial, which it would seem is responsible for a great deal of freak reception, there is yet to be considered the question of the casual "pick-ups" afforded by neighbouring systems. On the short waves down to about 50 metres this effect is most marked, and is amply demonstrated by the fact that it is possible to receive KDKA on 68 metres without any aerial connected to the set at a strength not much less than that obtained *with* an aerial connection. That the effect is present on the broadcast wavelengths, though to a smaller but quite appreciable extent, is shown by the results of a few observations carried out on several neighbouring aerial systems and described below.

Mutual Interference

When several receiving sets are operated on aerials erected quite close to one another some peculiar effects may also be observed; in particular, the mutual effect of two regenerative receivers operated on near-by aerials leads to curious and often annoying results, as any reader who has had occasion to explore the ether while his neighbour is doing the same thing may possibly have observed! However, the author was not concerned with radiation or reaction effects, but simply with carrying out a few tests with the object of seeing the effect of neighbouring pick-up systems upon reception on a particular aerial.

Aerials Used

The arrangements of the various aerials which were used is shown diagrammatically in Fig. 2, while Fig. 1 gives an indication of their respective heights. The indoor aerial consisted merely of a 25-ft. length of No. 22 D.C.C. passing through one room, out of the window, under the roof of a shelter, and finally through a ventilating shutter in the wall of the receiving room, with an ebonite ring as insulator at each end. The down-lead of the outdoor aerial marked No. 1 was taken to a lead-in device passing through the roof, whilst the down leads from the aerials marked Nos. 2 and 3 could be brought through a window in front of the working bench.

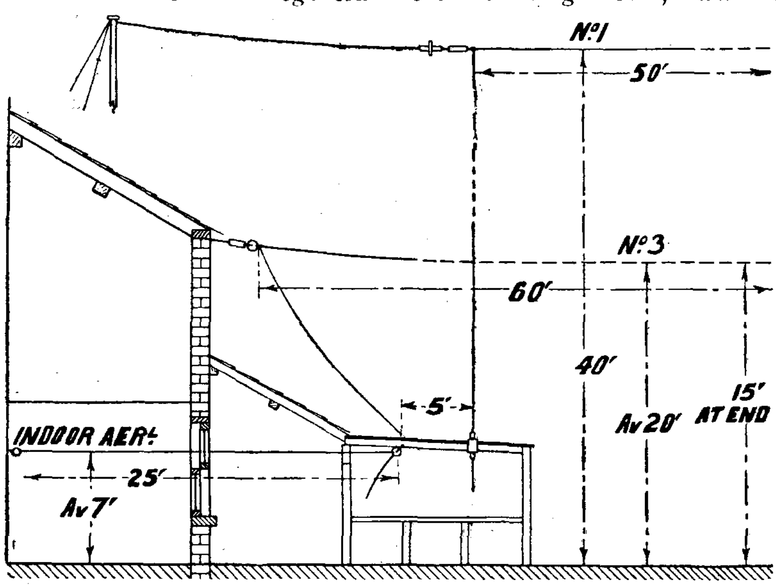
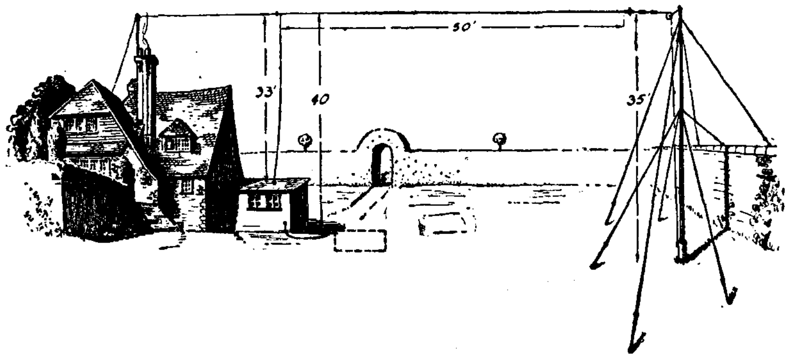


Fig. 1 gives an indication of the respective heights of the various aerials used. For simplicity Aerial No. 2 is not shown here, but its position and average height are given in Fig. 2.

For a preliminary test a

parallel tuned circuit, consisting of the equivalent of a No. 35 turn coil with a .0005 μF condenser across it, was connected to aerial No. 3 and to an earth connection, forming an ordinary parallel tuned aerial circuit. Across this was connected a Moullin voltmeter (applications of which have been described in *Wireless Weekly* by Mr. G. P. Kendall, B.Sc., and used in many fruitful investigations by him). Using the carrier wave from 2LO, a figure of 1.5 was obtained as a measure of the signal strength with aerial No. 1 earthed to a separate earth connection. With No. 1 aerial open—that is, the lead-in just disconnected from the earth terminal and left free—a figure of 2.0 was obtained. With the No. 1 aerial let down there was only a very slight decrease in signal strength, less than 0.1. These figures show what would be expected in the case of two aerials so close, namely, the shielding action of the larger aerial connected to earth and a very slight increase in signal strength due to the proximity of the larger aerial left free.



The arrangement of the aerial marked No. 1 in the accompanying diagrams. Aerial No. 3 was secured to the same mast at the free end, but aerial No. 2 was an entirely independent system supported by separate masts.

The Moullin voltmeter was then used to obtain a measure of the signal strength when connected across a parallel tuned circuit connected to aerial No. 1 and earthed as before; a figure of 6 was obtained. The effect of operating a crystal receiver tuned to 2LO on aerial No. 3 was then observed, and was found to give a reduction of from 6 to 2.5; with the crystal set operating on the indoor aerial in position A (see Fig. 2) and tuned to 2LO the decrease was from 6 to 5.5, which indicates an absorption effect, even with a small indoor aerial far removed from the aerial No. 1. During these tests the coils in the two aerial circuits were over 5 ft. apart, and this absorption effect appeared to be due to the mutual action of the two circuits as a whole, and could not be observed when either of the smaller aerials was removed.

Crystal Reception

Tests were then carried out in actual crystal reception on the indoor aerial; with a good

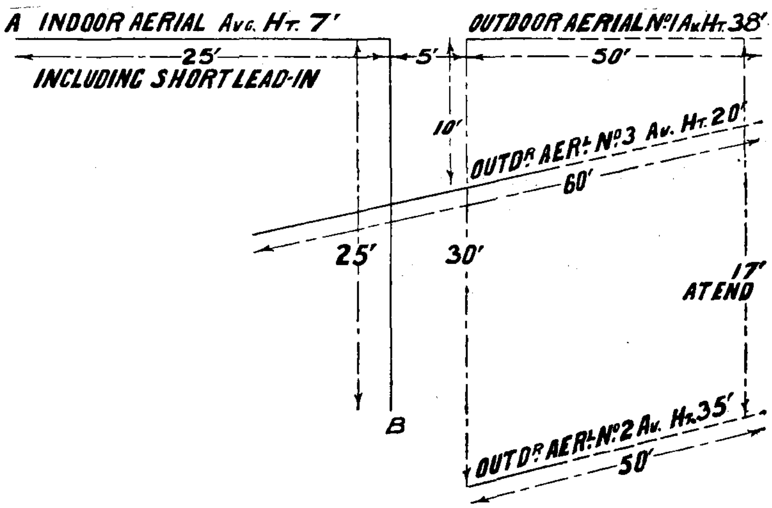


Fig. 2.—A diagrammatic plan view showing the lateral distances between the four aerials used.

crystal set connected to this and to a good earth, signals from 2LO were practically inaudible when the aerial No. 1 was earthed, but speech was just intelligible if the aerial No. 1 was left open. Bringing the lead-in of aerial No. 1 near to the indoor aerial made little difference to signals. However, connecting a parallel tuned circuit to aerial No. 1 and a separate earth, and tuning this circuit to the wavelength of 2LO, brought signals up to quite good strength.

Signal Strength Measurements

These results were confirmed by actual measurements with the Moullin voltmeter across a parallel tuned circuit connected to the indoor aerial and an earth connection. When the circuit formed by aerial No. 1, a coil and condenser in parallel, and a separate earth connection, was tuned to 2LO, a signal strength reading of 3 could be obtained, but on detuning this latter circuit by about 5 degrees on its .0005 μF condenser, no reading could be recorded, nor was it possible to obtain any reading with aerial No. 1 lead-in disconnected from the tuned circuit and left free. During these tests the coils in the two circuits were at right angles and 4 ft. apart; there seemed to be no "pick up" between the coils, since with the indoor aerial connection removed from the Moullin voltmeter circuit and the aerial No. 1 circuit tuned to the wavelength of 2LO no indication of signal strength could be obtained.

Aerials at Right Angles

With the indoor aerial arranged exactly at right angles to aerial No. 1, precisely the same effects, though slightly less in magnitude, were observed, both aurally and by measurement.

However, when energy was being drawn from the aerial No. 1 system (*e.g.*, crystal reception) when tuned to 2LO, the signal strength observed on the indoor aerial was reduced by about 50 per cent. both in the case when the indoor aerial was parallel to aerial No. 1 and at right angles to it.

Effect of More Distant Large Aerial

Further tests were carried out on aerial No. 2, which was quite removed from the indoor aerial, and during these tests aerial No. 1 was earthed. With a crystal set connected to the indoor aerial (in position A), and with the lead-in from No. 2 aerial left free, it was just possible to hear 2LO with straining; but when No. 2 aerial was tuned to the wavelength of 2LO as before, quite good crystal reception was possible. The coils in the two circuits were here 6 ft. apart, but the same effect was observed, though slightly less pronounced, when the lead-in of No. 2 aerial and the coil in that circuit were moved 20 ft. away from the crystal set and the indoor aerial.

Absorption Effect

In contrast to these results was that observed in crystal reception on aerial No. 1. Here the tuning of the circuit of aerial No. 2 to the wavelength of 2LO produced a marked decrease in signals on the crystal set.

Thus the aerial circuit No. 2, when tuned to 2LO, produced an absorption effect with respect to an aerial of similar characteristics, *i.e.*, No. 1, but provided, so to speak, an additional " pick-up " or " booster " with respect to the much smaller indoor aerial, in the case of crystal reception on both these latter aerials.

Increase in Signal Strength

The crystal reception on such a poor indoor aerial was in the nature of " freak " reception, since with all other aerial systems earthed it was only possible to hear 2LO very feebly, but merely tuning either No. 1 or No. 2 aerial to the wavelength of 2LO enabled one to obtain quite good reception. This latter condition is, of course, one in which a larger neighbouring aerial may quite conceivably be when a set connected to it is left tuned to a particular station and switched off.

Valve Reception

Valve reception on the indoor aerial confirmed the fact of the extra " pick-up " provided by a neighbouring larger aerial merely tuned to the wavelength of the station it was desired to receive. On a detector valve alone on the indoor aerial, it was, for instance, possible to pick up the carrier of Radio-Belge (Brussels) but not to resolve it; with No. 1 aerial tuned to the wavelength of SBR quite good reception was possible. The same was true of another Continental station, Radio-Toulouse. Some effect such as this may have been a contributory factor in the case of " freak " reception instanced in the beginning of this article.

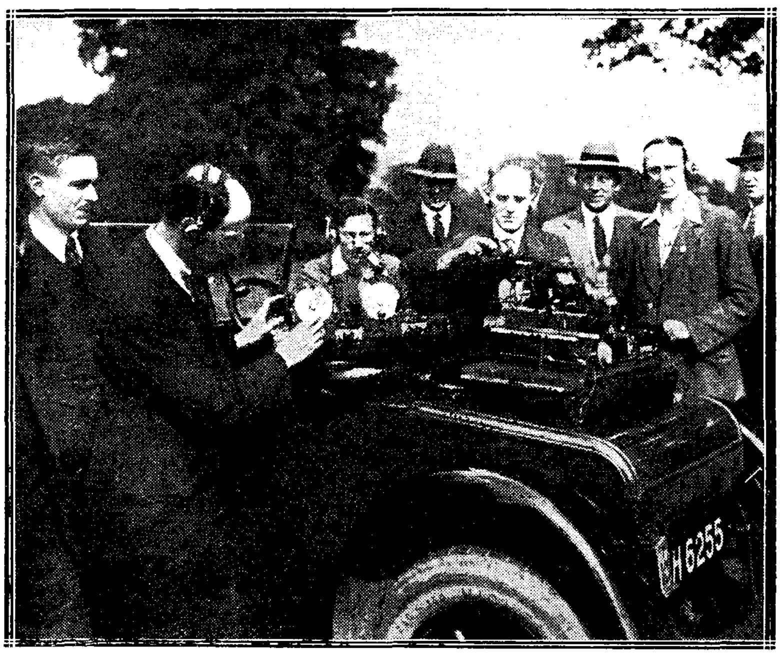
The Madrid Station

The Union Radio broadcasting station, which was opened at Madrid on June 17, has changed its call-sign from EAJ 20 to EAJ 7, and its wavelength will henceforth be 430 metres. A mixed programme will be broadcast every day from 3.30 to 4.30 p.m., and a musical programme on odd days of the month between 7 and 9 p.m. and on even days between 11 p.m. and 1 a.m. G.M.T.

The station has been erected on the roof of a large general store and consists of a Marconi 6kw. broadcasting transmitter of standard pattern similar to those used in many of the stations of the British Broadcasting Company and at Brussels, Rome, Cape Town, and elsewhere. The studio has been equipped with a Sykes microphone. Reports received from listeners during test transmissions indicate that the station functions with complete success and that reception is clear and strong.

Opera at Manchester

The Manchester station, which has already fifteen operas to its credit, will give a performance of Leoncavallo's " I Pagliacci " on Wednesday, July 15. Among the principals will be Miss Eda Bennie, Mr. Parry Jones, and Mr. Lee Thistlethwaite, who has played the baritone rôle in every opera produced at this station. A booklet containing notes and the words of the opera will be issued on similar lines to those issued for " La Traviata " and " Faust," several thousands of which were distributed free to listeners and found very helpful.

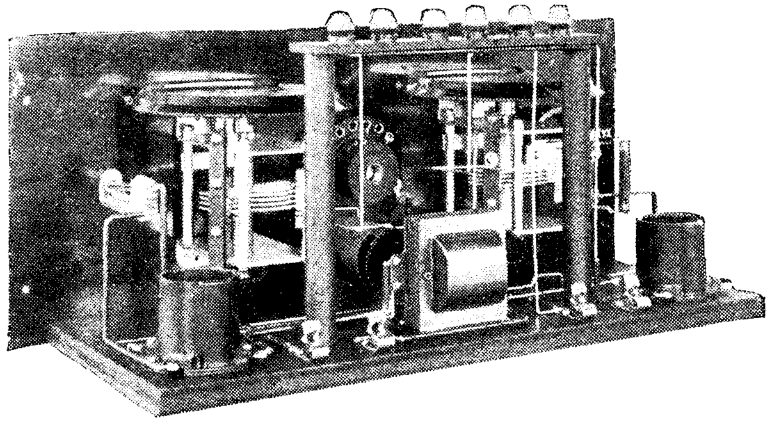


Members of the Eastern Metropolitan Radio Society with their mobile wireless station on the occasion of their field-day at Cuffley.

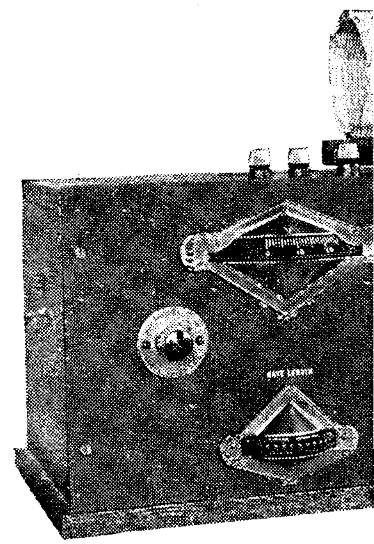
A RECEIVER FOR TEN TC

Practical details of a c...
Inst...

By PERCY W.



A view of the back of the receiver; the "volume control" switch is visible between the variable condensers.



This article, describ...
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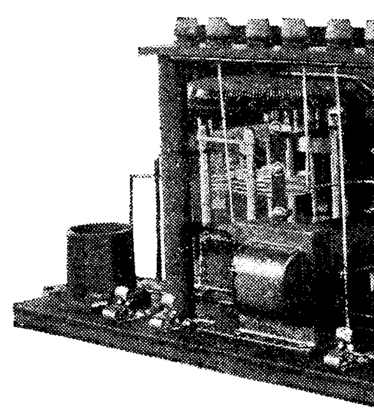


Another back-of-panel photogr...
of the wiring. The American t...
at the corners...

I AM very glad to be able to give readers of *Wireless Weekly* particulars of a very interesting short - wave receiver which is just being placed on the market here by the well-known firm of A. H. Grebe & Co., whose broadcasting station WAHG, from which I had the privilege of speaking recently, is often received in England. As full details of the circuit are given, and photographs from several angles, the short-wave experimenter should be able to gather from the article enough practical information to build a very useful short-wave set.

Valves

It is particularly noteworthy that the set works perfectly with the ordinary American valves of the UV 201A type, which correspond with our B.4, D.E.5, D.F.A., etc., valves. It is not even necessary to remove the bases, as is so often recommended on very short-wave receivers. Notice the special low-loss condensers working with edge-wise dial adjustment and vernier knob beneath the main dial. The "volume control" is really a resistance shunt across the primary of the L.F. transformer, shown as R3. Suitable voltages are given on the curves which accompany this article, and can be taken to apply to our own B.4 or D.E.5 type of valve.

Circuit

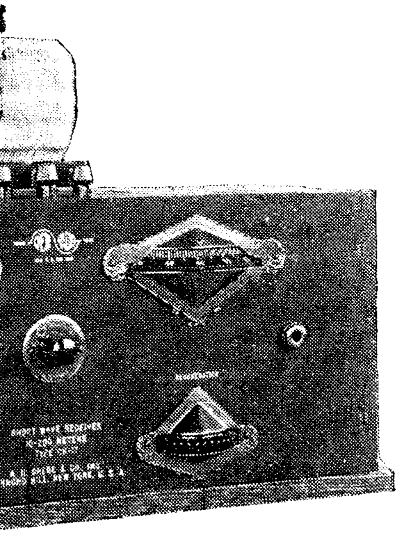
The "CR-17" employs a coupled regenerative circuit of familiar form with certain modifications in the anode circuit. In dealing with frequencies of the order of thirty million cycles, corresponding to a wavelength of 10 metres, the usual regenerative circuits fail to function, and while circuits have been designed to operate at these high frequencies, generally the frequency band has been too small to be of any practical use. The trouble with most circuits is that below a wavelength of 20 metres difficulty is experienced in making the circuit regenerate or oscillate, a requirement necessary for the reception of continuous waves. Circuits which do oscillate at these high frequencies, however, offer other difficulties.

The adjustable reaction coil circuit is useless at very short wavelengths, because a change in the reaction adjustment produces

) TWO HUNDRED METRES

everly-designed American ument.

HARRIS, M.I.R.E.



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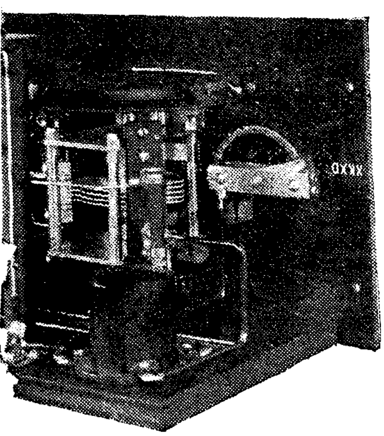
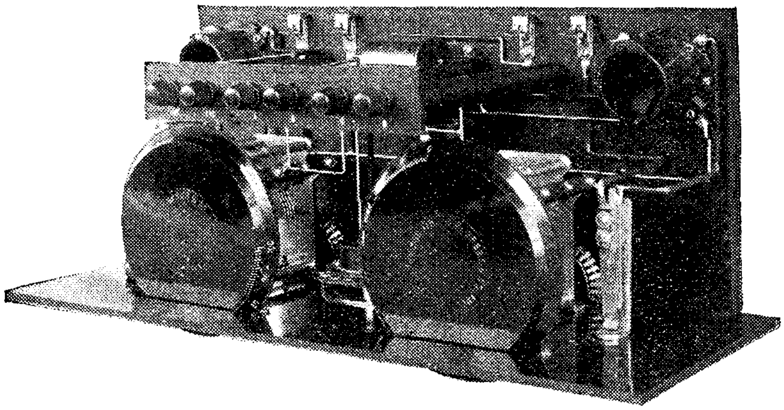


ɔh, showing clearly the simplicity ɔe valve-holders will be recognised ɔf the baseboard.



A photograph from above, showing the method of presenting the condenser dials edgewise to the operator.

so great a change in wavelength that the transmitting station cannot be received with any degree of certainty. On the other hand, the capacity coupling method sometimes used in reception at high frequencies is such that the body capacity effect is so great that tuning is destroyed and the receiver becomes impractical to operate.

Body-Capacity Eliminated

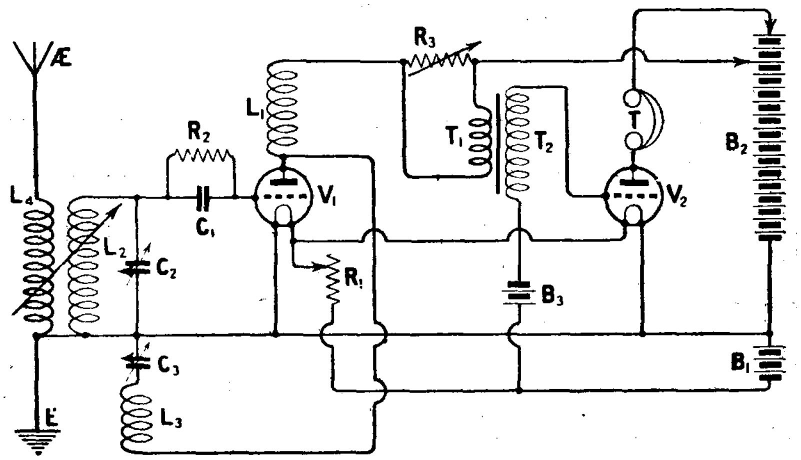
A circuit diagram of the "CR-17" is shown in this article, and it will be noticed that the rotor plates of both the wavelength condenser C2 and the reaction condenser C3 are at earth potential. This circuit arrangement has made possible a receiver which will operate below 10 metres without regeneration affecting wavelength and with body-capacity effects entirely eliminated. The secondary inductance L2 and the fixed reaction coil L3 are, in reality, a single winding, split in the centre, and the receiver is supplied with six coils to cover the wavelength range of 10 to 200 metres. The aerial coupling coil L4 is adjustable, and the receiver is supplied with three coupling coils, to be used in accordance with the wavelength charts shown in this article. Two grid-leak clips are mounted on the left of the tuning condenser, and a grid-leak of 3 to 5 megohms is recommended. The filament rheostat R1 is mounted to the left of the front panel. The small control knob in the centre of the panel operates a volume control resistance R3, which is useful in receiving during heavy atmospherics.

Wavelength Charts

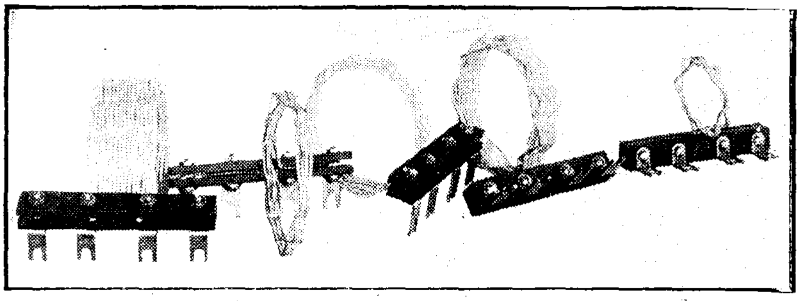
There are six wavelength charts furnished with this receiver, the purpose of which is to show the wavelength range of each coil, the particular wavelength corresponding to the dial settings, the correct dial setting on the reaction condenser for a given wavelength, the proper aerial coil to be used, and the correct detector and amplifier anode voltage. It will be noticed that, apart from the lowest wavelength range, as the wavelength is increased it is necessary to move the regeneration dial to a higher figure, but in general this dial will only have to be moved over a small part of the scale.

When the aerial coupling coil is connected and the coupling distance adjusted correctly, the receiver should regenerate very smoothly and upon further adjustment of the regeneration dial gradually go into oscillation. In some cases the receiver may fail to oscillate on a particular wavelength, and this is generally due to the fact that the natural period of the aerial and coupling coil is the same as the wavelength of the receiver. This condition can be avoided by either loosening the coupling or inserting either a condenser or a loading coil in series with the aerial so as to avoid this resonance condition.

When using the single-turn coupling coil, a single wire or aerial 8 ft. long should be connected to the terminal marked



The circuit of the Grebe "CR-17" Receiver. The moving plates of both tuning condensers are earthed as indicated.



Some of the interchangeable low-loss coils used for covering the range from 10 to 200 metres.

aerial, and a similar rod connected to the terminal marked "Gnd." to serve as a counterpoise. When using a single-turn coupling coil no earth should be connected to the receiver. An aerial suitable for use with the five-turn aerial coil is a single wire preferably 40 ft. long and vertical. This aerial should be used with an earth connected to the positive L.T. battery terminal. For use with the 10-turn coupling coil, a single wire 50 or 75 ft. long may be used in conjunction with an earth. It is not necessary, however, to erect separate aerials for each individual coupling coil, but it is advisable to use the special aerial recommended when using the single-turn coil on wavelengths between 10 and 19.5 metres. On wavelengths above 20 metres any form of aerial may be used, and exceptional results will be obtained by using a large aerial and tuning it to some multiple of the received wavelength by means of a variable condenser in series with the aerial.

□ □ □

The Wireless Telegraphy (Explanation) Bill

The text was issued recently of the Wireless Telegraphy (Explanation) Bill, the object of which is to explain the expressions "transmission" and "rent or royalty" in the Wireless Telegraphy Act, 1904. The operative clause declares :—

(1) The expression "transmission," where used in sub-section 7 of section 1 and section 2 of that Act in relation to messages, includes, and shall be deemed always to have included, the reception as well as the sending of messages.

(2) The expression "rent or royalty," where used in section 2 of that Act in relation to licences, does not include, and shall be deemed never to have included, fees (whether periodical or of any other kind) charged in respect of the grant or renewal of licences.

* * *

According to the Press, Mr. Wilbur, Secretary of the U.S. Navy, has peremptorily instructed Lieut.-Commander Byrd, in charge of the three Navy aeroplanes with the Macmillan Arctic Expedition, to substitute long-wave Navy wireless equipment for commercial short-wave apparatus, which Mr. Macmillan had selected.

Mr. Wilbur has ordered Lieut.-Commander Byrd to land the aeroplanes and *personnel* at Sydney, Nova Scotia, if Mr. Macmillan refuses to change the wireless equipment.

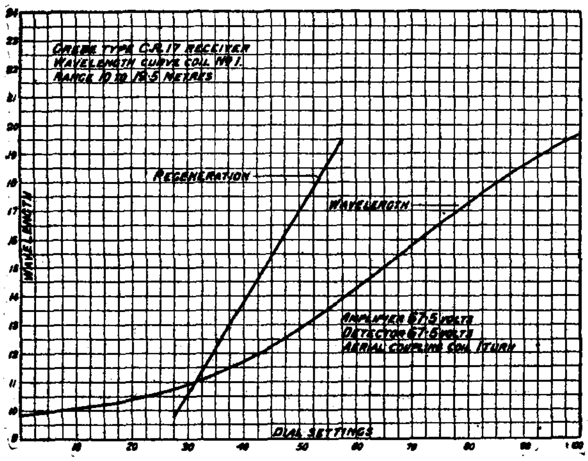
Mr. La Gorce, acting president of the Geographic Society, under whose auspices the Macmillan expedition is being arranged, declared that Mr. Macmillan would accept Navy equipment and proceed without delay.

The expedition left Wiscasset, Maine, for the far north on Saturday.

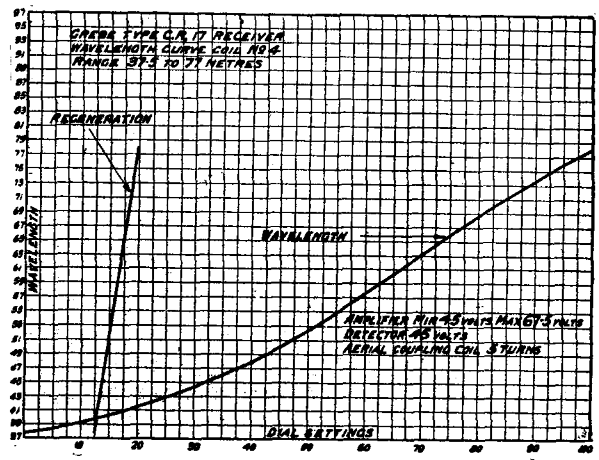
* * *

The famous Marconi Wireless Station at Clifdon, in Ireland, is to be dismantled, and has been sold for that purpose. This Marconi station has played a leading part in the development of wireless transmission, and pre-war wireless enthusiasts will remember it as the first wireless station to have regular communication with America, on a wavelength of 7,000 metres.

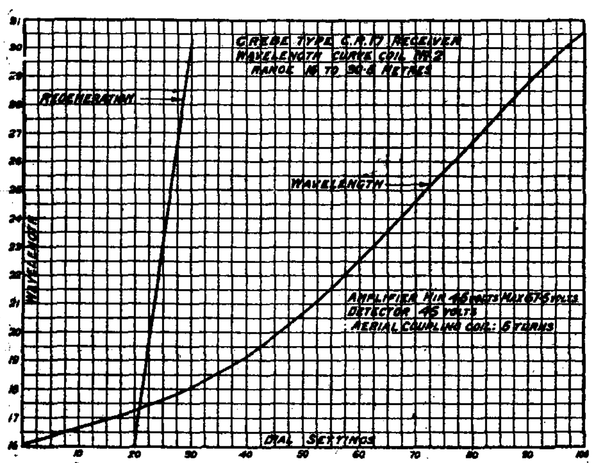
With the Grebe "CR-17" Receiver a complete set of wavelength charts is provided for use in conjunction with the six interchangeable coils.



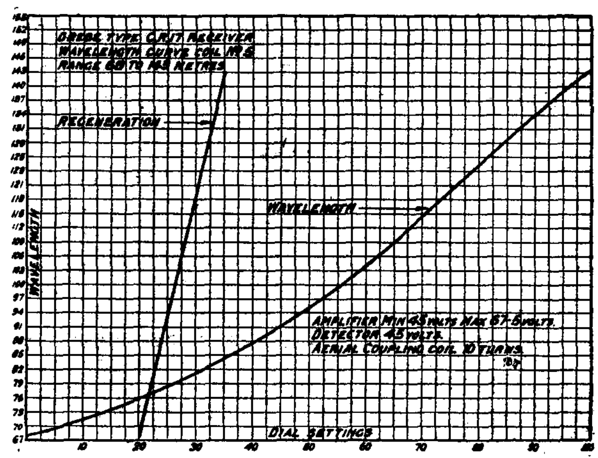
Coil No. 1.—10 to 19.5 metres.



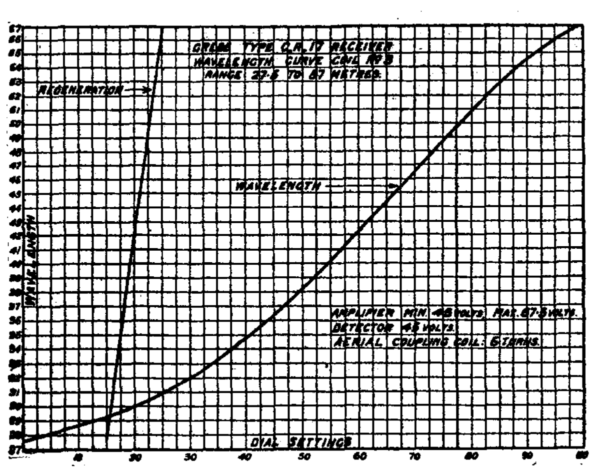
Coil No. 4.—37.5 to 77 metres.



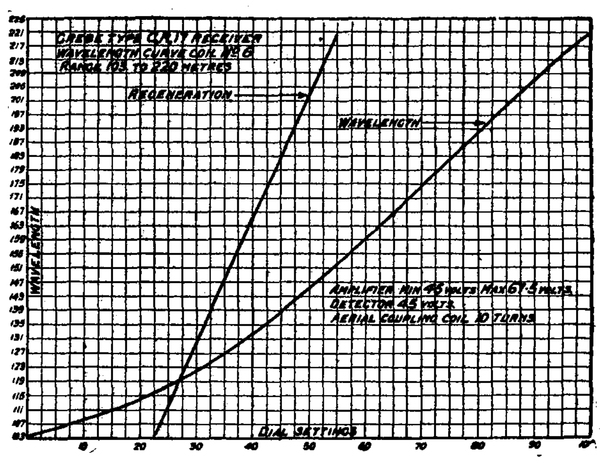
Coil No. 2.—16 to 30.5 metres.



Coil No. 5.—68 to 143 metres.



Coil No. 3.—27.5 to 57 metres.



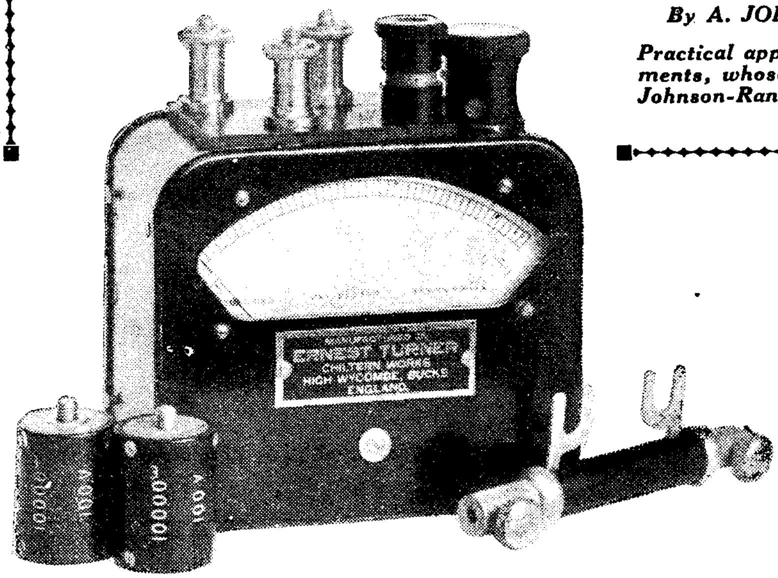
Coil No. 6.—103-220 metres.

The correct dial setting for wavelength and the corresponding adjustment of the condenser controlling regeneration can be read off from these charts. A generous amount of overlap in the wavelength bands covered is allowed between the successive sizes of coils.

Meters in Wireless Circuits

By A. JOHNSON-RANDALL, Staff Editor.

Practical applications of the measuring instruments, whose principles were outlined by Mr. Johnson-Randall in our last issue, are here given in detail.



A complete multi-range instrument, with the resistance pots and shunt employed in making measurements at its extreme ranges of volts and amperes.

LAST week I described briefly the principle of the moving coil voltmeter and ammeter, and I now propose to indicate some of the many applications of these instruments. From the point of view of economy I think that probably one of the most useful types an amateur can provide himself with is that which goes under various names according to make, but which I will call the universal multi-range type. It is, in other words, several different instruments in one. The instrument I possess will measure by the simple movement of a drum switch 0-10, 0-50, 0-500 milliamperes, 0-5, 0-50 volts, 0-100 milli-volts, and by the use of external resistance pots and shunts practically any range of values may be obtained. These instruments have only one drawback: they will not measure voltage and current simultaneously, and for that reason, if the cost can be borne, it is perhaps better to have a separate voltmeter and ammeter with at least two ranges each.

Instruments Recommended

For the amateur who cannot afford a number of instruments I would recommend the purchase of a really good milliammeter reading from 0-20 m/a and a high-resistance voltmeter to read from 0-150 volts. These two instruments I consider to be essential, but, of course, their applications are somewhat limited in comparison with the multi-range type. It is, however, still possible to purchase good secondhand, guaranteed, ex-W.D. instruments at a reasonable price.

One of the most valuable uses of a voltmeter is the determination of H.T. battery voltage or of the voltage applied to the anode of a valve. In Fig. 1 I have shown an ordinary conventional three-valve circuit of the 1-v-1 type, employing separate H.T. tappings to each valve. To measure the voltage applied to the anode of any of the valves is a very simple matter. Two flexible leads should be connected to the voltmeter terminals, and one of them (that joined to the voltmeter terminal marked −) should be attached to the negative plug or terminal of the battery. The + lead from the instrument should be joined to either of the points B, C or D, according as to whether it is desired to measure the voltage between AB, AC or AD. If the battery is not new it is as well to take the voltage when the set is just switched on and again just before it is switched off after a few hours' continuous use. In some cases it will be found that the voltage has dropped very considerably. This alone may

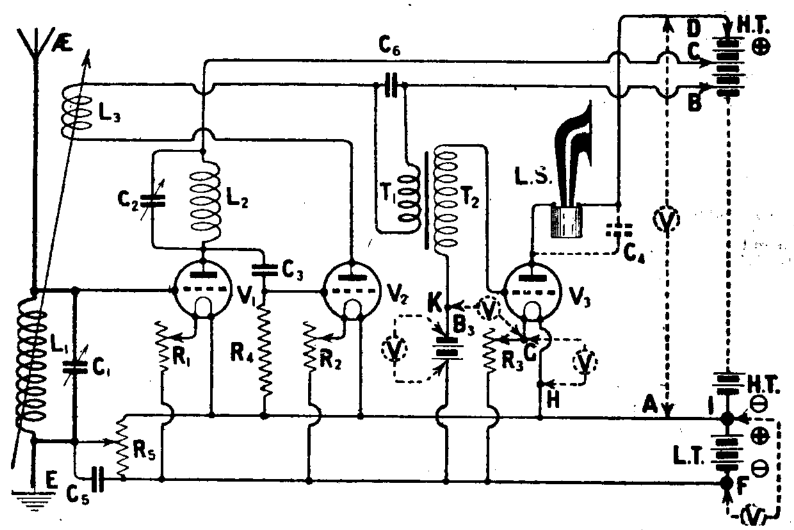


Fig. 1.—A type of circuit in common use, in which the correct points for applying voltmeters to measure L.T., H.T., and grid-bias values are shown.

account for severe distortion in the case of receivers used for loud-speaker work. For instance, take the case of a battery which is "feeding" a small-power valve of the DE5 type, and which, when the set is first switched on, gives a measured voltage of 100. According to the curve shown in Fig. 2, a suitable negative grid bias would be 4½ volts. This will permit a safe grid swing of 9 volts. If, after two or three hours the applied voltage has dropped to 80, the same grid swing will, as will be seen from the 80 volt curve, take our working point right down to the curved portion at ×, and so may cause distortion. This is not an extreme case, as I have known in practice of a drop of 30 volts occurring after three or four hours' continuous working.

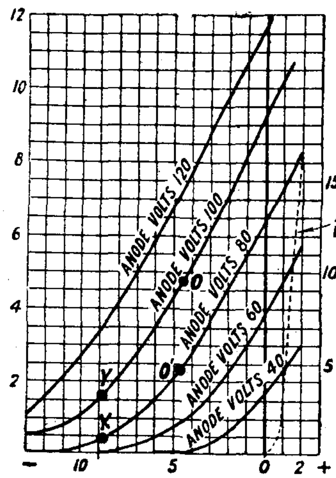
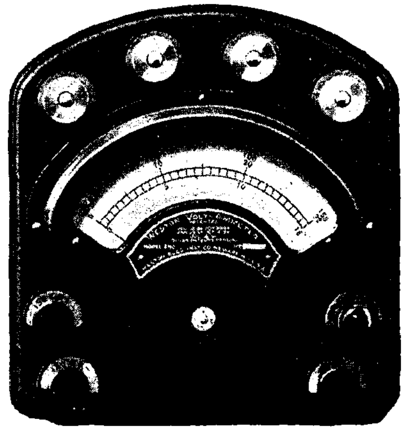


Fig. 2.—Illustrating why distortion occurs owing to a drop in the H.T. battery voltages.

To those who possess a two-range instrument the measurement of the smaller voltages in addition presents no difficulty. The L.T. battery voltage should be taken between the points I and F in Fig. 1, that is, the two flexible leads should be joined direct to the battery terminals or to the two main bus-bars from it.

Filament Batteries

An "open-circuit" reading has no value whatsoever, and the only reliable indication of the battery's condition is that taken on "load," i.e., when the battery is supplying current. In the case of an accumulator, the minimum reading should be 1.8 volts per cell, although in some cases this may vary slightly. Most makers mark the minimum safe voltage on the containing case of the battery. Dry batteries are subject to greater variations than accumulators, and no really definite values can be given,



A popular type of multi-range voltmeter and ammeter.

but the battery needs careful observation after the voltage per cell has dropped to 1.2-1.3.

Valve Filaments

The filament working voltage may be obtained by connecting the voltmeter between the points G and H in Fig. 1, and should be adjusted by means of the filament rheostat in accordance with the valve maker's instructions. When the filament rheostat is connected in the negative L.T. lead the drop in volts across the resistance, in the case of low-frequency amplifiers, must be allowed for in adjusting the grid bias. For example, if the voltage at the ter-

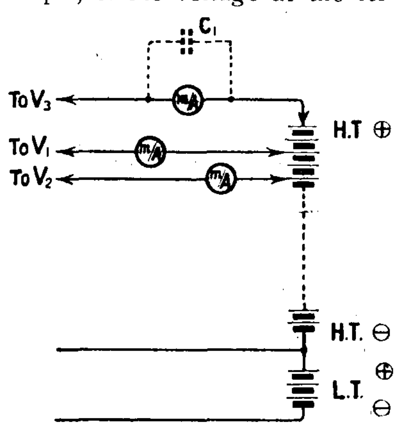


Fig. 3.—Showing how to measure the anode current taken by the different valves.

minals of the L.T. battery is 6, and that between the points G and H 4, then the drop across R3 will be 2 volts. Hence, if V3 requires a negative grid bias of 5 volts for efficient working, with a certain applied anode potential, then B3 must be adjusted to 3 volts.

Grid Potential

The voltage of the grid battery B3 should be measured in the same way as has already been described for the determination of L.T. battery voltage. This, however, will not be an indication of the total grid potential, as it does not include the voltage drop across the filament rheostat R3. The correct reading for the actual grid bias will be given by connecting the instrument across the points G and K.

Anode Current

Passing next to the milliammeter, one of its chief uses is in the measurement of anode current, and it forms a most useful check on the condition of the valves

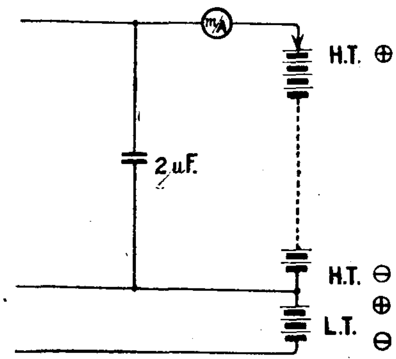


Fig. 4.—If a large condenser is permanently connected as shown, the condenser C1 of Fig. 3 will be unnecessary.

themselves, in addition to indicating the load on the H.T. battery. It should be connected in each + H.T. lead separately, as shown in Fig. 3, the total anode current being the sum of the readings for each valve. This, of course, will be the total load on the H.T. battery, and it is as well to point out that the heaviest load on the battery is between its negative terminal and the tapping of the valve V2, for not only is it supplying current for the valve V2, but it is also supplying that for V1 and V3, hence the voltage of the cells across this portion of the battery will be the first to drop. The normal load on the popular type of H.T. battery with small cells ought never to exceed 5 m/a, and if a small power-valve is used for loud-speaker work it is an economy to purchase one of the larger sizes specifically designed for this work. Small power-valves such as those commonly used for loud-speaker work in the home take about 5 m/a, while the ordinary general purpose valve requires in the neighbourhood of 2 m/a. The total load in the case of a 4-valve set may therefore easily be 10-11 m/a. If the H.T. battery is used without the usual shunting condenser between each tapping and the common negative, it may be necessary to connect a condenser (shown as C1 in Fig. 3) across the two terminals of the milliammeter, the windings of which, it must be remembered, are directly in series with the anode of the valve whose plate current we are measuring; the value of C1 may conveniently be .01 μF. If, on the other hand, as should be the case, a 2 μF condenser is shunted across the battery, the instrument should be connected as in Fig 4. An interesting point occurs here. In the family set for some considerable time I have made a practice of employing a separate H.T. battery for the last valve, which is a power valve, and until recently this battery had an ex-W.D. 2μF condenser permanently shunted across the positive and negative terminals. One night, upon switching off the valves, I noticed quite by accident that the needle of the milliammeter, which happened to be connected in circuit at the time, did not fall to zero, but remained at a position which gave a reading of ½ m/a. Upon investigation the condenser proved to be defective, but the fact remains that possibly for a long period this fault had placed a small constant load upon the battery day and night. I pass this on as one of the many valuable uses of a milliammeter. Finally, I would refer readers to that exceedingly interesting method of signal strength comparison, described by Mr. G. P. Kendall, B.Sc., in *Wireless Weekly*, Vol. 5, No. 12, Vol. 5, No. 13, Vol. 5, No. 14. Mr. Kendall described in a very simple manner how it was possible with the aid of a fine reading milliammeter to determine the relative efficiency of various tuning arrangements, basing his measurements on the fact that when a circuit is brought into resonance with a strong carrier wave a drop in anode current occurs.

Filament Current

The measurement of the filament current of individual valves in a wireless circuit is simply effected by inserting an ammeter in any one of the filament leads from the L.T. battery busbars. Disconnecting one of the the leads from the battery itself and joining the instrument in series between that lead and

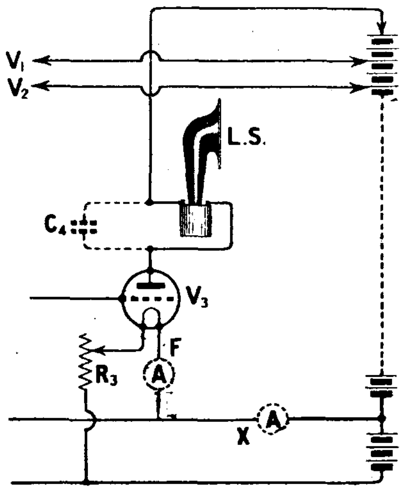


Fig. 5.—Ammeter connections to ascertain total filament current or that of one valve.

the terminal on the battery will give a reading representing the total consumption of the valves in circuit at the time. The correct method in both cases is shown in Fig. 5 at F and X respectively. It is probably better to place the ammeter in the positive lead, taking this lead to that marked with a + sign on the instrument, which

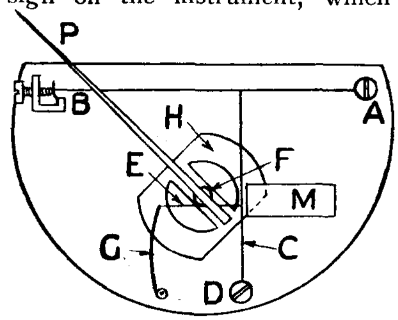


Fig. 6.—Details of the construction of a meter of the hot-wire type.

may be one with a convenient range of 0—5 amperes, although in these days of .06 valves one with a range of 0—1.5 amperes is very useful. When using a moving-coil instrument with the ordinary "zero left" scale, it is essential that it should be correctly connected in circuit, otherwise the needle will not indicate the reading, and the sudden movement against the stop to the left of zero may damage the instrument.

Moving-Iron Meters

The moving-iron type of instrument is not used very largely in the class of work just described, but the principle is frequently utilised in the cheaper forms of pocket-testing ammeters and voltmeters. One of the chief drawbacks is the difficulty in obtaining an evenly-divided scale, the general tendency being for the divisions to close up on the lower readings. A point in their favour, however, particularly in the case of larger instruments of this type, is that, owing to their simplicity, a good mechanical job results.

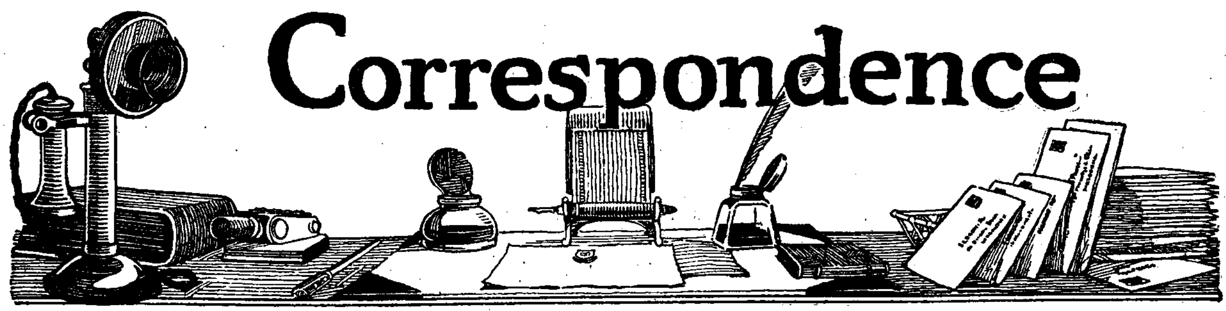
Hot-Wire Instruments

For the measurement of alternating current, in addition to continuous current, the principle of the expansion of a fine wire due to a current flowing along it is utilised very extensively.

The principle is, briefly, as follows: Referring to Fig. 6, a fine wire, usually of an alloy of platinum and silver, is secured between the two supports, A and B, a tension-adjusting device being provided. Attached to a point near the centre of the wire is another wire C of phosphor-bronze, this wire being fixed to a terminal at D. A fibre marked E in the sketch is attached to the wire C, passed round a small pulley F, and finally secured to a spring G. A current flowing along the wire between A and B raises its temperature, and hence causes it to expand. The resulting sag is taken up by the phosphor-bronze wire and transmitted to the pointer P, which is fixed to the small pulley. The spring G serves to keep both the wires and fibre in tension. A small aluminium disc H is attached to and moves with the pointer P between the poles of a permanent magnet M, its movement causing eddy currents to be generated in the disc, thus damping any tendency for the pointer to oscillate, and rendering the instrument "dead beat."

In the case of a voltmeter, a non-inductive resistance of a metal having a negligible temperature co-efficient is used in

(*Continued on page* 408.)



Correspondence

ENVELOPE No. 10

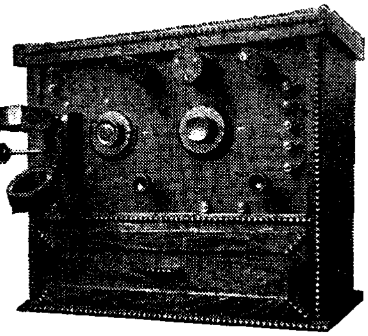
SIR,—I am enclosing photographs of the "Twin-Valve" Receiver described by Mr. John Scott-Taggart in Envelope No. 10, which perhaps you may consider would be of interest to your readers.

The results obtained have been beyond my expectations. I have been able to tune in the following stations: — London, Birmingham, Bournemouth, Cardiff, Glasgow, Liverpool, Manchester, Newcastle, Nottingham, Berlin (Voxhaus), Brussels, Hamburg, Petit Parisien, and others unidentified.

Most of the above are free from interference from London, but in one or two cases this station can be heard in the background.

In my case, best results are obtained from London, using parallel tuning with a No. 50 coil for aerial and No. 75 for reaction. For all other stations, best results are obtained using constant aerial tuning with a No. 35 coil for reaction with suitable coil in aerial to cover wavelength required.

I might mention that Brussels sometimes comes in almost as loud



The "Twin-Valve" Receiver made by C. A. G. T.

as London on the loud-speaker.—Yours faithfully,

C. A. G. T.

Tottenham, N.17.

SIMPLEX RADIO CHART No. 3

SIR,—Enclosed you will find photographs* of a four-valve set enclosed in a sloping cabinet constructed to instructions in your "No. 3 Simplex Radio Chart." I am very pleased with results. I have added a series-parallel switch, a .0005μF vernier variable condenser in the place of the .001, a .0003 and vernier anode condenser, H.T. and L.T. switches, C.A.T. .0001 fixed condenser, and Clix plugs to reaction coils. It does all you claim, and more besides. Another item is a "Meccano" worm and wheel for operating the reaction coil-holder. The set makes a highly interesting piece of apparatus.

My aerial is 30 ft. high, 34 ft. long, composed of parallel wires, each wire composed of 49 strands of gauge 26 phosphor-bronze. Earth, 7 ft. of 7/16 copper cable soldered to copper tube, buried 2 ft. below surface of ground.—Yours faithfully,

ANDREW TIBBLE.

Walthamstow, E.17.

* It is regretted that the photographs received were not suitable for reproduction.—ED.

ST100 WITH H.F. VALVE

SIR,—Having made the ST100 with extra H.F. valve (as described in *Modern Wireless* by Mr. J. Scott-Taggart, F.Inst.P., June, 1924), I am now writing to tell you what splendid L.S. results I get from many English and foreign stations as will be seen by the list I give. I could not properly control the three-valves (one Edison .06, B.T.H. B.5, and B.T.H. B.6) together, so made a separate complete amplifier. I have to cut out the extra H.F. for 5IT, five miles away, as signals almost paralyse a large Amplion.

I have heard a few local loud-speaker sets, including demonstrations by dealers, but I would "back" my ST100 (two or three valves) to beat them all for distance, volume and clarity.

The set is in use every day for at least four hours a day on the average.

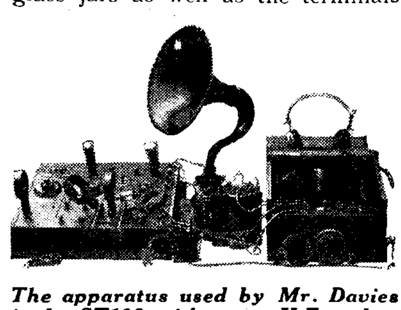
My next set will be the Omni set, Envelope No. 5.

I am a regular reader of *Wireless Weekly, Modern Wireless* and *The Wireless Constructor.*

List of stations received on L.S.: —Aberdeen, Birmingham, Glasgow, Newcastle, Bournemouth, Manchester, London, Cardiff, Petit Parisien (Paris), Nottingham, Stoke, Liverpool, 5XX, Radiola (Paris) Madrid, Radio Iberica, Postes and Telegraphs (Paris), Morse, Aircraft, Brussels, Frankfurt, and Rome.—Yours faithfully,

J. J. DAVIES, JUNR.

West Bromwich, Staffs.



The apparatus used by Mr. Davies is the ST100 with extra H.F. valve.

LECLANCHÉ CELLS FOR H.T.

SIR,—I am a regular reader of all your excellent publications from the moment they could be got in our country. As I see that the problem of high-tension supply for receiving circuits is still in discussion, I feel obliged to communicate the excellent results I am having with my Leclanché battery.

It is now just 1½ years since I assembled a battery of 90 Leclanché cells, each cell nearly 4 in. high and 2¾ in. diameter. I am very satisfied with this battery, and up till now the voltage has only dropped from 1.5 volts per cell to 1.4-1.45 volts. During these 1½ years the cells were only twice filled with pure water to compensate for the loss by evaporation. When refilling, the zincs were inspected and found in the best condition, nearly as clean as at the beginning and not corroded. No crystallisation has taken place, and the glass jars as well as the terminals were perfectly clean. The 90 cells are divided into three batches of 30 cells each and stored in three portable wooden cases, which are situated under the experimenting table. I can now, based on this 1½ years' trial, strongly recommend the use of such cells, and a considerable number of radio enthusiasts of my city who have hitherto used dry batteries or H.T. accumulators are now beginning to instal wet cells because they cost less than accumulators and require little or no attention.

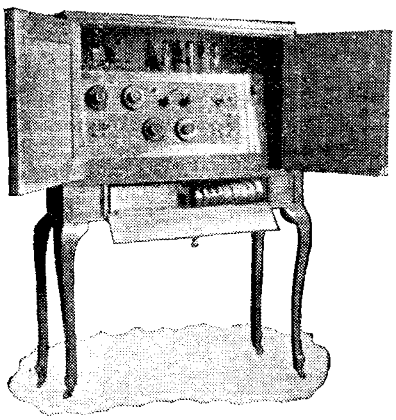
I beg you to accept my heartiest congratulations on all your excellent papers, which are doubtless the best in the world. American instructions are quite useless for us, because they are so superficial that even with American components satisfying results are difficult to obtain.—Yours faithfully,

ING. MICHEL.

Wien, Denmark.

THREE-VALVE DUAL

SIR,—You and many of your readers will no doubt be interested to receive a report on the three-



The "Three-Valve Dual" Receiver as made by Mr. Allbrook, which he uses with an indoor aerial.

valve dual circuit (*Modern Wireless*, April, 1924), by Mr. J. Scott-Taggart, F.Inst.P., A.M.I.E.E., from the point of view of an indoor aerial man, since there must be quite a large number of amateurs who, like myself, find the erection of an outdoor aerial impossible for some reason or another.

The adjustment of the anode resistance and grid bias brings 2LO in so perfectly on the loud-speaker that no desire is felt to tune in other B.B.C. stations. However, while 2LO is not working I have tuned in most of them, and several Continental stations, though not with sufficient volume to work the L.S. satisfactorily. 5XX, of course, comes in at about the same strength as London, and I am hoping by dint of experiment to obtain the others as well. My aerial is simply a length of wire running round the loft twice, roughly in the form of a spiral, and the earth is made to the main water pipe. Both leads come through the ceiling to the set. The cabinet I made with the object of having everything enclosed, but with all the variable factors to hand. The H.T. battery is placed in a recess under the panel and the grid bias on the right, two separate switch arms, connecting to studs giving roughly $1\frac{1}{2}$, 3, $4\frac{1}{2}$ and 6 volts negative. For the sake of convenience I use dull emitters, and a small 4-volt accumulator (which lasts for weeks) is housed in a separate compartment under the grid batteries, thereby eliminating the possibility of acid fumes affecting the wiring. The panel itself falls forward on hinges, so that any defect may be easily remedied.

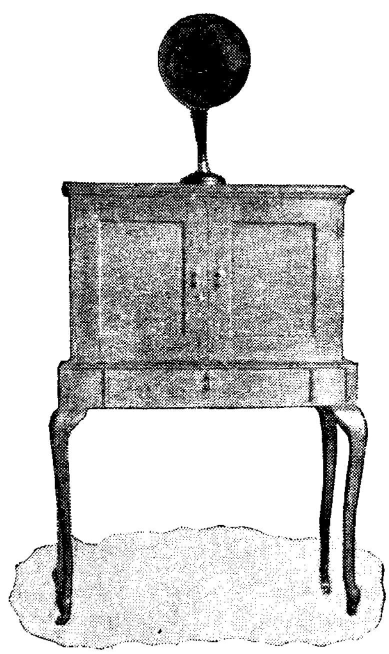
I should very much like to hear the results obtained by any of your readers using this circuit with an indoor aerial, as such comparisons are very helpful. Thanking you for the circuit.—Yours faithfully,

J. S. ALLBROOK.

Muswell Hill, N.10.

AMATEUR CO-OPERATION WANTED

SIR,—I would much appreciate publication of the following test times of my transmissions, as I am desirous of getting into touch with British amateur radio. I have been heard all over S. Africa. Power, 50 watts; wavelength, 85 to 90 metres. My call: CQ de A4L (repeated), Oxenham, Chemist, Capetown, K, and a code word for verification. Times of transmission: 9 p.m. G.M.T. nightly, until July 10, and at 11 p.m. G.M.T. on Sunday, July 5. All QSL cards acknowledged.



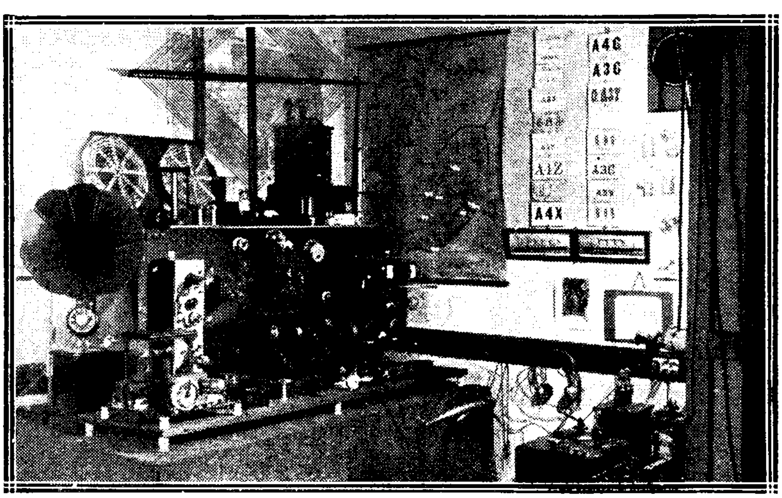
Mr. Allbrook's receiver is totally enclosed and has a "drop" panel for inspection purposes.

Best wishes to *Wireless Weekly*. In anticipation,—Yours faithfully,

R. OXENHAM.

Cape Town.

[It is regretted that this letter was received too late for insertion in our last issue.—ED.]



The receiving and transmitting apparatus used by Mr. Oxenham, of Cape Town, who is seeking the assistance of amateurs in this country.

RADIO A4L

SIR,—Enclosed please find photograph of my station, A4L, Cape Town; if you can make any use of it kindly do so.

In reference to my request for you to publish test times of my transmissions on 85 metres, it may be of some interest to British amateurs to see a photograph of the station they are endeavouring to hear. After my transmissions I shall listen in for replies between 65 and 105 metres, also between 40 and 50 metres.—Yours faithfully,

R. OXENHAM.

Cape Town.

A CHOKE-COUPLED THREE-VALVE RECEIVER

SIR,—I have constructed the "Choke-Coupled Three-Valve Receiver" described by John W. Barber in *Wireless Weekly* for May 27 (Vol. 6, No. 8), and have found it excellent as a means of musical reproduction.

I have constructed many Radio Press sets and have not yet found one where its possibilities have been over-rated. I am very keen on the Puriflex, and have constructed one, using a choke-coupling for the last stage, and this has improved the volume without any detriment to the musical reproduction.—Yours faithfully,

ARTHUR VICKERS.

Blackheath, S.E.3.

A LADY READER AND THE "TRI-CELL" RECEIVER

SIR,—I thought perhaps you might be interested to know the results obtained by a lady reader who has just completed the construction of the "Tri-cell" reflex set described in the September issue of *Modern Wireless* by Mr. Percy W. Harris.

I am quite a novice, but, having obtained fair reception with a crystal set, made according to instructions given in "Twelve Tested Wireless Sets" (R.P. series No. 14, by Mr. Percy W. Harris), I thought I would try to make the "Tri-cell." I would like to thank you for the clear diagrams, etc., which have enabled me to build a thoroughly efficient receiver.

My aerial is rather screened by trees, but is about 35 ft. high, and of single 7/22 wire. I have used "Electron" wire as lead in, and also for the lead to earth, the latter being an old bucket and some wire-netting buried about $2\frac{1}{2}$ ft. deep.

Liverpool comes in very loudly on the phones, quite equal to a friend's 2-valve set (Liverpool is about 18 miles by air); Manchester (46 miles), Belfast (140 miles), Bournemouth (200), and London (195) all at comfortable phone strength. Glasgow not so loud, but speech quite distinct. Excepting Liverpool, the only relay stations so far are Edinburgh and Leeds-Bradford (both verified by hearing the name of the station given), rather faint but clear. Several amateurs come in well, 5PX (B'ham) being one of the best.

Of half a dozen foreign stations, one announcing in Spanish, three French, and one German, Petit Parisien is the only one identified so far, this station coming in at fair strength.

As I have not yet obtained coils suitable for the longer wavelengths I have not tried for Chelmsford or Radiola, but have no doubt that I shall be able to add them to the list in due course.

Again thanking you.—Yours faithfully,

(MISS) E. S. ROBERTS.

Prestatyn, Flints.

ENVELOPE No. 8

SIR,—With reference to the Radio Press Envelope No. 8 ("A Single-Valve Reflex Receiver," by Herbert K. Simpson) I received from you a short time ago, I have made the same up and am writing to let you know the result.

As I am very close to 5NO, I made it up to work a small loud-speaker, which it does splendidly, the Savoy Bands being heard all over the house on an inside aerial.

I put the aerial outside, being a trifle curious as to range, and when 5NO was not working I have tuned in Edinburgh, Glasgow, Aberdeen, Manchester, Birmingham, Bournemouth. Of the other B.B.C. stations, the only one I have not succeeded in getting is Cardiff. The Cape Town Orchestra transmitted recently from Bournemouth and Chelmsford came through splendidly. I also get a French or Belgian station pretty regularly, but have not been able to catch the call sign so far.

The crystal was the only trouble I had, having to try one or two makes to get the best results.

I now intend to build up the "Twin-Valve" loud-speaker set by John Scott-Taggart, F.Inst.P., A.M.I.E.E., described in Envelope No. 10, and if you see fit to publish the results I have obtained, I should like to be put in touch with one who has built the "Twin-Valve."

Wishing your publications the success they deserve.—Yours faithfully,

R. G. HARRISON.

Newcastle-on-Tyne.

ENVELOPE No. 9

SIR,—I think that after several months' use I should be able to give you a really accurate and fair description of the results with the "Single Valve Receiver," constructed according to Envelope No. 9.

I am seldom addicted to gushing, but I really must express my delight at having made such a splendid little set.

On three yards of ordinary bell wire, with an inferior earth, I have received during the past winter London, Cardiff, Manchester, Newcastle, Glasgow and many Continental stations, while the local relay station was received with strength sufficient to enable a junior loud-speaker to be quite audible anywhere in a small room.

During the recent warm weather, usually considered unsuitable for long-distance reception, I have received several B.B.C. stations at surprising strength.

I have come to the conclusion that it is an "All Season Set," and one which does not need favourable conditions!—Yours faithfully,

Hull. EDWARD S. BRAMLEY.

PROTECT YOUR VALVES AND TELEPHONES

SIR,—The following is a hint which many of your readers might find useful:—

As the proportion of valve-set users who at some time or other burn out a valve by accidentally connecting the high-tension battery across the filament must be very high, and there must be also a fair number who have ruined, or at any rate, damaged telephones by putting the high-tension current through them, they might like to try the following method for protection of phones and valves.

A simple and inexpensive method of reducing the risk of both sorts of accident, particularly on the ordinary set where the low-tension, high-tension and telephone terminals are all on one edge of the panel, is to use different types of terminal for the different purposes.

The method recommended is to use ordinary pillar-type terminals for the low-tension, telephone terminals for the telephones, and "Newey" clips, "Clix," or some such terminal for the high-tension. If, in addition, the ends of the leads from the accumulator are fitted with spade ends, the ends of the leads from the high-tension battery are fitted with "Newey" clips, and the telephone leads or extension leads are fitted with pin ends, the risk of a mis-connection is almost negligible.—Yours faithfully,

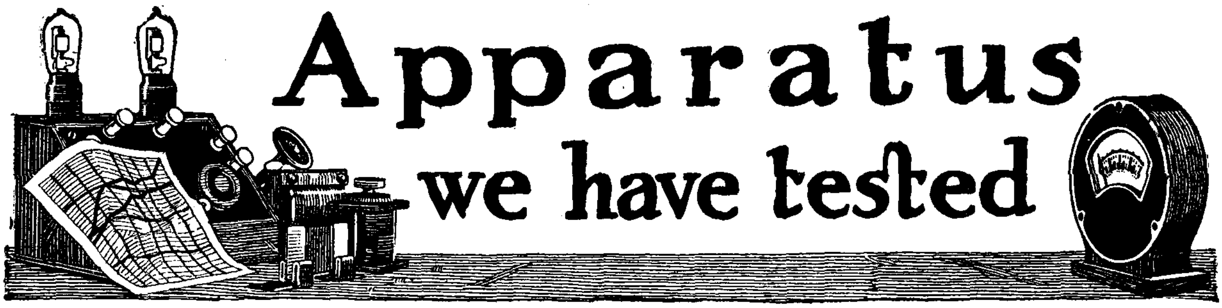
R. G. MARSH.

Woodford Green, Essex.

METERS IN WIRELESS CIRCUITS

(continued from p. 404)

series with the instrument, but in the case of ammeters a shunt is, of course, employed. The chief disadvantage of hot wire instruments, from the point of view of the transmitting amateur, is their large consumption of power, and in some cases their sluggish action. The accuracy of any but first-class instruments is also open to doubt.



Conducted by A. D. COWPER, M.Sc., Staff Editor.

Fellows "Volutone" Loud-Speaker

A sample of their "Volutone" loud-speaker, a medium-sized instrument but one of considerable power, has been submitted for an extensive practical trial by Messrs. Fellows Magneto Co., Ltd. This is of the usual vertical type, about 20 ins. high, and is finished in dull black; the resistance of the windings was approximately 2,000 ohms. A control handle projects from the side of the base. On practical trial, in conjunction with reliable equipment, this instrument showed a good degree of sensitiveness, combined with an ability to handle a large volume of sound, but without rattling or other signs of distress. The tone was somewhat "low-pitched," i.e., the lower tones appeared to receive some preferential amplification, but the effect was not unpleasant, the performance marking a considerable improvement over some familiar types of large instrument. A suitable value of fixed condenser of moderate size, about .0015 μF in this case, shunted across the windings, appeared to be called for, to obtain the best results. Whilst not a low-priced instrument, the power and good tone of this type should certainly render it popular amongst a large public.

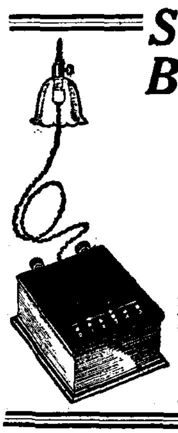
"Alembic" Safety Aerial-Earth Switch

From Messrs. J. Millet comes a type of safety aerial switch in which elaborate double precautions are taken against possible damage to a set by lightning discharges. There is permanently available a short spark-gap between carbon poles, between the aerial and the earth-connections; this will discharge ordinary "statics" and prevent the accumulation of any considerable charge on the aerial. An alternative path is provided for normal use, via a replaceable fuse (a fine wire in a removeable glass tube) rated at 4 amperes, and a two-way single-pole switch. In one position this connects direct to the terminal to which the set is to be wired; in the second "safety" position it is connected direct to earth. Thus during thunderstorms, the set is wholly isolated, and the aerial earthed both via the spark-gap and via the fuse and switch, whilst in normal use the set is protected against casual discharges by the fuse, the spark-gap being continuously available in addition.

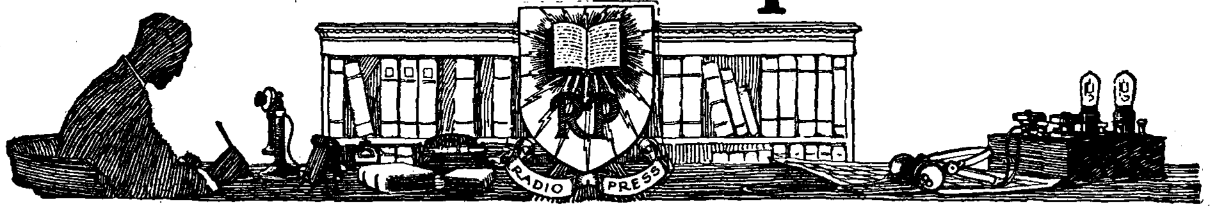
The device is substantially made, being mounted on the standard type of heavy porcelain base; the switch has a strong, insulated handle. The general appearance is business-like, and not unduly obtrusive when in position in the window, etc. Rather larger terminal screws might have been provided with advantage; it is a matter of experience that as a result of swinging in the wind and so on it is not easy to make a permanent secure connection with 7/22's aerial-wire under a small cheese-head screw on the ordinary pattern of switch.

A Compact Mica Variable Condenser

From Messrs. General Radio comes an interesting type of compact mica-and-air dielectric variable condenser, the "Express," which is hardly larger than a bevel tuning-scale, and is fixed actually on the outside of the panel by one bolt, two terminal screws also passing through the panel, leaving the back of the panel almost completely clear. The outside diameter is about $3\frac{1}{2}$ in., and it stands some $1\frac{1}{4}$ in. above the panel surface. A bevel scale round the periphery is divided into 100 divisions. The nominal range is given as from .00001 μF to .001 μF. The internal construction is very simple; a dished plate of thin springy copper is pressed progressively into contact with a sheet of mica dielectric overlying a brass plate, as the bevel scale is screwed down home on a coarse-thread screw, thus giving a variation of capacity between the plates. As usual with two-plate mica-and-air variable condensers, the rate of variation of capacity was found to vary considerably at different points of the scale, being extremely rapid for the last fraction of a turn. On calibration of the sample, the minimum capacity (when three whole turns out) was found to be about 18 $\mu\mu$F, after eliminating capacities of leads; the maximum when screwed right home (*i.e.*, just below 100 divisions) was .00037 μF. When one turn out, at the beginning of the scale, the capacity was .000043 μF. The curve showed a very steep variation of capacity in the last 10 divisions of the scale, so that the really useful portion was in effect limited to about two-thirds of the scale. In conjunction with an ordinary No. 60 plug-in coil of moderate distributed capacity, a *useful* range of from just below 300 metres to above 400 metres was obtained, or with a No. 75 from below 400 to above 500 metres, covering thus the B.B.C. range. The tuning scale was fairly flat under these conditions, and also in a secondary circuit. There was no sensible difference in ease of oscillation when using this condenser, in comparison with a standard air-dielectric one. As a reaction condenser in a Reinartz or Hartley type of circuit the condenser was found to operate admirably, giving smooth control and providing a convenient range of capacities, whilst hand-capacity effects were less prominent than usual, as the hand did not come near any conducting portion. In this capacity the instrument lends itself to an exceedingly neat and compact arrangement, particularly suitable for portable sets; it can be strongly recommended for this purpose. A No. 35 or 50 reaction closely coupled to a No. 60 grid secondary was found suitable for the B.B.C. range in this connection. It would appear that the specimen submitted must have been of some other capacity than that mentioned by the makers.



Information Department



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E. W. F. (SALISBURY) states that he is using a moving coil Voltmeter of 0 to 120 volts by a good maker for testing high-tension batteries. He has been told, however, that to obtain a correct reading he should place a resistance in shunt with the meter and asks whether this is so and what resistance should be used.

In reply to our correspondent's query a resistance in shunt with a meter should never be used for reading the voltages of a high-tension battery, as a parallel resistance with an instrument results in the total resistance of the instrument and the shunt being less than the smaller of the two. Hence if a resistance is used in parallel with a meter, more instead of less current will be taken from the H.T. battery which is an object to avoid.

Consulting the makers of the instrument mentioned, we have obtained from them the fact that the resistance of their instruments of the type mentioned is from 60 to 70 ohms per volt per scale division. Taking the lower of these two numbers, for safety, for a 120-volt instrument the resistance will be 7,200 ohms. This used on a 100-volt high-tension battery would take a current of approximately 14 milliamperes from the battery. This is a fairly high value of H.T. current to take from the ordinary type of high-tension battery, but providing the voltmeter is switched out of circuit directly the reading is taken, little harm will be done. If, however, it is desired to cut down the current taken, a series resistance should be used, and if this is made equal to the resistance of the instrument, the scale reading of the latter will have to be doubled to give the correct voltage being measured. If the series resistance is made twice that of the voltmeter, the voltmeter reading must be multiplied by three.

L. C. (PORT TALBOT) states that he is building a Neutrodyne receiver and wishes to incorporate an H.F. transformer of a certain make which is tapped to cover a wave-length range of 150 to 600 metres. He inquires whether this transformer is likely to give satisfactory results.

The whole principle of the Neutrodyne receiver is based upon the use of certain special transformers, which are absolutely essential to enable the proper neutralising of the circuit to be performed. With the type of transformers our correspondent refers to, we are afraid that satisfactorily neutralisation on this extended wavelength band will be impossible, and he is advised to adhere more strictly to the design as given.

R. F. (BRADFORD) is constructing the Two-valve Amplifier de Luxe described in Radio Press Envelope Number 7, but wishes to dispense with the stud switch in order to save space. He asks for the necessary alterations.

The alteration our correspondent requires is quite a simple one, and an examination of the blue print given in the envelope will show that it will merely be necessary to take the lead from the potentiometer slider which goes to the arm of the switch S.3 out to a terminal on the panel which will become grid bias positive. The lead which goes to No. 1 stud of the switch should be taken out to a further terminal which will become grid bias negative. The grid-bias battery is now connected between these two terminals, and a suitable size of battery would be one of 6 or 9 volts tapped in 1½-volt steps.

D. B. (Hastings) has a 4-volt 30 actual ampere accumulator and uses this to light the filaments of three D.E.3 valves and one B.T.H. B.6 valve. He wishes to know how long the accumulator should last used on the average for three hours a day.

A very simple calculation will soon give the time the battery should last. D.E.3-type valves take a filament current of .06 milliamperes, so that for three valves the total current will be .18 amperes. The B.6 valve takes a filament current of .12 amperes, and therefore the total current consumption of the four valves is .3 amperes. Used for three hours a night, the ampere hours taken from the battery will be 3 multiplied by .3, namely .9. This figure divided into the actual capacity of the accumulator will give the number of days' service to be expected. It will thus be seen that the battery should last approximately 33 days, but in practice we would advise our correspondent to have it charged somewhat more frequently if he wishes to get the maximum life out of the battery.

D. R. (BUCKINGHAM) wishes to know what is a Noden rectifier.

The Noden rectifier is one of chemical type often used for charging accumulators from A.C. mains. It consists of two metal electrodes, usually aluminium and lead, immersed in a solution of either ammonium phosphate or sodium bicarbonate, and under certain conditions will allow a current to pass in one direction only, namely, from the lead to the aluminium plate. In practice it makes a good rectifier capable of carrying considerable current.

S. G. (BOSCOMBE) has constructed the 3-valve Neutrodyne receiver described by Mr. Harris in "The Wireless Constructor." He states that the set works excellently except for one small fault —namely, that he cannot get down to the wavelength of the Cardiff Station. An ordinary barrel-type H.F. transformer is used for the Neutrodyne and anode coils, and this is marked for a wavelength range of 300 to 600 metres, when the primary is tuned by a .0003 μF. variable condenser.

The trouble our correspondent is experiencing is by no means an unusual one, since when H.F. transformers are used for Neutrodyne units, the transformer functions best when the secondary is made the anode coil, and in this case the minimum wavelength of 300 metres is not obtainable. The substitution of either a Neutrodyne unit or a one size smaller H.F. transformer will cure the trouble.

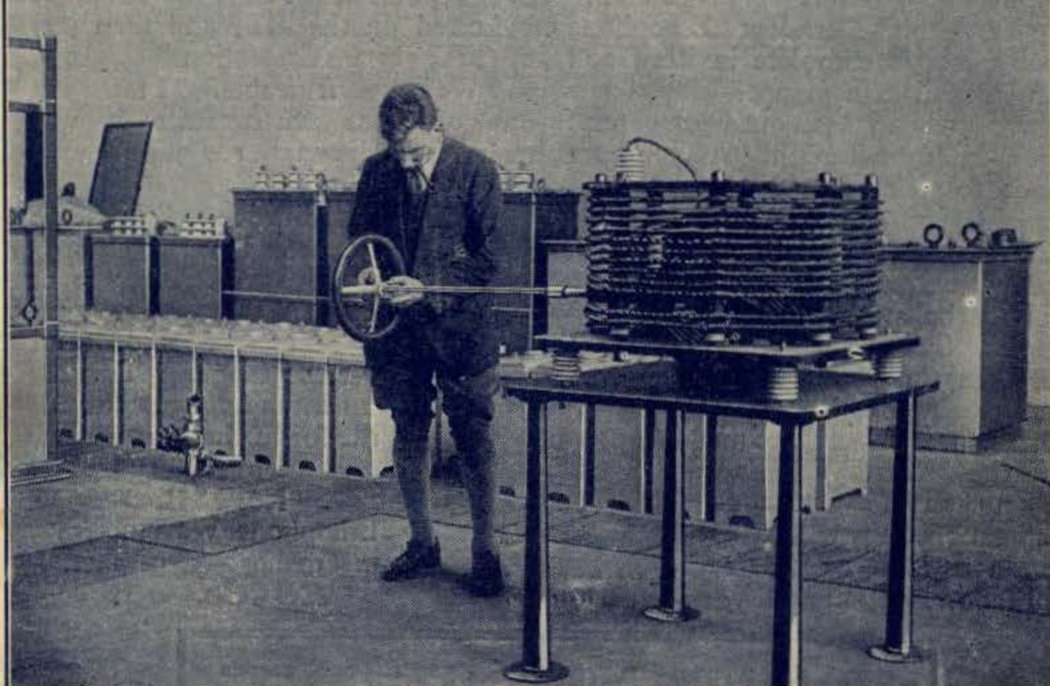
Printed for the Proprietors, RADIO PRESS, LTD., of Bush House, Strand, W.C.2. by THE AVENUE PRESS (L. Upcott Gill & Son, Ltd.), 55-57, Drury Lane, W.C.2, and Published by the Proprietors, RADIO PRESS, LTD., at Bush House, Strand, W.C.2, on Wednesday of each week. Address for Subscriptions and Editorial Communications:—Bush House Strand, London, W.C. Advertisement Managers:—BARCLAYS ADVERTISING, LTD., Bush House, Strand, London, W.C.2. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates:—32/6 per annum, 16/3 for six months, post free. Sole Agents for Australasia:—GORDON & GOTCH (Australasia), LTD. For Canada:—IMPERIAL NEWS, LTD. For South Africa:—CENTRAL NEWS AGENCY, LTD. For Japan:—SALE & FRAZAR, LTD.

Wireless Weekly, 6d. Net. Wednesday July 8th, 1925

Wireless Weekly

Vol. 6. No. 14.

PROGRESS AT THE DAVENTRY STATION



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Wireless Weekly

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New Wavelengths for Broadcasting

A DEVELOPMENT which will be watched with much interest in this country is foreshadowed by discussions in the American technical Press concerning the allocation of a possible new waveband for broadcasting, and it may not be generally realised that this development is one which may have considerable influence on wireless progress as a whole. The system of competitive broadcasting in vogue in the United States, which results in the opening of more and more stations, has already produced a somewhat crowded condition upon the band which roughly corresponds to our own 300 to 500 metre one, and it is expected that some additional outlet for further stations will be sought.

The American authorities have adopted as a general guiding principle that the stations should be separated as regards their wavelengths by a frequency difference of 10 kilocycles. Exceptions to this rule are being made only in cases where there are modifying geographical considerations, and hence the possible number of stations upon the present band is strictly limited, and the effect is already felt in the fact that numerous would-be broadcasters are finding difficulty in securing the allotment of a wavelength for their purpose.

An outlet upon the wavelengths above 600 metres appears to be out of the question for the accommodation of any considerable number of new stations, and attention is therefore being turned in the direction of the waves below 200 metres. The suggestion is being made that the band from 150 metres to 200 metres should be allotted for broadcasting purposes, and the proposal in its present form is that this band should be used for the allocation of wavelengths to new stations rather than for any re-distribution among existing ones. The experiences of the amateur transmitters seem to suggest that it will be found possible in broadcasting upon these wavelengths to cover considerably greater distances with the present amounts of power, although, no doubt, the American broadcast listener will gain a new insight into the meaning of the word "fading" by the adoption of such waves.

The expected improvement in the ranges of broadcasting stations working upon waves between 150 and 200 metres opens up an interesting vista of possibilities to those British experimenters who are keen upon feats of Transatlantic reception, which should give a considerable fillip to the development of the super-heterodyne receiver on these moderately short wavelengths in the hands of the average experimenter.

In preliminary discussions which may lead to a definite recommendation being made to the Conference which will be held in Washington next September, many authorities of the American broadcasting world have expressed the opinion that the changes in the apparatus which will be needed will not present undue difficulties to the designer and manufacturer, notwithstanding the American practice of all-enclosed sets with fixed H.F. inter-valve couplings, and it will be interesting to note the progress which may be made in the attempts which will, no doubt, follow to secure effective high-frequency amplification upon these moderately short wavelengths.

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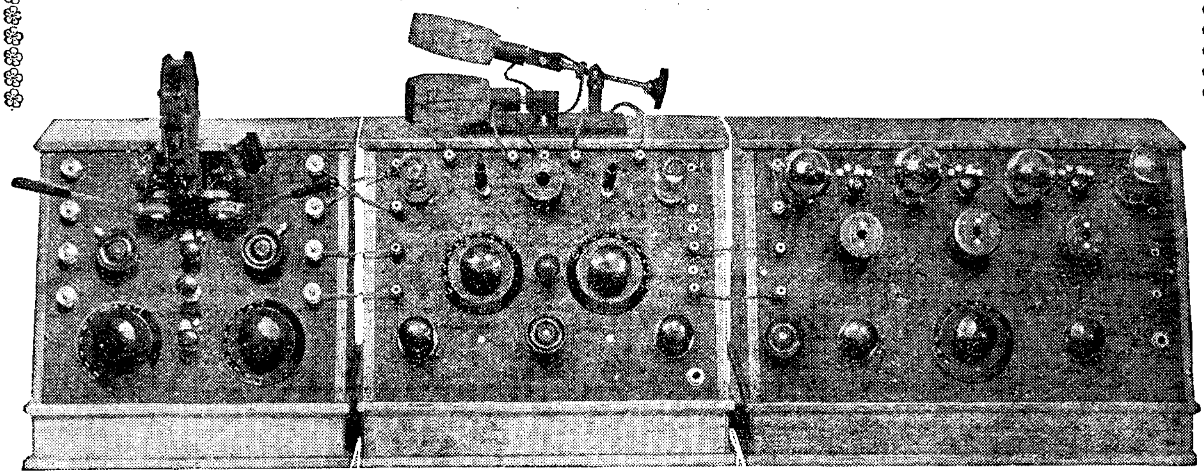
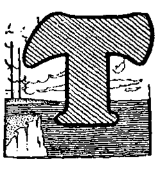
Getting the Most from a Super-Heterodyne

By G. P. KENDALL, B.Sc., Staff Editor.



An experimenter's supersonic receiver described by the author in the April, 1925, issue of "Modern Wireless," which is arranged to give a form of the Tropadyne circuit.



TO build a super-heterodyne receiver with care and conscientious accuracy from a dependable design, and to obtain good results at once from the finished set are by no means one and the same thing, for the one does not inevitably and naturally follow upon the other. This, of course, is true to some extent of all multi-valve sets, but it is a fact which must be faced in connection with the super-heterodyne that it demands considerably more practice, care and patience in manipulation to obtain the full results of which the set is capable than almost any other type, possible exceptions being made in favour of such circuits as the super-regenerative.

Operation

Given the necessary condition of a painstaking copy of a good and dependable design, good results will no doubt ultimately be forthcoming, but the inevitable period occupied in getting the hang of the new set is naturally considerably longer in the case of a super-heterodyne, and it is in the hope of giving some assistance to those who are passing through this painful period that these notes are being written. It is not intended to go very far into the technique of the operation of the super-heterodyne receiver, but rather to deal with the more obvious points which must be attended to before anything approaching satisfactory results will be obtained.

The Frame Aerial

It is proposed to include in these notes some general hints on obtaining the best results of which a super-heterodyne is capable, and in this connection it must not be forgotten that the frame aerial, as regards its design and details, has an important influence upon those results. In dealing with the frame aerial it must be emphasised at the outset that the quality of this accessory may make a really surprising difference to signals, and, as an example, I would cite the fact that I recently compared two frames, of which one was 26 in. in diameter and the other 48 in., the larger frame being of decidedly inefficient construction, wound with a fine gauge of wire and rather poorly insulated. Of the two, the smaller one gave pronouncedly better signals, although, to judge from their sizes, the advantage should have been all the other way.

This test was carried out with a super-heterodyne receiver employing seven valves, the first valve being the first detector, followed by three intermediate amplifiers, the second detector, and one low frequency stage, and a separate oscillator was used. It is to be observed that in this set no high frequency amplification upon the short wave was used, and no reaction effects were obtainable into the frame aerial circuit, so that any losses present here exerted their full influence in reducing signal strength. From this it should be concluded that although the frame aerial is of great importance with any super-heterodyne receiver, yet it should receive most special attention when there is no means of reducing its damping by means of the reaction effect produced by a stage of high frequency amplification upon the short wavelength.

Reducing Frame Losses.

When a stage of tuned high frequency amplification is used upon the short wavelengths, of course very considerable reaction effects will be applied to the frame aerial, and it is usual to provide either a potentiometer or some other device to stabilise this first high frequency stage and prevent actual self-oscillation. By adjusting this stage to the usual point a little below the oscillating condition, a good deal can be done to minimise losses in the frame aerial, but the reader must be careful not to conclude that such losses can be entirely wiped out in this way.

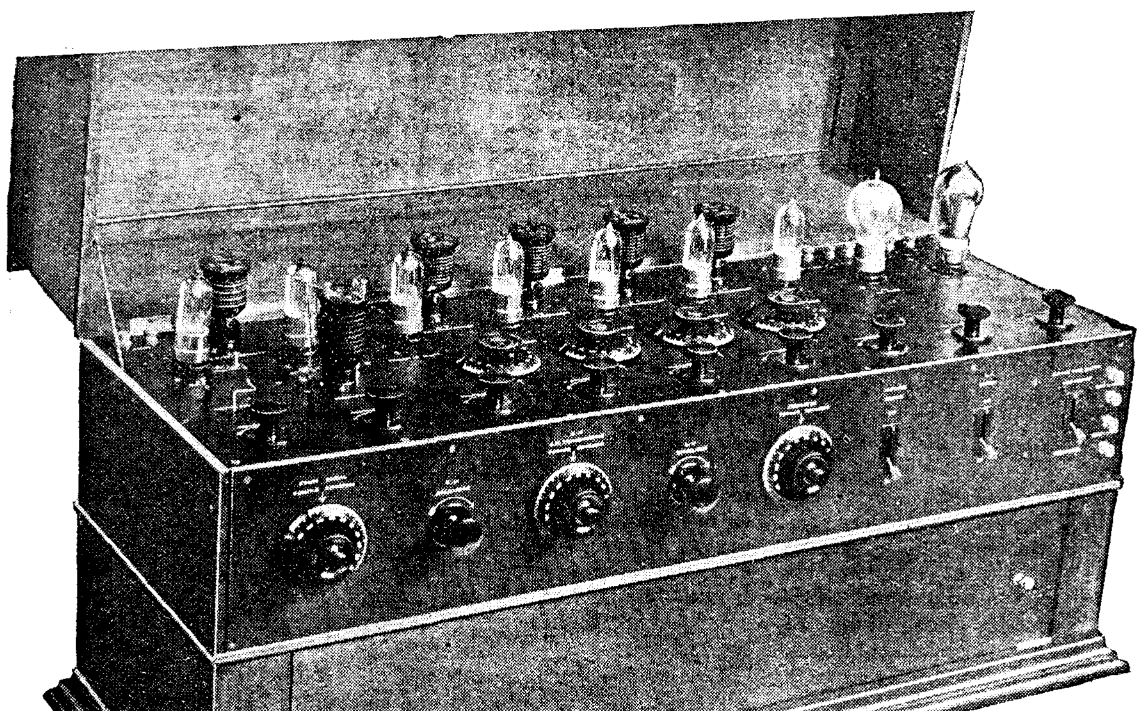
Construction of the Frame

In criticising a frame aerial, here are some of the points which should be given attention : In the first place, the usual rule as to gauge of wire must be borne in mind, and a frame which is wound with a thin single strand should be rejected. The actual line of demarcation between fine and coarse being somewhat of a matter of opinion, probably if the experimenter adopts No. 18 as his minimum gauge he will be on the safe side.

The insulation of a frame aerial should, of course, be given the closest possible attention, just as is done in the case of an outside aerial, and due care should be devoted to the insulation of the turns themselves at the points at which they are supported, and to the mounting of the terminals on the frame. When the winding consists of rubber-covered wire or cotton-covered and paraffin waxed bell wire, as is often the case, no special attention is usually needed at the supporting points, but pains must still be taken to see that the ends of the winding are really well insulated.

Number of Turns

Remember that the energy-collecting power of a frame aerial bears a very direct relationship to the actual number of turns used upon any given diameter, and in order to be able to use the maximum number of turns the capacity of the winding must be kept down to the smallest reasonable figure. Therefore, the turns must be well spaced apart from one another, and something like half an inch is a desirable figure. For similar reasons, when using a frame aerial which is provided with tappings, as are some of the commercial specimens, endeavour to include as many turns in circuit as possible, and work as low upon the condenser scale as is convenient, bearing in mind that a reduction below a scale reading of about 20 deg. may or may not lead to any further improvement in signals, depending upon the design of the condenser employed. This, of course, is a point familiar to those who have studied the articles of Mr. Sylvan Harris upon the high frequency resistance of variable condensers, and a certain amount of experiment is needed to determine whether reductions below this critical scale reading do or do not lead to an improvement in signal strength when the inductance in the circuit is represented by a frame aerial, which also functions as a collector of energy.



This nine-valve super-heterodyne receiver, described by Mr. John Scott-Taggart in the May, 1925, issue of "Modern Wireless," is extremely popular. The transformers used for inter-valve coupling in the long-wave amplifier are of the standard plug-in type.

Dimensions

The size of a frame aerial, assuming that its efficiency has been considered in all its other details, is one of the principal factors governing the amount of energy which it will pick up. In general, the larger the better, provided that it is still possible to tune down to the desired wavelengths, and the actual size adopted is generally a matter of compromise between this consideration and those of compactness and general convenience. Probably a diameter of 2 ft. should be taken as a minimum for general purposes, if long distance reception is the aim of the owner, and a 3-ft. or 4-ft. frame should be used when possible. It is, however, found in practice that with very large frames, say 4 ft. or 5 ft. in diameter, that a considerable increase in the capacity of the frame, and also losses in any dielectric material which may be brought into the electrostatic field thereby produced. If the reader possesses a frame having these undesirable features, as a rule a very little simple constructional work will rectify matters. This is a point to which attention may well be directed when comparing different frames with a view to purchase.

Outside Aerials

Various schemes have been devised in America with the object of increasing the amount of available energy supplied by the frame aerial, most of these devices depending upon the combination of outside aerial and frame, and some of them undoubtedly serve a useful purpose where the frame is being used crease in signal strength is often obtained.

An Alternative Method

The only other method which I have found of much use is to connect the filament circuit side of the frame aerial to earth and bring a lead from the aerial on to a tapping on the frame winding, which is one turn removed from the earth end. Here, again, directional effects are usually eliminated, but signal strength generally benefits greatly. On the whole, it seems better to depend upon the amount of energy which can be picked up by a good frame aerial, so long as it can be used in anything like a good locality, since such energy should be quite adequate to normal needs, if the super-heterodyne receiver itself is doing its duty properly.

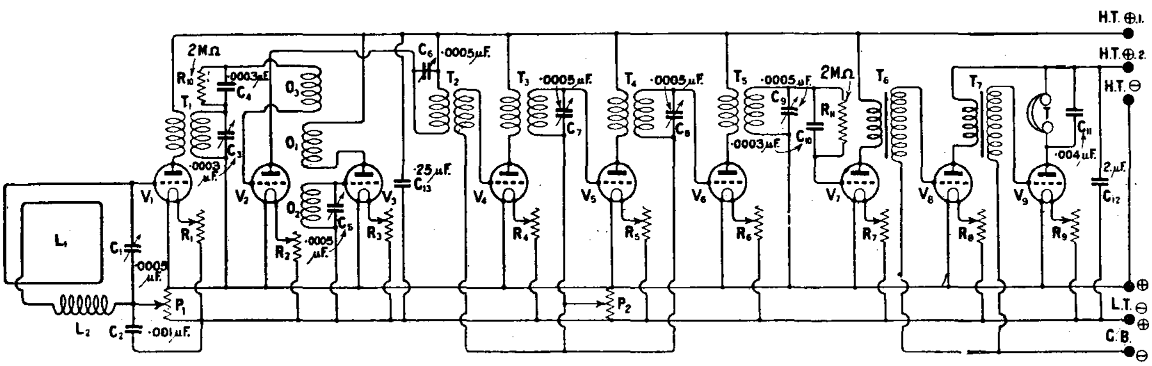


***Fig. 1.**—A simplified circuit diagram of the nine-valve super-heterodyne illustrated on the previous page. The loading coil L2 is only needed in exceptional cases where frame aerials having very few turns are used.*

the problem of interference by a really very nearby main station is somewhat intensified, and it may be that a better ratio of desired to undesired signals may be obtained with a rather smaller frame.

Tappings

A final point regarding the practical details of a frame aerial: The use of tappings is generally condemned upon theoretical grounds, allegations of very serious dead-end losses being usually made, but there are a number of popular types of frames in existence where tappings are provided, and the use of such aerials should perhaps be considered. Where tappings are provided care should be taken to see that they have not been made in such a way that there is a considerable bunch of wiring going to the closely-arranged studs of a switch, since one may have here in a badly shielded position. In general, of course, attempts to use an outside aerial with a super-heterodyne merely result in the picking up of a large amount of noise and general interference, so that the desired signal may be no more audible than before. It is possible, however, by arranging that the outside aerial shall be only very lightly coupled to the frame circuit, and in this way some small benefit may usually be derived.

One such scheme is to connect a standard No. 50 plug-in coil in series between aerial and earth (no tuning condenser being provided) and to place this coil at the centre of the frame aerial, and in the same plane with it. As a rule directional effects are very largely wiped out by this method, and the interference problem may be somewhat intensified, but a very considerable in-

The Oscillator

A detail of the receiver itself which may profitably receive consideration before dealing with the actual operation of the set is the oscillator and its adjustments, and, of course, here it is rather difficult to generalise, since so many different arrangements are current. Taking first the more commonly used separate oscillator system, it is proposed to confine our considerations to the type of oscillator circuit shown in the accompanying complete circuit diagram of a super-heterodyne receiver (Fig. 1). Here a simple reaction coil type of self-oscillating circuit is used, and it is probable that for the various coils involved in this circuit the reader will use one of the commercially-produced "oscillator couplers."

Adjustments

In many of these couplers all

the magnetic couplings between the windings are permanently fixed at some value which the manufacturer has found to be suitable under the majority of conditions, and the only adjustments necessary are those of the filament current and anode voltage of the oscillator valve and, possibly, also the choice of a suitable valve to produce satisfactory self-oscillation over the complete range of the tuning condenser associated with the oscillator.

Test for Oscillation

In the majority of the oscillator couplers now upon the market suitable windings have been chosen by the manufacturers, so that practically any type of general-purpose valve may be used as the oscillator, and a very little adjustment of plate voltage will secure effective working. The procedure adopted should therefore be—first of all to assure oneself that the oscillator is actually oscillating sufficiently strongly over the whole range of its condenser, and then to proceed to tune in some station whose signal strength can be used as a method of estimating the correct functioning of the oscillator for the final adjustments of H.T. and L.T.

The actual procedure to be adopted must inevitably be slightly different in the cases of different sets, but the following outline should serve as a general guide. First, see that all the valves of the receiver except the oscillator are alight, and that all the necessary connections to batteries, etc., have been made. Insert in the oscillator valve socket a bright-emitter valve for preference, and turn this up to the full brilliance used in normal working. It is usual in superheterodyne receivers to find there is a separate terminal for the high-tension supply to the oscillator valve, and, for a start, a value of perhaps 45 volts should be applied to this terminal.

Potentiometer Setting

Adjust the potentiometer of the intermediate frequency amplifier so that this part of the set is not actually oscillating, but is somewhere near the verge of self-oscillation, which can be done quite easily by listening to the indications in the telephones as the potentiometer is revolved from the positive end towards the negative end. At some point it is probable that a "plop" will be heard, followed by the steady slight hiss and crackle heard in an oscillating receiver, whereupon the potentiometer should be turned back slightly towards the positive end so that self-oscillation ceases. (If the receiver possesses a similar control for the short-wave side this potentiometer should be set upon the positive end.)

A Simple Test

Now set the condenser of the oscillator circuit to, perhaps, 20 or 30 deg. upon its scale, and touch the grid of the oscillator valve. A distinct "plop" should be heard in the 'phones, provided that this valve is oscillating, and the difference between the sound produced when the oscillator is actually functioning and when it is not oscillating can be estimated by turning down the filament of this valve and again touching its grid. Quite a faint click will usually be heard under these circumstances, a very slightly louder one when the valve is fully alight and not oscillating, and a much louder one when it is oscillating properly.

If no sign of self-oscillation can be obtained from this test, confirmation should be obtained by turning the potentiometer of the long-wave amplifier round towards the negative side until self-oscillation starts in this part of the set. Now revolve the dial of the oscillator condenser and note whether any whistles which sound like carrier waves are heard. If no such whistles are heard at any point upon the dial it is probable that the oscillator valve is not oscillating, and attention should be devoted to determining the cause of the trouble.

Coupler Connections

Most of the commercial oscillator couplers are sent out with diagrams which show the correct connections to their various terminals, and if these are followed self-oscillation will generally be produced satisfactorily so long as the component is in proper order. Lacking self-oscillation, however, the experiment should be tried of reversing the connections to the grid winding of the coupler, or to the plate winding.

It will probably be found that one set of connections to the coupler produces the signs of self oscillation which we have been considering, and it should then be noted whether these signs are obtained at *any* reading of the oscillator condenser dial; in other words, whether the valve oscillates freely all round the dial of this condenser. This is largely a matter of adjustment of the H.T. voltage, and, in general, it may be assumed that, if the oscillator functions over the lower range of the condenser dial but fails to oscillate over the higher range, more H.T. should be applied, and possibly the filament should be brightened a little in the case of most valves.

Where the oscillator circuits include a variable coupling between the plate and grid windings—that is to say, an adjustment of the magnetic reaction—a slightly different procedure may be adopted, consisting in the choice of some arbitrary value of high-tension voltage, say 60 volts, or possibly a little more, and then the adjustment of the reaction coupling to produce self-oscillation over the whole range of the oscillator condenser.

I have specified that a bright-emitter valve should be used for the preliminary tests on the oscillator, but if the design of the set is such that it is only possible to use a dull-emitter, a very similar procedure may be adopted, with the exception that in most cases it is better to start with the high-tension voltage arranged at a rather lower figure—say 30 volts—and that the increases should be in small steps, if it is found that this voltage is inadequate. Little difficulty will, as a rule, be experienced with a dull-emitter valve in this position, provided that the necessary separate high-tension terminal is provided. Where this terminal is not provided, of course, it is usually a fairly simple matter to apply to the whole set such a voltage as will represent a good average value for all the valves being employed, and then choose such a type of valve for the oscillator as will give the desired results. Upon this point, of course, I cannot give very much assistance, since the procedure will vary very much with the different types of instruments.

Selective Reception on the Broadcast Band

Some Notes Discussing an Interesting Circuit.

By A. D. COWPER, M.Sc., Staff Editor.

In this contribution Mr. Cowper discloses some further conclusions he has arrived at, resulting from experiments in selective reception.

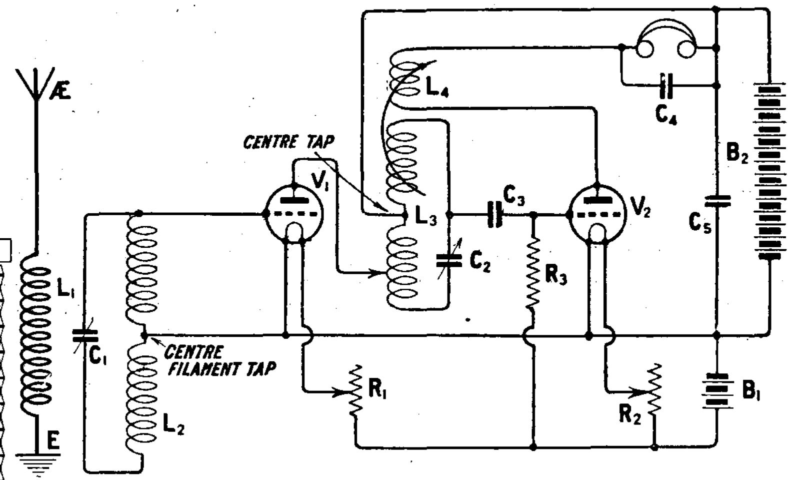


Fig. 2.—The circuit resulting from these experiments is as given in the above drawing.

THE circuit described here was developed as the result of a considerable amount of experimental work, to provide a solution to a definite problem: that of applying the principle of low-loss, lightly-damped circuits with sharp resonance peaks to a practicable receiver, so as to provide both a selective aerial-coupling and a further stage of wave-filter. A very pressing radio problem of the day is that of the mutual interference between the crowded broadcasting stations of Europe. With new, powerful stations opening up almost daily, in a narrow available band, we appear to be rapidly approaching the chronic condition of congestion that they have experienced in the States for some time past; extreme

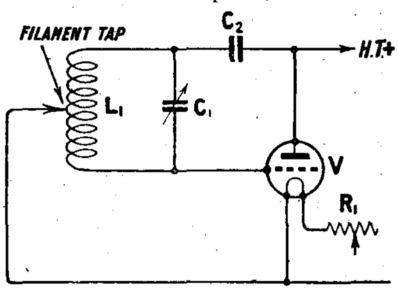


Fig. 1.—A typical oscillator circuit of the Hartley type, drawn in simplified form.

selectivity is then an absolute necessity in any receiver which claims to reach out to more than the local, loud station; and still more extreme selectivity if, as is often the case, the receiver is situated very close to the local station.

In every broadcasting centre there are many enthusiasts who would like to listen to the distant stations, and are willing to take a little trouble in operating and tuning their sets; for such, this highly selective and at the same time stable arrangement is suggested. But for enjoyable reception—in so far as such distant reception *can* be enjoyable under ordinary circumstances — the writer is in complete agreement with the Chief Engineer of the B.B.C. on this one point, that a really enjoyable performance is actually only an exceptional occurrence and that the chief interest is in the feat of reception —a sufficiently selective coupling must be interposed, and the necessary reaction-effect must be sufficiently periodic in its action.

The Circuit

The circuit to be discussed is evolved from two Hartley (transmitter - type) circuits lightly coupled through the medium of the first valve. The typical Hartley oscillator-circuit is shown in Fig. 1; by reducing the value of the condenser C2 the circuit can be stabilised sufficiently for use as a receiving circuit, as in some versions described recently by the writer. In Fig. 2 the essential H.F. circuits of the actual receiver are shown in a simplified form; both tuning inductances are arranged symmetrically about the filament lead, as in the Hartley circuit, but the condenser C2 (Fig. 1) is omitted. An aperiodic aerial coil is coupled with the first inductance, symmetrically; thus the casual capacity couplings between these inductances are largely balanced out, giving a selective, almost purely, magnetic coupling to avoid shock excitation and interference by powerful local stations. Some loss is introduced by the resulting halving of the oscillating P.D. on the grid of the valve, but this is almost compensated for by the light damping and diminished stray-capacity effects. Actually a small negative grid bias is successfully introduced to reduce grid-current damping.

Intervalve Coupling

The intervalve coupling closely resembles the "series-tuned-anode" coupling introduced by the writer (*Wireless Weekly*, Vol. 2, No. 19, November 21, 1923), but has the H.T. connection made to the middle (neutral) point in the inductance, avoiding thereby the use of a radio-choke for this purpose, and giving the symmetrical arrangement desired. This coupling, by itself, gives in general a stable arrangement without any neutralising expedients. Here, for extra security and selectivity, the coupling is made lighter still by connecting the anode-lead to a point about midway between the middle and lower end of the inductance. Full reaction effects are then introduced by a reaction coil in the plate circuit of the following detector valve, in the form of a swinging rotor arranged in the end of the inductance. Experiment showed that the circuit was most easy to handle when the coupling was made completely stable in this manner (in spite of some loss), and a fairly large reaction coil made available, though kept some distance away and generally only lightly coupled. Self-oscillation on another frequency than that to which the grids were tuned (presumably controlled by the inductance of this rotor-coil and its associated casual capacities) resulted when a smaller reaction coil, more closely coupled, was tried. The general arrangement of the inductances and their rotors, etc., must be provisionally adhered to fairly closely until experience has been gained with the circuit, for there are many pitfalls in connection with such lightly-damped, interconnected circuits.

Aerial Coupling

The aerial coupling is made variable by a vario-coupler of the American type, with a primary of about 20-25 turns of No. 18 d.c.c. wire wound upon a 3-in. former or as a "hank coil," on a spindle arranged at about 45 degrees to the axis of the stator. Both main inductances should be wound as ultra-low-loss coils with No. 18 d.c.c. or enamel-covered wire spaced about 14 to the inch, on squirrel-cage formers of the six-sided variety, now becoming familiar, in this case 5 in. diameter. Sixty turns with this spacing will cover from about 250 to 500 m. with a .0002 μF variable tuning-condenser, or to 600 m. with a .0003 μF. The two coils only differ in their rotors, and in the tapping at No. 15 turn on the second. The reaction-rotor can be the ordinary spherical one of well-dried wood about $2\frac{3}{4}$ in. diameter, with about 60 turns of No. 26 d.c.c. wire on it, i.e., wound full; or a short cylindrical former about 3 in. diameter with a similar number of turns—this is not critical. The spindle of this roto: is at right-angles to the axis of the inductance at the grid end and just clear of the windings.

Neutralising Couplings

When fitting up the actual receiver it is essential to eliminate the unwanted direct magnetic coupling between the inductances by inclining them at the proper "neutralising-angle" of around 60 degrees and quite 15 in. apart. A practical method of mounting is on small brackets of bent brass sheet on a base-board; obviously, the spindles of the vario-coupler and reaction-coupler, though not quite parallel from necessity, can be arranged to project through a vertical front panel on which the tuning condensers, etc., are mounted; or a simple gearing could be provided for distant control. Since the two tuning inductances are identical except for the aerial lead and reaction-coupling respectively, they could conveniently be tuned by a double, coupled condenser, with e.g., a small two-plate fine-adjustment condenser in parallel with the second for final balancing. As hand-capacity effects are always very troublesome with

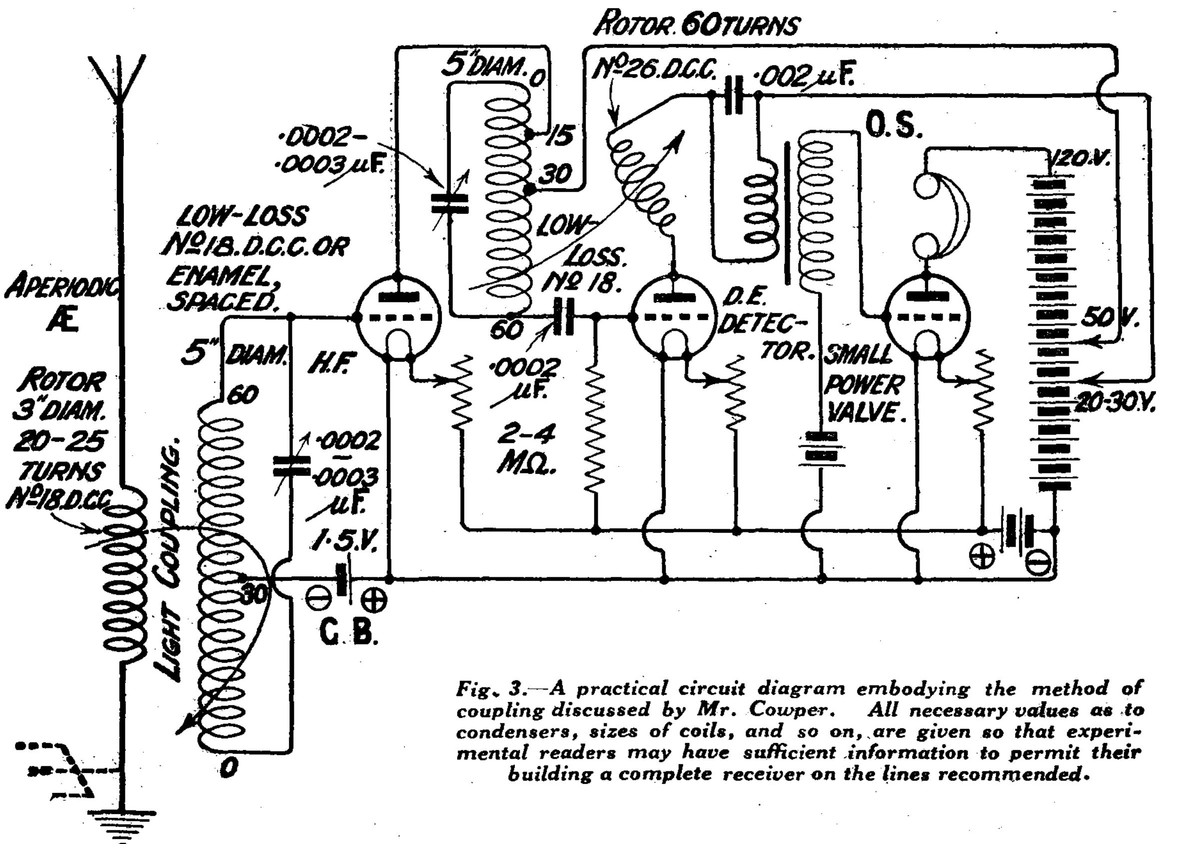


Fig. 3.—A practical circuit diagram embodying the method of coupling discussed by Mr. Cowper. All necessary values as to condensers, sizes of coils, and so on, are given so that experimental readers may have sufficient information to permit their building a complete receiver on the lines recommended.

this type of circuit, and fine tuning is essential, a fine-geared tuning condenser is called for at each point. A geared double tuning condenser of standard type, with rotors insulated from one another and with a grounded shield, about .0002 μF capacity each side, would be very desirable in this connection; perhaps some day such instruments will become available on the English market. Then with a uniform safe reaction setting most stations that are going to be worth listening to on the L.S. will come in each with a single adjustment: that of the double condenser.

Operation and Results

The inductances were adjusted in position so that a strong signal (e.g., GNF or local broadcast) was not handed on when the first grid-connection was broken and stability obtained at all points. Then first the filter-stage was tuned by means of a wavemeter, as usual; then the aerial-secondary with aerial coupling about one-half maximum. With reaction just below self-oscillation the wanted station came in faintly by slight searching on the secondary; then, by cautiously decreasing the primary coupling and retuning, the transmission was obtained at good strength and without excessive interference. Heavy atmospherics and morse on the same wave, with local oscillators, remained, of course. On a large, high aerial, close to the local station, the latter was practically eliminated without the use of wave-traps and within 10 metres. Several foreign stations were listened to on the loud-speaker at all-over-the-house strength late at night, and on an efficient suburban aerial, with quite unprecedented clearness and quality, and without excessively fine tuning. With low zero-capacity condensers it was possible to receive local amateur telephony on 200 m. at good loud-speaker strength. The results in general on the B.B.C. main and relay stations, and the usual round of the Continentals, showed no great gain over a selective O –V –1, and less volume than a O –V –2 receiver, but increased steadiness and greater ease in obtaining worth-while reproduction of distant telephony on the L.S. Another stage of efficient low-frequency amplification would be very desirable for the more-distant stations or in daylight.

Casual Couplings

If stability is not obtained in a first trial of the circuit, casual couplings between the inductances should first receive attention; finally, the tapping point for the anode connection on the second tuning inductance can be lowered towards the "H.T." centre connection, so as to include less turns in the anode circuit.

THE MANCHESTER STATION

In answer to many requests the programme at Manchester on Saturday, July 25, has been arranged for the special benefit of those who wish to dance to "loud-speakers." The dances, which will be played by the Scarlet Syncopators Band, will last for seven minutes, and in between there will be three-minute intervals filled in with song and humour. During a ten-minute interlude there will be a song recital by Miss Miriam Licette, the well-known B.N.O.C. soprano.

The weekly Chamber Music Concert at Manchester is being provided by Miss Dorothy Silk, soprano, Mr. William Anderson, bass, and the 2ZY String Quartet. The latter are including in their programme two movements from Quartet No. 1 in A Flat by Eric Fogg, a young composer who is the official accompanist at the Manchester Station.

Listeners must not feel alarmed by Manchester's "High Speed" programme for July 22. The speed will not be a matter of morse. The idea is simply to give eighteen artists, none of whom has yet had the opportunity of broadcasting, a few minutes each in which to display their qualities as singers, entertainers and instrumentalists.

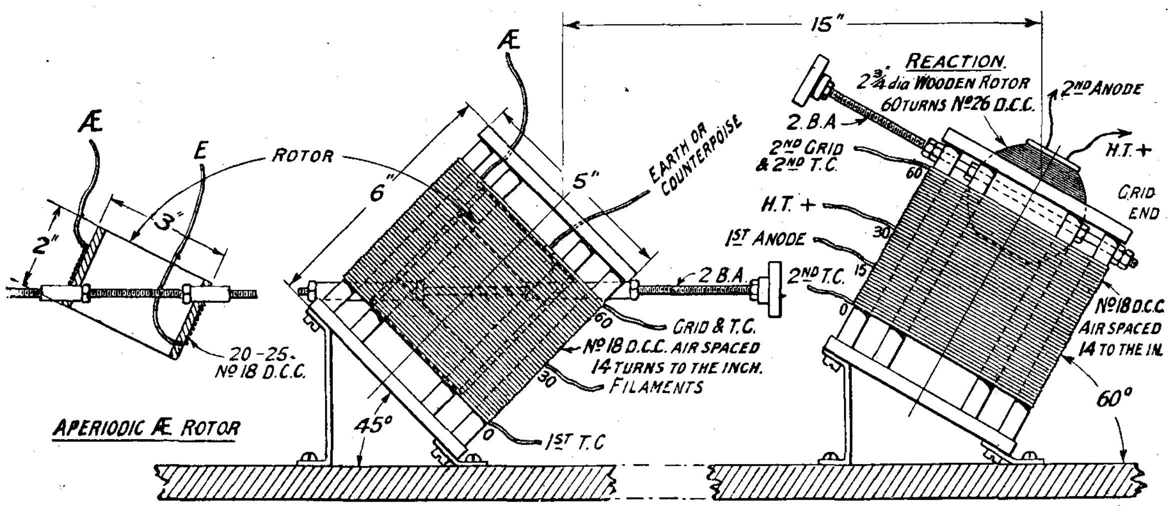
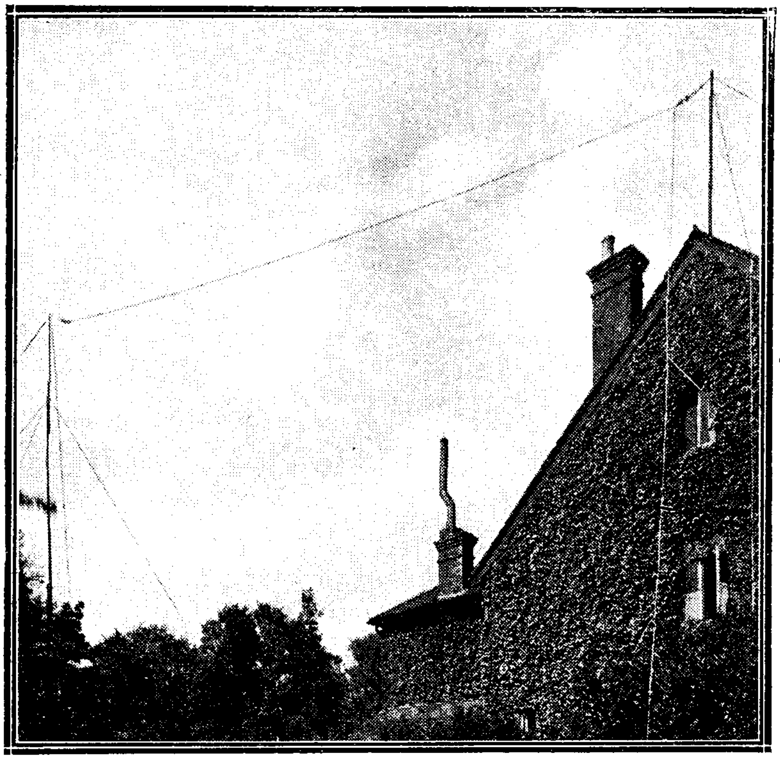


***Fig. 4.**—Constructional details and disposition of the coils used in the tuner, together with similar details of the anode and reaction coils. The aperiodic cerial coil is shown separately on the left.*

The Story of Short Wave Development


The masts and aerial now used at 2DX for short wave work.

By W. K. ALFORD (2DX)

On June 7, 2DX called SMLV when using a power of 100 watts and an indoor aerial only 10 feet long, but failed to hear any reply. Recently, however, a report has been received from the Punjab stating that he was heard there at good strength. On June 28 Mr. Alford was successful in establishing communication with Brazilian 1AB on 42 metres, using 60 watts.

RADIO telegraphy, ever since its inception, has been essentially a science of "surprises," and, as time went on, these "surprises" have become more and more startling.

The development of short wavelengths for long-distance transmission has brought to light some extraordinary phenomena, which are at the moment adding to the complication of the theories put forward by Clark Maxwell and Oliver Heaviside. It would, however, appear that any theoretical deliberations are more safely founded on the hypotheses of these two great men than in newly-formulated theories.

Wavelength Changes

It is curious to look back over the comparatively few useful years which radio has lived, and note the change which has taken place in various peoples' ideas on the wavelength which is most suitable for long-distance communication, as distinct from the actual type of apparatus used.

In the very early days a wavelength of 2,000 metres was considered amply long, and many early long-distance experiments were carried out in the region of this wavelength; then, when the commercial value of radio communication was firmly established, a sudden jump was made to five or six times this wavelength, and matters rested here for a time.

Long Wave Congestion

The great march of radio went on, and its commercial scope met with another ever-increasing menace in the form of congestion of the wavelength space, which was then thought to be the most useful. This condition brought about a further development of the use of longer and longer wavelengths, till the culmination was reached at the end of the Great War, by the use of a 24,000-metre wave, by the great French station at Croix d'Hins, Bordeaux.

The possible congestion just mentioned has very nearly reached serious dimensions at the present time between the limits of 10,000 and 20,000 metres wavelength, and there is hardly room for the safe operation of any more high-power or "trans-world" stations; and it was this condition, combined with the collaboration of certain amateur experimenters, which brought about the investigation of shorter and shorter wavelengths.

The Pioneer Work

It is a fact beyond all doubt that the amateur has proved his worth in these pioneer investigations. His investigations were more or less forced upon him, since he had to be accommodated in such wavelength bands as would cause least interference to any other radio service. It must be stated, however, that the extraordinary long-distance communications which have been performed by amateurs on short wavelengths are only representative of pioneering work in this direction, as the propagation of short waves and their application to communication between one point and another was very ably demonstrated by the Marconi Company and C. S. Franklin many years ago in their experiments between London and Birmingham, and it is interesting to note, too, that these experiments employed telephony transmission.

A Misapprehension

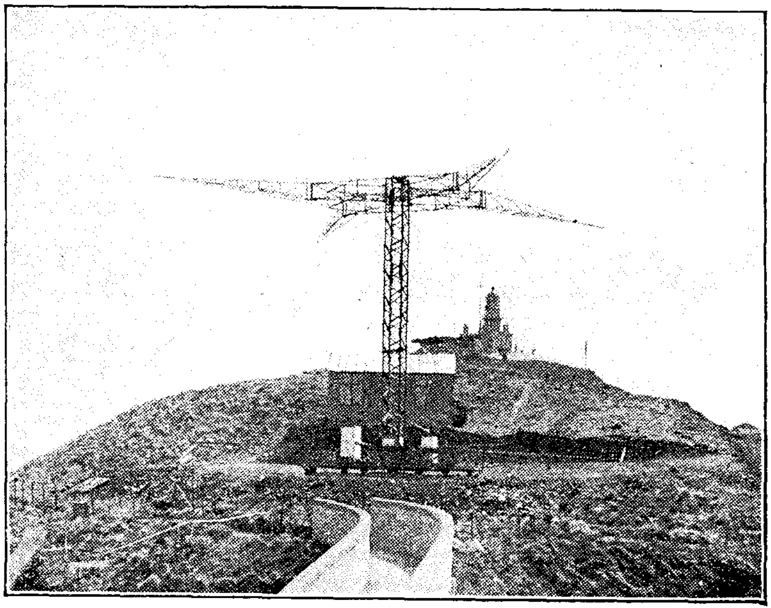
This point has been mentioned, as there seems to be a considerable misapprehension at the present time on the part of a large number of amateurs investigating short wavelengths that they are the only people who have ever done anything in that branch of the science.

Sudden Developments

Up to about a year or so ago the process of investigation of shorter and shorter wavelengths was extremely slow, and when a certain apparent downward limit was reached things remained stationary for quite a time, till during the last eight or ten months a tremendous downward rush has taken place.

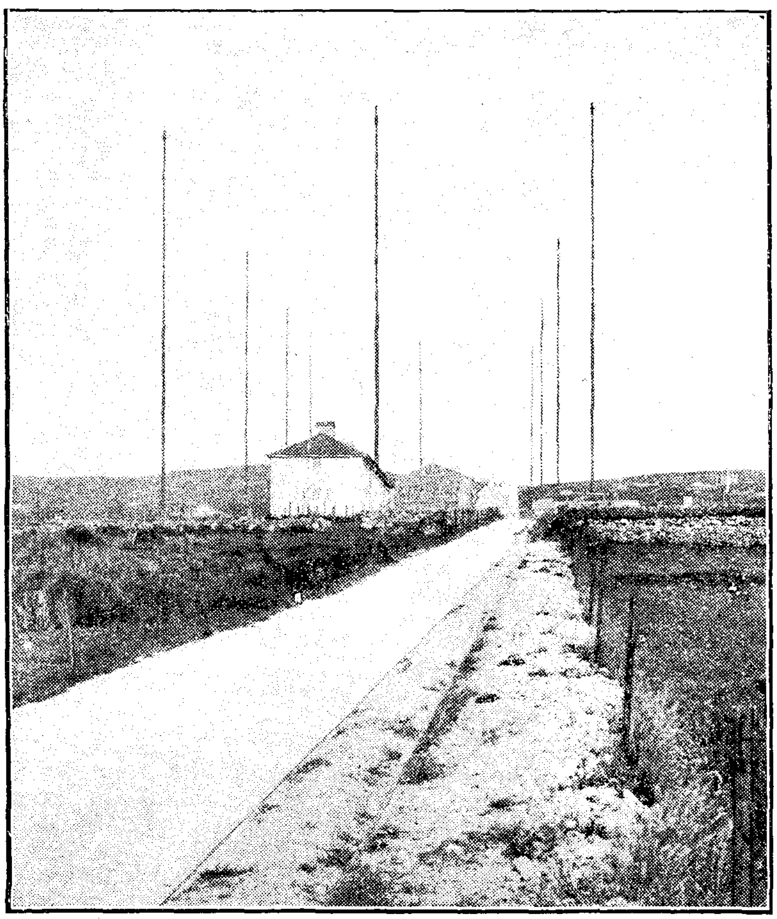
In actual figures the process of full investigation of 200 metres wavelength down to 100 metres took nearly two years, whereas in the last few months the region from 100 metres to 5 metres, and even less, has been investigated; not fully, however, but sufficiently to bring about some of the extraordinary "surprises" to which one is becoming accustomed in short-wave radio.

It may be well to analyse simply the characteristics of what may be termed "the various stopping places" in the downward rush of wavelength, and for simplicity we may as well take the wavelengths which have been allotted for amateur experimental work in this country.



A station which uses a relatively short wave: the "Wireless Beacon" at Inchkeith.

1. 1,000 *Metres.*—In the early days this wavelength gave quite satisfactory results, until the increase in the number of spark stations when working on a 600-metres wavelength, and harmonics from high-powered, so-called "continuous wave" stations employing the Poulsen Arc, gave rise to a continuous and hopeless interference.



A typical high-power long wave station is that at Carnarvon, the long aerial system necessitating the use of many lofty masts.

2. 440 *Metres.*—This "camping place" gave quite good results, but interference was again prominent, and the advent of broadcasting eventually made this region untenable, and it should be noted that in both "1" and "2" mentioned above, no long-distance work—i.e., over 400-500 miles—was attempted.

3. 200 *Metres.*—We now reach the region when things began to happen with considerable suddenness, and it was in the winter of 1921 that a certain amateur experimenter from America, named Paul Godley, came to England, for the purpose, it is alleged, of showing Englishmen that low-power amateur signals from America could be definitely received at this side of the Atlantic on this wavelength. He succeeded, and it was probably this discovery, which was soon amply corroborated by many British amateurs, which led to the first actual two-way communication across the Atlantic, performed in the first place by a Frenchman, Leon Deloy (8AB),

and secondly by an Englishman, Mr. J. A. Partridge (2KF), the American being F. A. Schnell (1MO) in each case.

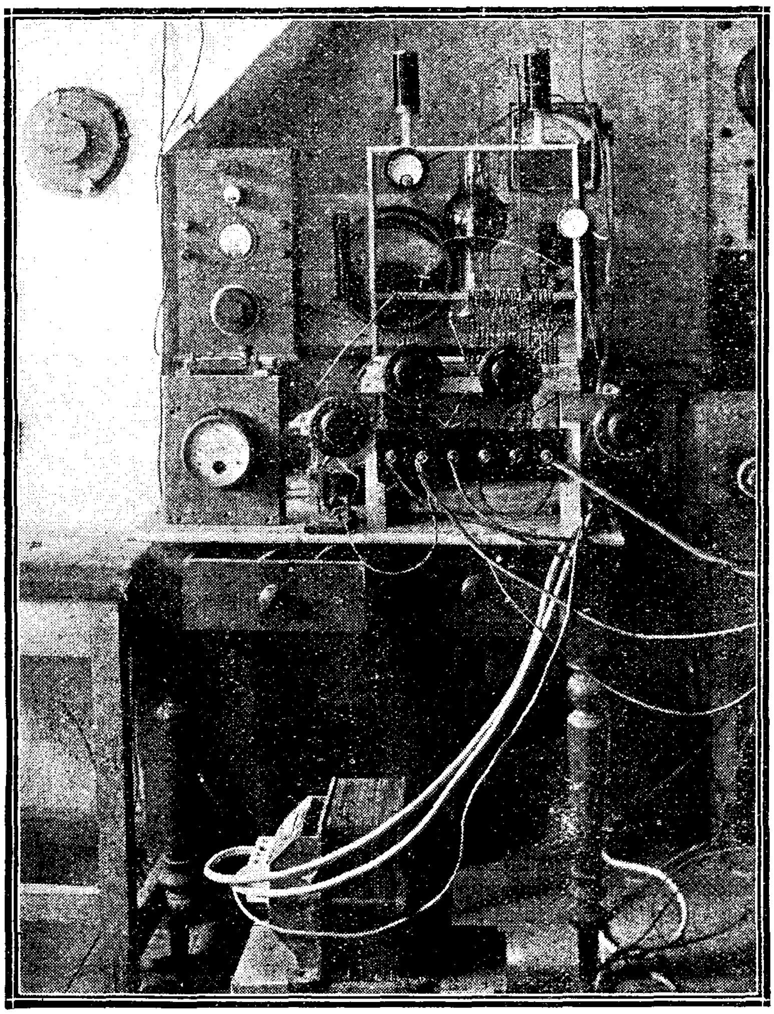
4. 100 *Metres.*—Although the wonderful things which were being done on the 200-metres band were still being added to, a number of experimenters dropped to 100 metres, and the accomplishments mentioned above resulted. Since that date "trans-Atlantic" and, one may say, "trans-world" communication has gradually grown to almost a commonplace.

5. 75-80 *Metres.*—This wavelength was, and is still, used largely by American amateur transmitters, and has roughly the same characteristics as the 100-metre region, although a certain power input to a transmitter seems to travel further on the shorter wave, probably owing to the lesser risk of interference due to more "kilocycles" being available per station.

Effects of Daylight

All the transmissions previously referred to were very definitely affected by daylight and darkness, and even on the 75-metre band it was practically impossible to hear any low-powered station across the Atlantic in daylight, whereas the same station would give loud signals after dark.

The phenomenon of fading is slightly less prominent on this wavelength than on the higher ones previously mentioned, and a somewhat new phenomenon was brought to light during the broadcast transmissions from East Pittsburg, U.S.A., on a 68-metres wavelength, in the form of a tremendous distortion of speech and music, known as "night-effect," and it is suggested that this is due to the formation of "diffraction bands" round the receiving station.



The short wave transmitter at 2DX. The filament transformer may be seen on the floor.

6. 40-50 *Metres.*—We now come into the region where extremely complex and conflicting characteristics exist regarding the effective range of signals in daylight and darkness, and we seem to be very near the wavelength which should travel equally well in daylight or darkness.

Twenty-Metre Characteristics

As will be explained later, 20-metre signals definitely travel better in daylight, and we know that 70-75 metres travel better in darkness; therefore it is reasonable to look for the above-mentioned conditions. Much long-distance communication has been effected on this wavelength, and it seems at the moment that if effective communication during both daylight and darkness can be obtained on this wavelength, that it will be a much more useful region than 20 metres or less where the difficulties governing the steady and consistent working of the transmitting apparatus are very difficult. Atmospherics are decidedly less troublesome at this wavelength than any of those previously mentioned, and this is a very great consideration.

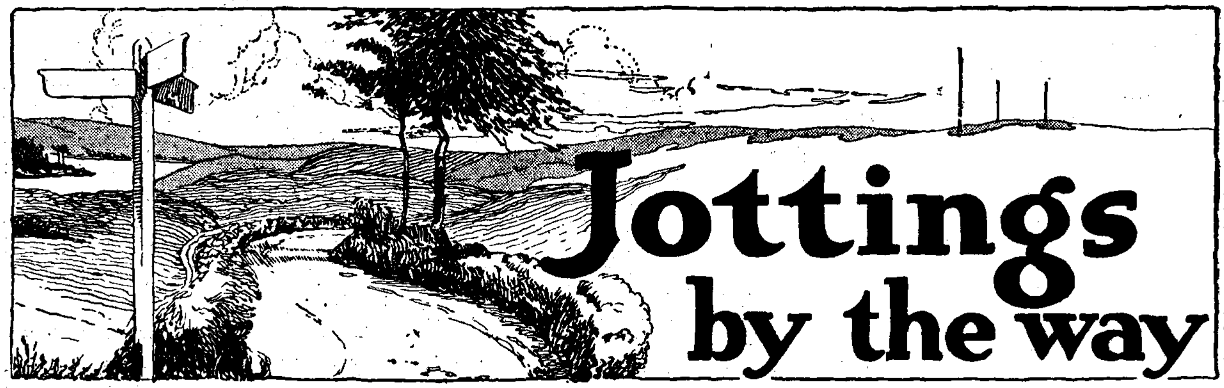
7. 20 *Metres or Less.*—Signals on this wavelength definitely travel better by day than by night, and what is more extraordinary still, it does not seem to be possible to receive a station of, say, 200 watts input power in the region lying between 20 and 400 miles of the transmitting station.

Five Metres

Up to the present, 5-metre transmissions have not been successfully used for long-distance transmissions, although, doubtless, something will very shortly be done in this direction.

Here, again, as in the 20-metre transmission, the physical conditions governing the operation of the transmitting gear are very delicate, which can be realised to the full when one considers that the frequency is, roughly, sixty million per second.

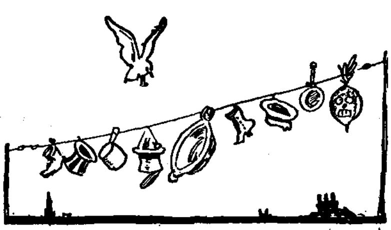
(To be continued)



Jottings by the way

Pigeons

I HAVE been meaning for a long time, though somehow I have always forgotten to do so, to introduce the enthralling subject of pigeons. My attention as a wireless man was first called to these attractive fowl by a letter which I read, with astonishment and admiration mingled, in a daily paper some time ago. The writer, a lady, stated that she had often seen carrier pigeons drop dead when crossing the track of wireless waves. Though I personally have never witnessed this phenomenon, possibly because I do not know that I could tell a carrier pigeon from a lesser spotted jubjub when on the wing, I can quite understand how the immolation of these gallant birds upon the altar of duty takes place. It is simply a case of the carrier wave heterodyning the carrier pigeon, which must obviously lead to unpleasant consequences for the latter. I have seen sparrows, starlings and even tomtits wilt on coming within range of Poddleby's loud-speaker when it is giving its well-known signal-strength-with-purity performance; but when Poddleby's most powerful set really gets going strong men like myself and Snaggsby have been known to turn pale and to complain of a feeling of giddiness. The signal strength is certainly there, but the purity, despite a multitude of shunts, exists mainly in Poddleby's vivid imagination.



Turnip lanterns, top hats, old boots, and all kinds of picturesque oddments.

A Grave Danger

But apart from the perils which they suffer through these awful wireless waves, which, as, of course, you know, are responsible for rainy summers, droughts, baldness, rough channel crossings, high rates and divers other calamities, it appears that carrier pigeons are addicted to the reprehensible practice of committing suicide by hurling themselves violently against aerial wires. I know this to be a fact, because it was stated by someone who is an M.P., or else he is not, I forget which. He also remarked in a communication to the Press that it was desirable that we should fix corks to our aerials, and that, having been in touch with the B.B.C., he had found that they had no objection to our adorning them in this way. I had thought some time ago of corking my aerial, but I hesitated to do so until I knew that the practice was officially sanctioned. Now that I know where I stand I have treated the dangerous wires in the proper way.

The Perfect Aerial

In the first place, I have mounted upon my mast a little rest-house for tired pigeons, complete with bath and every modern convenience. A printed notice invites all travellers through the air to step in and take an easy for a few minutes. The wire itself is decorated with turnip lanterns (which are illuminated at night-time for the benefit of night birds), ancient top hats, old boots and all kinds of picturesque oddments. I am proud to say that so far no pigeon has met an untimely death by colliding with my aerial, and that several other birds are rearing healthy families in the top hats, old boots and whatnot. I cannot say that I appreciate their presence, for as the youngsters grow their increasing weight causes my wire to sag and reduces my otherwise excellent " DX " range. Further, when they start screaming for food, I am never quite sure whether it is I or they or the man next door that is oscillating.

Observed walking one day from the station carrying a lethal weapon.

Archibald

Poddleby, I regret to say, has none of the fine feelings that have urged me thus to make my aerial perfectly safe for feathered friends. Though I told him that there was now no objection to their use, he refused to suspend even a few paltry corks. His aerial is perfectly bare, and forms a constant menace to the birdies. For a long time he used to point a finger of scorn at my safety-first arrangement, laughing at me for being no longer able to tune in the more distant stations. And then one day Nemesis bit him, so to speak, in the neck. It all came about through Archibald, the tame pigeon which is the pride of General Blood Thunderby's life. Archibald has a perfect passion for perching on wires. He used to come and sit on my aerial before I garnished it, and drove me nearly frantic with his never-ending "curooo, curooo." Now that I have hung out the danger signals he no longer patronises my wire, and he has gone to Poddleby's instead, and Poddleby, I am sorry to say, is not at all glad to see him.

Retribution

Archibald, I think, recognises that Poddleby is no friend to birds. When he first began to pay his visits he would select a time when my fat friend was engaged in ultra-short wave transmission. He would then seat himself upon the wire, and after combing each feather carefully with his beak, would start to swing. Poor Poddleby, who, after strenuous endeavours, had just picked up something on an incredibly small number of metres, found his tuning going all over the place as Archibald got properly into his stride. When he told Professor Goop and myself his difficulty we offered at once to make a little clockwork mechanism which would move the aerial tuning condenser up and down, keeping time with Archibald. Poddleby was quite rude about this suggestion, and stated that he had found the only possible cure all by himself. When he was observed walking up one day from the station carrying a lethal weapon we gathered that he was thinking of taking pot shots at Archibald.

Rifle Practice

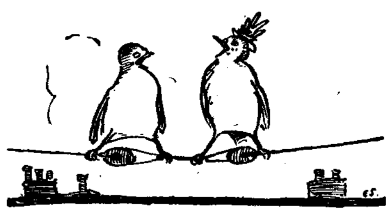
This was actually the case, and had Poddleby been the kind of shot that you see at the movies, Archibald would have been in a pie before this. Luckily for Archibald, Poddleby's marksmanship is at no time of a high order, and when he received a visitation from the pigeon he trembled so with wrath that his bullets went simply anywhere. His bag up to to-day is two aerial insulators, one aerial wire (his own), and one earth lead (mine). Archibald simply loved the game. When Poddleby issued forth armed to the teeth and vowing vengeance he just went on swinging. As each shot was fired he would leap into the air, flutter towards the ground as if mortally wounded, and then with a defiant "curooo" fly upwards again and perch himself once more on the aerial.

The General

I need hardly say that General Blood Thunderby did not take this assault on his pet lying down. As soon as he heard that Poddleby had armed himself and contemplated violence he raced

With a defiant "curooo" he would fly upwards again and perch himself once more on the aerial.

down to pay the secretary of the Little Puddleton Club a visit. Exactly what happened no one will ever know, though I gather that Poddleby explained that his rook rifle was really a worn-out second-hand one that he had purchased at the cost of a few pence in order to use it as an earth plate. Anyhow, it was solemnly interred on the following morning in his back garden, and has not since been brought into use as a death-dealing, or would-be death-dealing, weapon. Poddleby told me afterwards that when the General turned up Archibald fluttered down and sat upon his shoulder. He longed to lay the bird out with the poker,



Archibald introduced Belinda, who bestrode the second insulator, after duly wetting her feet.

but hardly cared to do so for fear of missing his drive and cutting a divot out of the respected president of the Little Puddleton Wireless Club. That is Poddleby's account. I cannot give you the General's, for if you broach the subject to him he grows purple in the face and appears to speak in Hindustani or some other language that is quite beyond the comprehension of any of our members.

Archibald Scores

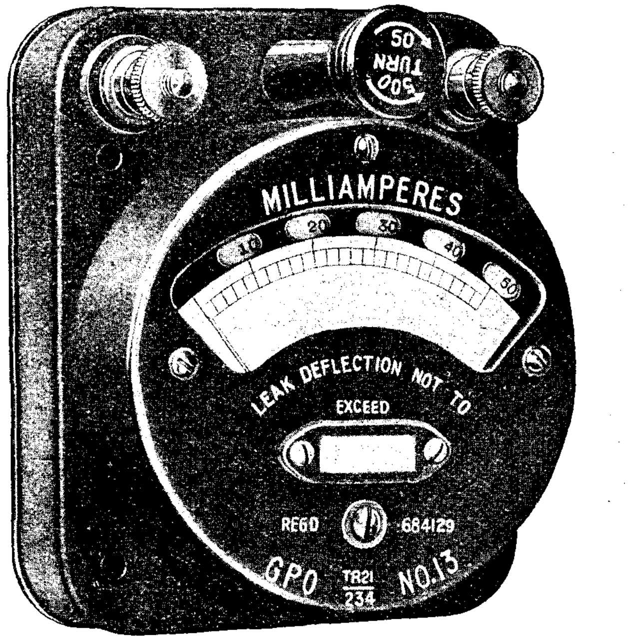
Archibald has now developed a scheme which really floors Poddleby. He comes floating along from the General's dovecot, and remarking "curooo, curooo," paddles for some time in my bird bath. Then when his feet are thoroughly wet he flits gracefully away from my garden and settles upon Poddleby's aerial. He so arranges himself that he stands astride the single insulator at the lead-in end. Owing to his small ohmic resistance, especially when his feet are wet, he is thus able to cut down Poddleby's signal strength and range to a remarkable extent. Poddleby has tried all sorts of expedients, but Archibald has him every time. If Poddleby suddenly lowers his aerial, Archibald soars lightly off it and remains fluttering until it is raised again, when he once more perches himself astride the insulator. Poddleby only yesterday inserted a second insulator in series with the first, thinking that he would thus thwart Archibald's machinations. All that Archibald did was to bring along Belinda, who bestrode the second insulator—after duly wetting her feet—whilst he dealt with the first. I rather think that Poddleby is beaten. Anyhow, he asked me the other day if I had any old hats or boots that I had no further use for.

WIRELESS WAYFARER.

WIRELESS MEASUREMENTS

By A. JOHNSON-RANDALL,
Staff Editor.

An article of value to those readers who wish to acquaint themselves with simple wireless measurements.



A milliammeter is one of the most useful of wireless measuring instruments.

IN the previous article I described the uses of voltmeters and ammeters in ordinary wireless receiving circuits, and also gave a brief description of the principle of the thermal-expansion hot-wire type of instrument, which, as I pointed out, suffers from the disadvantage of consuming rather a large amount of energy, and that in the cheaper forms the accuracy is somewhat doubtful.

Another type especially suitable for use in alternating current circuits, and one that is utilised by amateur transmitters for the measurement of aerial current, is the thermo-couple instrument.

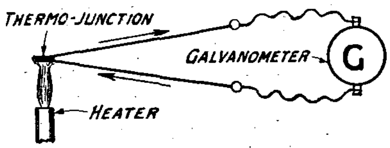


Fig. 1.—Illustrating the principle of a thermo-couple.

The Thermo-Couple

It is fairly common knowledge that if the junction between two dissimilar metals be heated, an electromotive force will be produced, and that, provided the circuit is complete, a current will flow. Amongst the many metals possessing this property may be mentioned bismuth and antimony, and platinum and silver. The principle is illustrated in an elementary manner in Fig. 1, two dissimilar metals such as bismuth and antimony being joined at one end to form a thermo junction. When the junction is heated by some means an E.M.F. will be produced, and the galvanometer G will be deflected. It is therefore obvious that if we produce the heating by a current flowing in an external circuit, the deflection produced in the case of a suitably-designed instrument will be a measure of the current flowing in that circuit.

This may be seen in Fig. 2. The current to be measured is passed through a resistance wire A A1, which forms the heater. A thermo-couple has one junction attached to this wire, the other two ends being joined to a sensitive measuring instrument G. Upon the wire A A1 being heated by the current flowing through it, an E.M.F. is produced across the two ends of the couple, and G may be calibrated so that the deflection is an indication of the current through A A1.

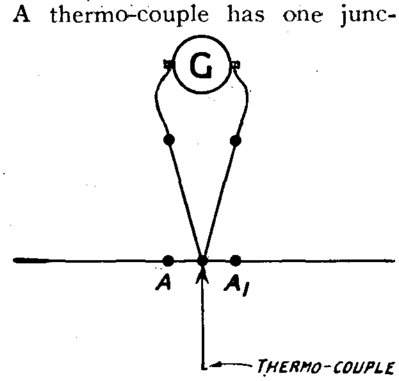


Fig. 2.—Illustrating the explanation of the thermo-couple instrument given in the text.

There are many modifications of this principle, one well-known meter enclosing both the thermo junction and heater in a glass bulb, which is exhausted to a high degree of vacuum. These instruments are particularly suitable for high-frequency work, since they are quite independent of frequency.

Electrostatic Voltmeters

For the measurement of high-voltages an instrument called the electrostatic voltmeter is used. Although of little or no value to the average amateur, it is nevertheless of interest to transmitters, and I will therefore very briefly describe one type. Electrostatic voltmeters depend for their action upon the force exerted between two sets of vanes at a considerable difference of potential, and one of the most popular forms is that known as the multicellular type.

Uses

Referring to Fig. 3, the moving vanes which carry the pointer are suspended by a fine wire W, which is secured at the other end to a spring. A zero adjusting device is provided just above the spring. A damping device, consisting of a perforated plate moving in a vessel filled with oil, is attached to the lower end of the spindle. Upon being switched into circuit, the moving vanes are attracted into the space between the fixed ones, and the resulting deflection of the pointer indicates the voltage. The electrostatic instrument is very convenient for measuring voltages in the neighbourhood of 1,000, and in some forms may be used for voltages of less than 100.

Frequency

The measurement of frequency may be divided into two parts,

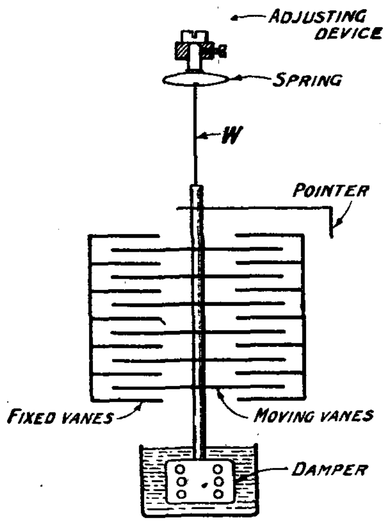


Fig. 3.—The multi-cellular type of electrostatic voltmeter.

viz., the determination of wavelength, which is of interest both to the transmitting and receiving amateur alike, and the measurement of the periodicity of an alternating current such as the output frequency of an alternator used for supplying current to a step-up transformer. This, of course, does not concern the experimenter who is interested only in reception, but those transmitters who possess their own generators naturally wish to have some means of measuring the frequency. They may do this either by direct reading or by a simple calculation, provided they have access to a " rev-counter." The formula for the frequency of an alternating current generator is, where f = frequency in cycles per second, P = number of pairs of poles, and N = number of revolutions per minute.

$$f = \frac{P \times N}{60}$$

Hence, provided the number of revolutions per minute can be

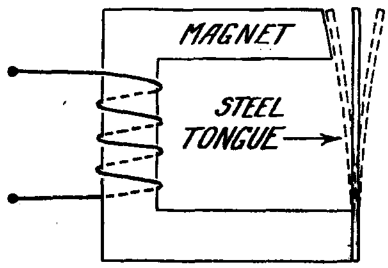


Fig. 4.—The principle of resonance applied to the measurement of an alternating current.

determined, it is quite an easy matter to find f.

The other method employs the principle of resonance, and is illustrated in Fig. 4. A steel tongue, if placed before an electro-magnet, as shown, will vibrate when its natural period corresponds with the frequency of the alternating current. Hence, if a number of tongues of different lengths are used, they will each vibrate at one particular frequency corresponding with that of the alternating current supply at the moment, and we thus have a simple means of measurement. In some well-known types of instrument a

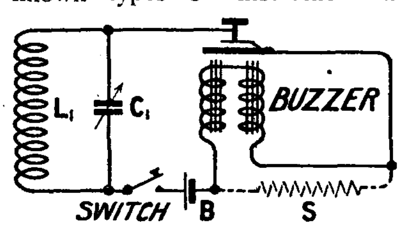


Fig. 5.—Illustrating the circuit of a simple buzzer wavemeter.

number of tongues or reeds are mounted in a row and placed in the magnetic field of a coil connected in the supply circuit. As the frequency changes the reed corresponding to that frequency will vibrate, the frequency to which the reed is tuned being marked against it on the face of the instrument.

Measurement of Wavelength

One of the most valuable of all measurements is that of wavelength, since by knowing the wavelength of a certain station the listener may, if he is fortunate enough to possess a wavemeter, adjust his receiver correctly for the reception of the desired station instead of having to work in the dark, so to speak, by constantly searching with his receiver in a state of oscillation in a vain endeavour to locate a carrier wave. This method is, for real long-distance work, hopelessly inefficient, and, in addition, it interferes badly with the reception of other listeners, not only causing loud howls to be emitted in neighbouring receivers when heterodyning a carrier-wave, but very often producing violent distortion as well.

Crystal Users

The owner of a crystal set will also find a buzzer wavemeter of

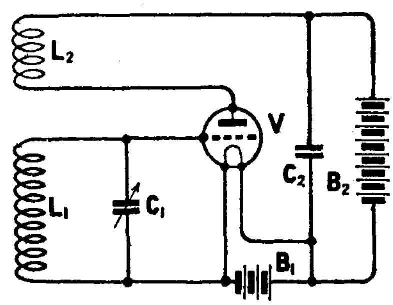


Fig. 6.—The circuit of a heterodyne wavemeter.

great value in adjusting his crystal detector to the most sensitive point. Furthermore, it will be found most useful for ascertaining the wavelength range of a given coil and condenser, or to test whether the receiver is functioning properly. To the transmitting amateur a wavemeter is essential, since without one it is most difficult for him to adjust his apparatus to the desired wavelength.

Types of Wavemeters

Wavemeters in general are of two types, viz., those which use a small buzzer as an exciter, and those which make use of an oscillating valve and which are called heterodyne wavemeters. The most popular form from the point of view of the receiving amateur is the type which utilises a buzzer, and such a circuit is shown in Fig. 5. An inductance coil L_1, which may be a plug-in coil, has joined in parallel with it a variable condenser C_1. Across this tuned circuit is connected a small high-note buzzer in series with a dry cell. A non-inductive shunt wound with resistance wire is usually placed across the two magnet windings, and tends to reduce sparking at the contacts of the buzzer "make and break."

Operation

The wavemeter is calibrated against a standard, and if it is desired to adjust the receiver to a given wavelength the switch is closed and the instrument is placed near to the set. The condenser dial is then rotated to a reading representing the required wavelength (this is obtained by referring to the calibration chart), and the receiver is then adjusted to the point where the continuous musical note from the wavemeter is loudest. If the wavemeter note should be heard over a wide range the instrument should be placed in a position where it can be heard only with a certain definite adjustment of the receiver. The set will then be tuned to the required wavelength.

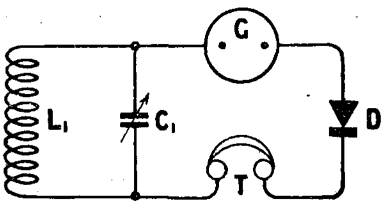


***Fig. 7.**—A simple transmitting wavemeter, using the telephones as a choke.*

The heterodyne wavemeter is of somewhat more complicated construction, and requires a valve with its attendant batteries. Fig. 6 shows the circuit of an instrument of this type, the coil L1, as before, being tuned by the variable condenser C1. Another coil L2 is closely coupled to L4, and the number of turns, together with the value of the battery B2, should be adjusted so as to permit smooth oscillation over the whole range of C1.

The instrument, as in the case of the buzzer type, should be calibrated against a standard, after which it is ready for use. To adjust a receiver to a given wavelength, set the wavemeter condenser C1 to a value representing the wavelength required, and tune the receiver in an oscillating condition until a note is heard in the telephones or loudspeaker. Then finally adjust it to the "silent point." The receiver is then tuned to the desired wavelength.

Heterodyne wavemeters require very careful handling, since if the valve is broken the instrument will need re-calibrating. Any variation in H.T. or L.T. values will also tend to upset the calibration. While being more accurate than buzzer wavemeters, the beginner will be well advised to use the latter type in preference to the former on account of the much greater ease of handling. Buzzer wavemeters are usually sufficiently accurate for most purposes, and, apart from the occasional renewal of the dry cell and a slight adjustment of the buzzer itself, require no attention. One of the chief difficulties in the design of an efficient wavemeter is that of constancy.

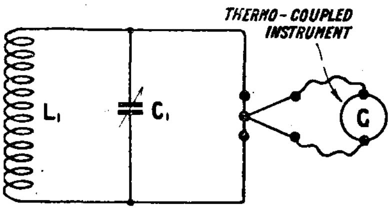
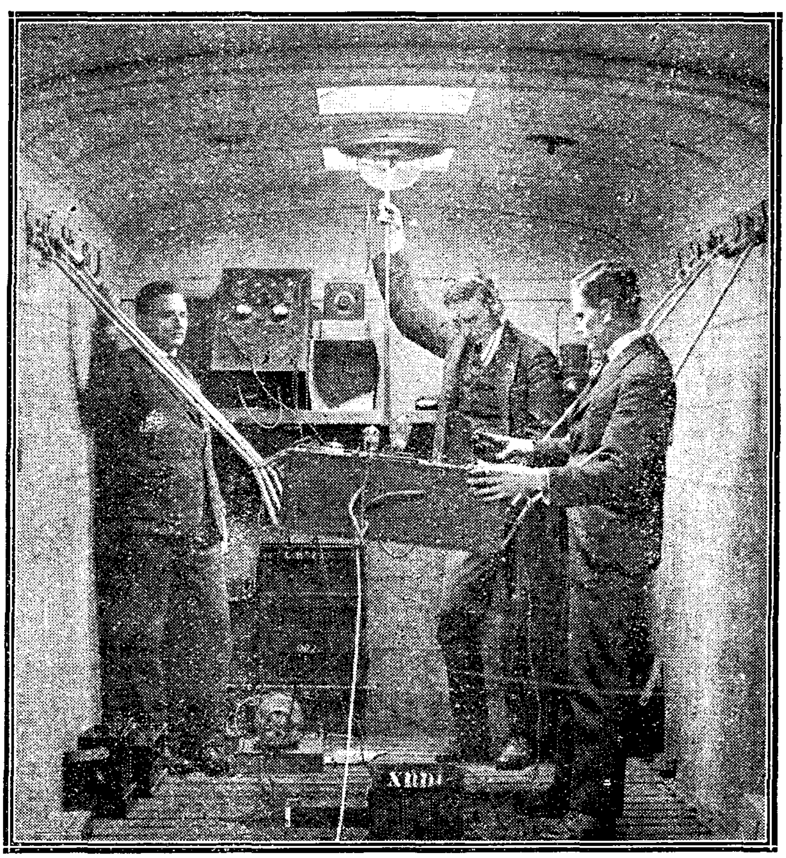


***Fig. 8.**—The use of a thermo-coupled instrument as a resonance indicator in a transmitting wavemeter.*

The inductance coils must be rigid in construction and immune to atmospheric changes, and the variable condenser must be a first-class mechanical job, proof against end-plate warping and shake, or, in fact, anything which would cause changes in capacity during use. Unless absolute constancy is assured, it is useless to go to the expense entailed by accurate calibration, since after a short period has elapsed the calibration may no longer be correct. For the transmitting amateur a simple wavemeter was described by Mr. Percy W. Harris in *Wireless Weekly*, Vol. 5, No. 2, in which he made use of the circuit shown in Fig. 7, the telephones acting as a choke. Readers will obtain full details of the construction and method of calibration of this instrument by referring to the article mentioned.

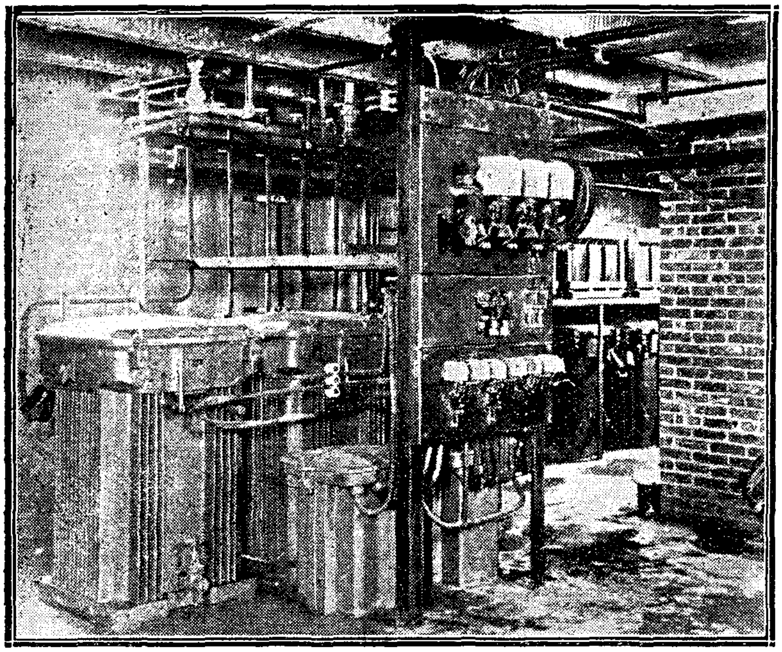
A standard Weston galvanometer was used as a means of indicating resonance. An alternative scheme would be to utilise a sensitive thermo-coupled instrument (since these are independent of frequency), as shown in Fig. 8.



The apparatus used by the B.B.C. on the Scotch Express for the transmission in connection with the Railway Centenary.

The New KDKA Station

Some interesting facts concerning tests made with the old and new stations, which seem to indicate that the new station is the better of the two for long distance work. These facts were obtained direct from the station engineers and are a result of Mr. Harris's visit to the Company operating KDKA.



The transformer and control panel at the new station

THE new home of station KDKA, a mile from the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company, which operates the station, has housed the company's short-wave equipment for several months, and recently the long-wave set was moved from the old position in a building at the East Pittsburgh Works.

To ensure the great power necessary for the operation of this station, the company supplying the electrical power has established a regular sub-station in the basement of the building. The sub-station is supplied by two feeder lines from two different power circuits fed by two different generating stations, thus guarding against the possibility of interruptions to the service during a broadcasting period.

The Aerial

The aerial for the 309-metres or long wavelength set covers quite a large area. It is supported on 95-ft. wooden poles, placed so as to form a diamond-shape figure. A cage aerial leads from the one nearest the building to each of the other three, which in turn are tied together. This, with a somewhat similar counterpoise about 10 ft. above the ground, constitutes the aerial and earth system. A copper tube running up the main pole connects the top and counterpoise through an inductance coil. This copper tube is very rigid, and, together with the use of the wooden poles, helps to maintain a constant wavelength. A further reduction of losses is secured through the method of coupling the aerial and transmitter, which does away with the necessity of carrying the main aerial circuit into the transmitter room, and increases the radiating efficiency.

Tests

The main KDKA studio remains in its position in a building at the East Pittsburgh Works. Wire circuits link up the station with other studios situated at convenient places about the city.

That a low aerial on a hill is better for radio transmission than a high aerial in a valley was indicated by tests conducted by the station staff in connection with the transferring of the station from the original situation on top of a nine-story building at the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Company, to the new building on a high hill nearby.

A definite difference in favour of the new position was established by the test, although not all the difference was due to the change in location, as the losses of energy were considerably less in the new building.

Listeners' Co-operation

In one test, alternate numbers of a musical programme were broadcast from each station, using the same power and adjustments at each. By prearrangement, listeners in every large city in the country listened to the programme, and made detailed comparative reports on the reception of the alternate numbers. The listeners did not know from which of the two stations any of the numbers was broadcast.

When the new long wavelength transmitter was built and installed in the new building, it was tested, and used for broadcasting an occasional programme.

Comparisons

After running the two stations alternately for some time, it was decided to make a definite test under like conditions. The older position on the building at the East Pittsburgh Works had the higher aerial, but the losses also were considerably greater. The aerial was stretched among tall chimneys, and other conditions tended to make the losses greater. The new station, on the contrary, had a less effective aerial height, but the losses were greatly reduced, through the practically non-metallic construction of the building in which the transmitting set was housed, the freedom from interference by neighbouring objects, and the suspension of the aerial on wooden poles instead of steel towers. The only guy wires on the poles at the new building are back stays, and these are split up by insulators. The aerial system in use was adopted with the purpose of keeping the losses at the minimum.

Observations

During the night of the test, which was national in scope, the Westinghouse observers were mainly in the larger cities, and in practically every state in the union. These observers or checkers forwarded to the station written reports indicating the signal strength, the comparison between selections, and the quality of signals, paying particular attention to high and low frequencies, and the amount of fading noted.

Each selection was numbered, the odd numbered selections being sent from one station and the even numbered ones from the other station. The observers, however, did not know from which station any of the numbers was being transmitted. The amount of the power put into each transmitter and the modulation of the two stations were identical; the difference in signals would therefore indicate the degree of efficiency of the transmitting set, installation, or the location.

Transmission

The two transmitters, more than a mile apart, had to be synchronised, or put in tune with each other, so that the observers would not be misled by one of the sets being out of tune. The two sets were perfectly synchronised by both being operated at the same time for a few seconds at the beginning of the test, and one set adjusted until a zero beat note showed that the two were in tune.

The general public, of course, was not informed of the test, and if listeners-in noticed any difference in the numbers they did not report their observations to the station.

The reports from the checkers in the various cities, however, came in promptly by mail after the night of the test; and as they were very complete enabled the staff to check the results accurately.

Summary

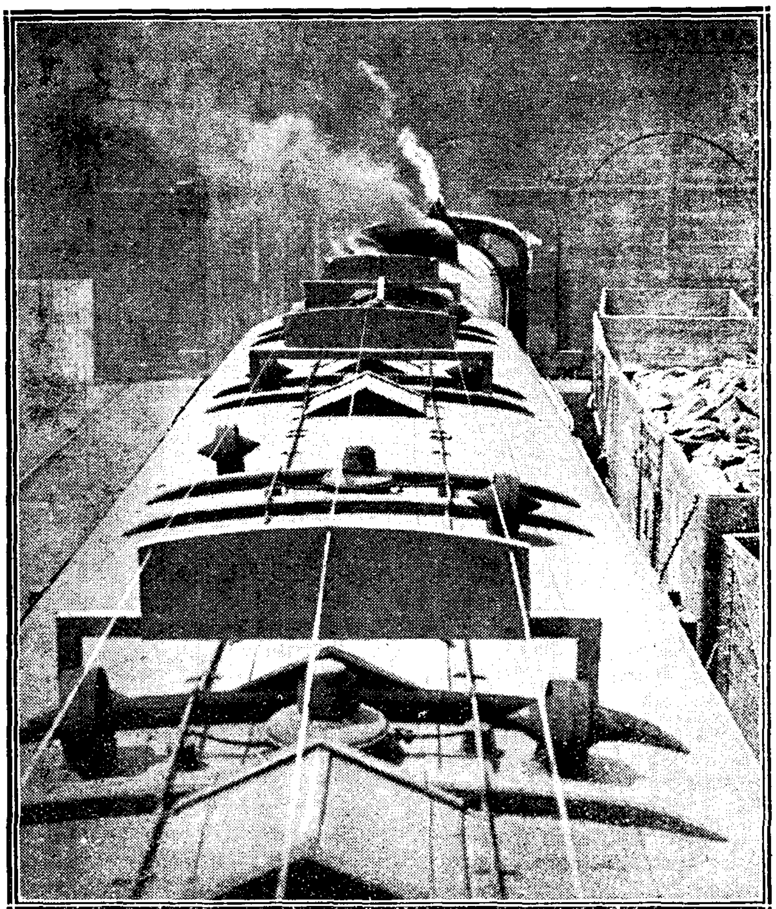
A brief summary of the reports showed that within a radius of 400 to 500 miles the energy from the station was great enough to make it unnecessary for the listeners to make very critical adjustments of their sets or make them extremely sensitive. In spite of this, however, the majority of the reports indicated that the reception of the new station was the better of the two.

Outside this radius, however, and at distances of a thousand miles or more, the results were very marked, the reception in every case showing a decided superiority for the new station. In the cities farther from Pittsburgh, especially, the difference was so great that listeners were unanimous in saying that the reception of the numbers from the new station was clear and strong, while that of the ones from the old station was weak.

Distances over 500 Miles

The reports indicated to the station staff that where it was necessary for the listener to make adjustments of extreme sensitiveness in order to get programmes over long distances, the difference in signals received was more pronounced. This was true in every report made from a distance of more than 500 miles from Pittsburgh. Such reports came from Los Angeles, San Francisco, Salt Lake City, Denver, Minneapolis, New Orleans, and other cities in the part of the United States most remote from Pittsburgh, indicating that with reasonably good radio conditions, KDKA can be heard all over the country.

The observations in the Pacific Coast cities were during daylight reception, as it was daylight on the coast until within a few



The aerial which was fitted to the Scotch express on the occasion of the transmission from the footplate of the engine.

minutes of the close of the concert. This constitutes a remarkable transmission record.

The observations were made on whatever set the particular observer happened to own, including practically every well-known type of receiver.

Fading

The reports on the comparative fading in the numbers broadcast from the two stations was of especial interest to the Westinghouse engineers. The new station operating on the higher ground showed less fading than the old one. These results seemed to support a theory long held by the engineers as to a cause of fading. This theory holds that some of the radio waves are radiated upward into air strata and are reflected back to earth; changes in the upper strata cause changes in the reflection of the waves, with the result that the signals vary in reception. As the old station was down in a valley surrounded on all sides by hills, it is believed that the hills absorbed most of the direct radiation, and that only the reflected energy reached the receiving sets. In other words, the waves leaving the station horizontally were absorbed, and only those rising vertically reached the receiving sets of the listeners.

In the new station the waves radiated horizontally are able to reach the sets, with the result that less fading was present.

More extended tests to see whether this theory is correct are being planned by the management and staff of the station. All the programmes from KDKA are now broadcast from the new station.

A READER'S SUCCESS

SIR,—Having completed several sets from your various publications I thought it might be of interest to you to know what results have been obtained. The first was "The Transatlantic V" (June, 1924, *Modern Wireless,* by Mr. Percy W. Harris), using all the components specified by Mr. Harris (and Cossor Dull Emitters throughout). Music, etc., from the three stations, Johannesburg 550 miles, Durban 500, and Cape Town 400 miles, leave nothing to be desired as far as both purity and volume are concerned; Bournemouth and WGY have also been received on several occasions at fair telephone strength, the only trouble being X's, which appear to be with us always!

The second set completed was the short-wave one-valve receiver by Mr. Stanley G. Rattee, in the March issue of *Modern Wireless.* This is truly a delightfully simple and efficient set. Elsewhere in one of the issues it was referred to as the "Transatlantic I," a most appropriate name! Using an outdoor aerial, 50 ft. long and 40 ft. high, KDKA is picked up without fail from after midnight, results improving until closing time, when this station is at its best (5—6 a.m). One morning after picking him up the aerial was disconnected from the set —signal strength was very slightly reduced, but did not cause any difficulty in following the programme. Amateurs are frequently picked up and their morse followed without much effort.

The third set was a single valve with reaction (*Modern Wireless,* October, 1924, also by Mr. Stanley G. Rattee). This, like the above sets, proved a great success.

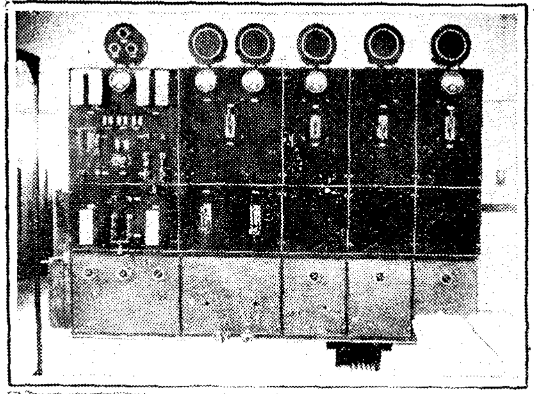
I would like to add that I find *Modern Wireless, Wireless Weekly* and *The Wireless Constructor* invaluable, and they are regularly followed.—Yours faithfully,

N. MACINTYRE.

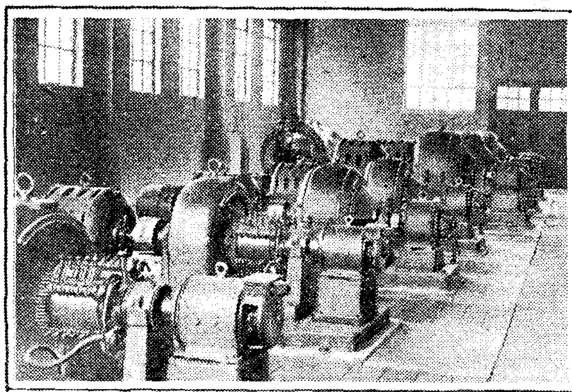
Port Elizabeth.
S. Africa.

THE AIR PAGEANT

Their Majesties the King and Queen at Hendon on the occasion of the Royal Air Force Pageant on June 27th. The spoken command given by the King and simultaneously broadcast was heard throughout the country.



The Operating Switchboard.



The Generators.

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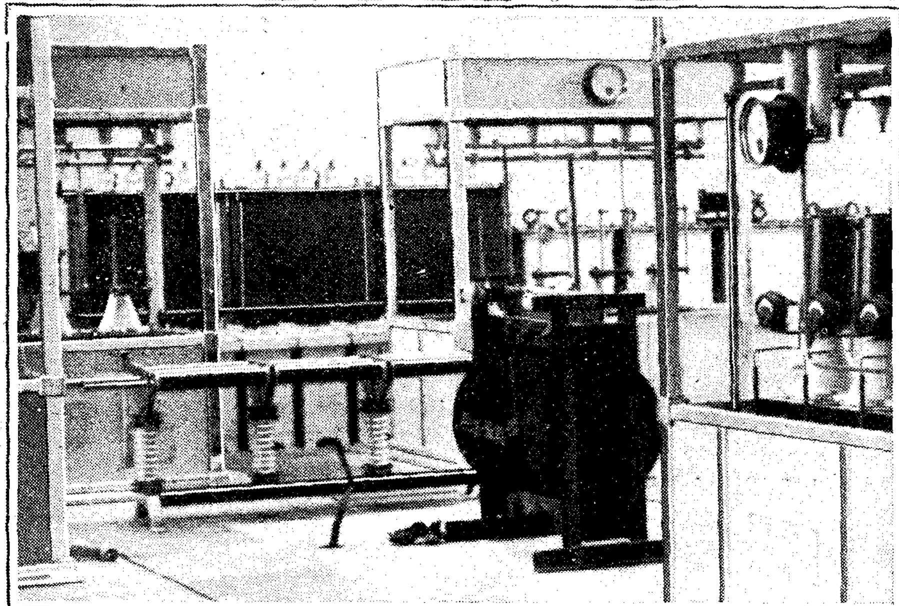
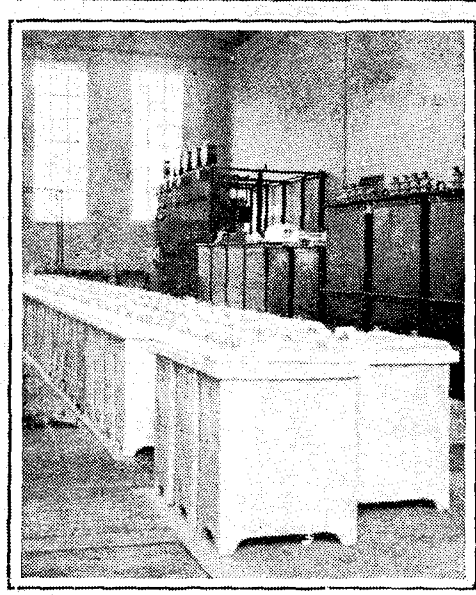
The Station as seen fr
the Masts.

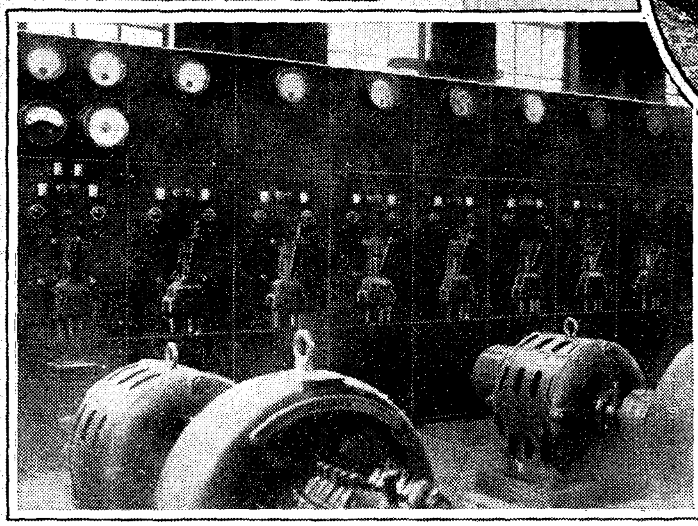


The Speech Transformer.

Lowering one o
Earth Plates



The Condensers and Transformers.



The Power Control Switchboard.

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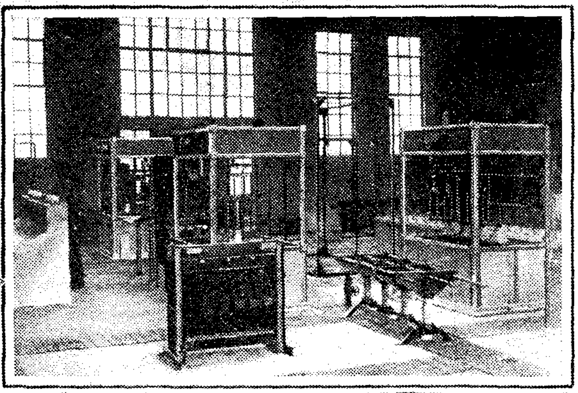
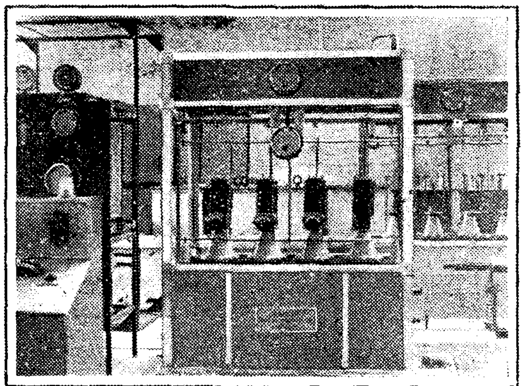


A General View of the Interior.



Part of the Amplifying Apparatus.

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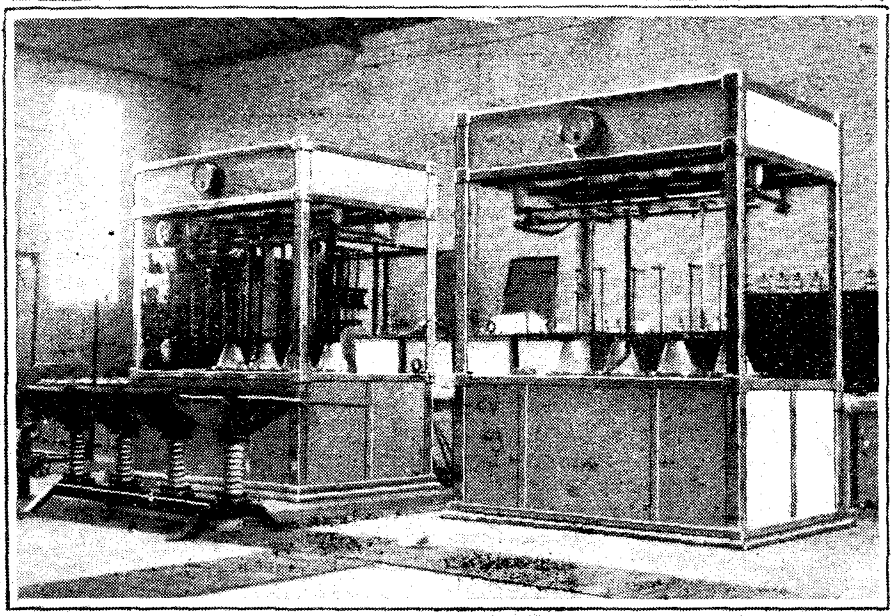
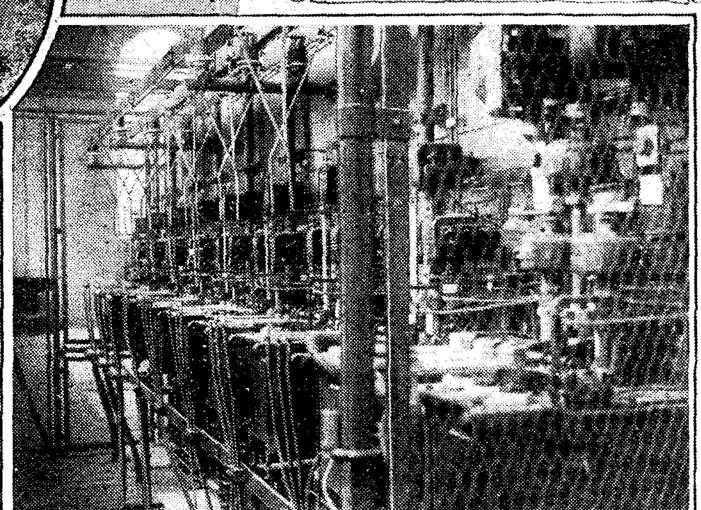
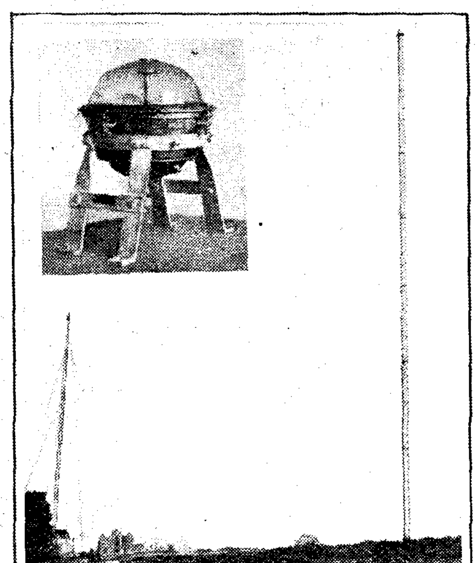


The Rectifying Apparatus.



The Wiring behind the Power Control Switchboard.



Each Mast is fitted with a Beacon Light (inset).

A Long Wave Circuit on the Omni Receiver

The connections given in this description result in a circuit particularly suitable for the reception of long waves and will enable Chelmsford, Radio-Paris and similar stations to be received over very considerable distances.

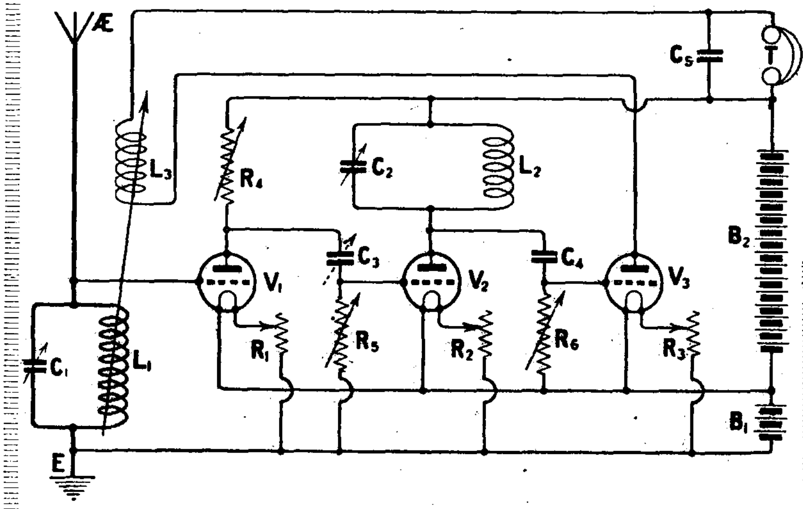


Fig. 1.—The theoretical circuit, which may be connected up on the Omni receiver in the manner described in the text.

In view of the general interest taken in the reception of the British Broadcasting Company's high-powered station at Chelmsford, it is thought that a description of a circuit suitable for the reception of this station at considerable distances will prove of interest to those readers who possess Omni receivers.

In Fig. 1 is shown a circuit in which two stages of high-frequency amplification are employed, followed by a valve detector. The use of resistance-capacity coupling for the first stage of amplification renders the circuit unsuitable for use upon the lower broadcast wavelengths, but results in simplified tuning and greater stability on the longer waves, where good results are obtained.

The Circuit

The action of the circuit is as follows: The aerial is tuned by the coil L1 and variable condenser C1 of 0.0005 μF capacity, the incoming signals being applied direct to the grid of the first valve, which amplifies at high frequency. The anode circuit of this valve contains the resistance R4 of variable value, the potentials across which are transferred to the grid of the second valve *via* the condenser C3, the usual grid-leak R5, which in this case is variable, being provided.

The anode circuit of the second valve is tuned by the coil L2 and variable condenser C2 of 0.0005 μF capacity, the potentials across L2 C2 being communicated to the grid of the last valve which acts as the detector. The connections of the variable resistance R6 are those of an ordinary grid-leak for the valve V3, in whose anode circuit is the coil L3 coupled to L1 in order to obtain reaction, and the telephones T shunted by C5 of 0.002 μF.

Connections Required

To wire up the circuit on the Omni receiver, the following connections upon the terminal board are required:—

51—17	34—49
17—18	49—24
25—26	6—19
25—52	27—16
17—12	16—5
4—36	13—40
44—24	8—41
4—2	33—31
10—14	31—39
14—35	47—23
43—48	23—24
6—50	32—40
50—42	48—52

Coils to Use

While the circuit is intended primarily for the reception of Chelmsford upon 1,600 metres, other long-wave stations may be tuned in successfully when suitable coils are employed.

Aerial Coil

The aerial coil must be plugged into the centre fixed socket of the three-coil holder on the left-hand side of the cabinet, while the socket of the reaction coil is the front moving member of the same holder. As indicated by the theoretical diagram, the anode coil L2 is not coupled to either of the other coils, the fixed socket in the top left-hand corner of the panel being wired to receive this coil.

Chelmsford may be received with a No. 150 coil in the aerial socket, No. 250 for the anode, and, say, No. 200 for reaction. Regarding the latter coil, however, it may be stated that experiment is always advisable, to determine which size is the most suitable for the reader's particular conditions.

Radio-Paris and Eiffel Tower

Two other stations which should not prove difficult to tune in are Radio-Paris and Eiffel Tower. For the former, the following coil sizes will be found suitable:—Aerial, No. 150 or 200; anode, No. 250; reaction coil size is again a matter of experiment. Eiffel Tower requires a No. 250 coil in the aerial socket, and a No. 300 for the anode, with, say, a No. 300 for reaction.

Operating the Set

Having connected the batteries, telephones, aerial and earth, and inserted the coils and valves, tuning may be carried out. The condenser C3 is the variable condenser connected internally to terminals 2 and 10, and since this is being utilised as a high-frequency coupling condenser, it may be adjusted to its maximum capacity or a little short of this value according to results. The two coils in the holder on the side of the cabinet should be kept well apart when first tuning, the latter process consisting of the rotation of the dials of the variable condensers C1 and C2. When signals are obtained, try varying the values of the two grid-leaks and the anode resistance by means of the knobs on the front of the panel until best results are obtained.

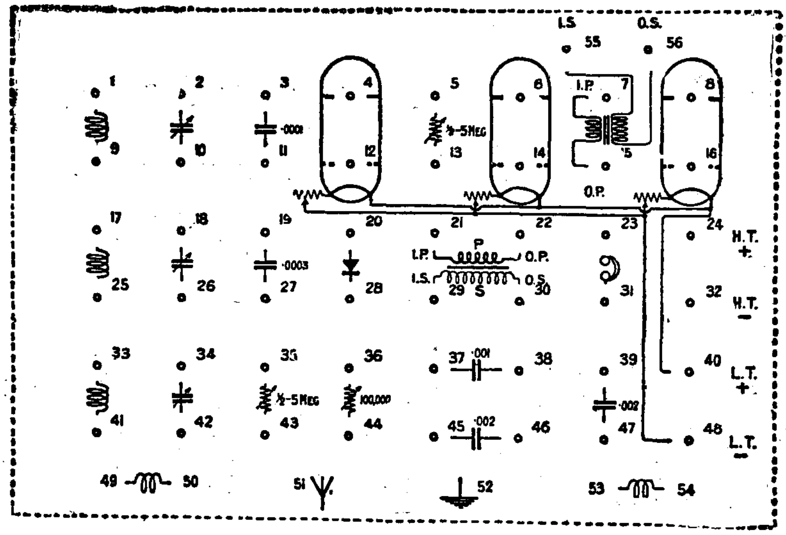


Fig. 2.—The terminal board.

Reaction

The effect of bringing the reaction coil towards the aerial coil should now be observed, retuning at the same time upon the aerial tuning condenser. If no increase in signal strength results it is probable that the connections to the reaction coil need to be reversed. This is accomplished by making the following alterations on the terminal board :—Disconnect the leads 8—41 and 33—31, and join 8—33 and 41—31. Judicious use of the reaction coil with careful tuning on the aerial condenser should now result in a definite increase in signal strength.

Some Experiments

In the theoretical diagram it will be observed that the condenser C3 has drawn through it a dotted arrow, this indicating that the condenser is of variable value when desired. An interesting experiment is to try the effect of varying the capacity of this condenser until maximum results are observed. It will generally be found that efficiency falls off considerably below a certain value.

The Anode Condenser

It may be found that adjustment of the anode tuning condenser C2 is too critical for ease of tuning, in which case the desirability of a lower maximum value is indicated. This may be secured by connecting in series with the present condenser a fixed condenser of 0.001 μF capacity, for, as most readers will know, when two condensers are placed in series, the resultant capacity is lower than that of either of the two condensers by itself. The following alterations effect the desired change :—Disconnect 42—50 and join 38—50 and 42—37.

Separate H.T.

A glance at the circuit diagram will show that, owing to the resistance R4 in the anode circuit of the first valve, this valve receives a considerably smaller anode potential than do the second and third valves. This arrangement is not ideal, and a useful experiment consists in the application of a separate anode potential to each valve. For this purpose it is necessary to disconnect the two leads 44—24 and 49—24. Terminal 44 will now feed the first valve, 49 the second valve, while terminal 24, or the H.T. + terminal on the panel, is that supplying the last valve. It is therefore only necessary to connect the negative of the H.T. battery to its usual terminal on the panel and take suitable tappings from the battery to the terminals mentioned. The detector valve will, in general, require a lower anode potential than that which gives best results with the H.F. valves.

THE RUGBY STATION.

The "earth" lead-in at the Hillmorton Station, Rugby, is of very elaborate construction and very carefully insulated.

Quality and Wireless Components

By A. V. D. HORT.

Some notes of interest to the home constructor upon the subject of choosing condensers, coil holders, resistances and switches for incorporation in his apparatus.

IN everything connected with wireless, from the construction of a simple crystal set to the erection of a high-power commercial station, it is quality which tells; only by the employment of good materials can the home con-

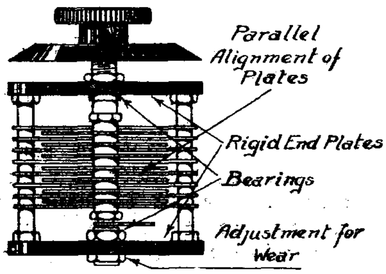


Fig. 1.—Variable condensers differ widely in construction, but the main features to examine are common to all makes.

structor or the wireless engineer feel sure of obtaining the results at which he aims. But many, especially those who have only recently decided, or such as have yet to decide, to construct their own receiving sets, may well be dismayed at the imposing array of advertisements to be seen on turning over the pages of any publication dealing with wireless or at the similar display of accessories in shop windows. It is, of course, out of the question here to recommend an article made by one manufacturer as being superior to other makes; nor is it possible to assert positively that price is a sound guide and that the most expensive components are necessarily the best; they may be so, but most people have to rest content with something cheaper; yet that something must be reliable.

Mechanical Construction

The purpose of the present article, then, is to indicate what points should be looked for in selecting some of the components for a receiver. It is not suggested that the components discussed need necessarily be perfect in every detail mentioned; in fact, the main feature necessary is sound and careful workmanship. Only those components are dealt with which can be mechanically, and consequently electrically, defective: such parts as fixed condensers or resistances cannot be checked merely by inspection.

Variable Condensers.

For whatever type of set it is required, a variable condenser should be carefully selected if it is to give good service. There has been some difference of opinion on the subject of the best material for the end plates, and many people think metal plates undesirable. Provided that ebonite bushes of generous size are provided in such plates, it is maintained that there is little, if anything, to choose between them and ebonite; it is essential that the ends be stiff enough to make the whole instrument rigid. The fixed and moving plates next claim attention, and with them the bearings of the spindle. The main points to notice here are the correct parallel alignment of the plates when in any position, the possibility of adjusting the spindle to take up wear, and the

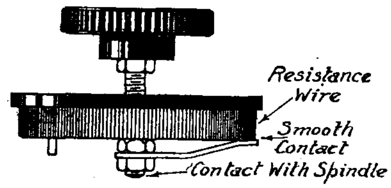


Fig. 2.—Be sure that the wire is of the right ohmic resistance and current-carrying capacity.

method of making contact with the moving plates. The spindle should turn freely without stiff points and without "shake" in the bearings in any direction, while the connection to it should be capable of providing an electrically silent contact; in addition, turning the knob should not cause the spindle to move up or down in its bearings.

The control room at the Johannesburg broadcasting station.

Filament Rheostats

The spindle of a filament rheostat or of a potentiometer made on similar lines should be studied with the same points in mind. The wire forming the actual resistance may be mounted in a variety of ways, and if, as is usually the case, bare wire is

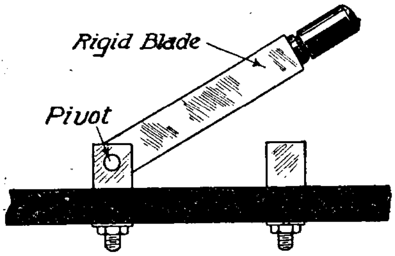


Fig. 3.—Defective switch contacts sometimes cause noises which are hard to trace.

used, the method should be such that the turns cannot easily be displaced by the movement of the contact finger, causing adjacent turns to touch and so lowering the total resistance unintentionally. The contact finger should run smoothly without missing any turns, and should be securely fixed to the spindle. Finally, the actual resistance of the rheostat or potentiometer should be ascertained, if possible, in order to ensure that the correct type is chosen for the purpose for which it is required.

Resistance Wire

In considering rheostats there are two points to which attention should be paid; it is not sufficient that the resistance only should be correct; the wire must also be capable of carrying without overheating the required amount of current for the valve or valves which it is to control.

Change-over Switches

In switches of any type good electrical contacts with ample bearing surface are essential. The familiar pattern of " knife " switch is most likely to be faulty at the pivot; as indicated in Fig. 3 the switch blade should be of heavy enough gauge metal not to bend easily, and it should be clamped firmly in its clip at the centre point of the switch : a bad contact here is likely to be obscured if the switch is only examined when in the " on " position; faults in the outer clips will be more obvious. In examining " key " and " barrel " switches, especially if they are to be used in parts of a circuit carrying H.F. currents, low capacity between the blades or contacts of the switch is the most desirable feature to look for.

Stud Switches

The points enumerated in discussing the spindles of variable condensers and filament resistances apply equally to those of stud switches. Also the switch arm should move smoothly over the studs, without tending to chop between them when turned in either direction. If parts of such a switch are purchased to mount on a panel, either spring washers should be provided or the arm made sufficiently springy to keep it in good contact with the studs; it is hardly possible to rely on so placing a rigid arm on the spindle that it bears evenly on all the studs without being unduly stiff to turn.

Coil-holders for fixed and moving coils are not very likely to be defective. If light coils only are to be used, such as the ordinary standard plug-in honeycomb or duolateral coils used for the reception of broadcasting, the moving coil-holder may turn quite freely without disadvantage. But if heavier coils are to be inserted, trouble may arise from the moving coil falling by its weight either away from or towards the fixed coil, according to its position. Here the position in which the holder is to be mounted on the set must be taken

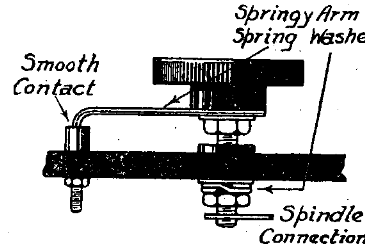


Fig. 4.—Badly made switches are more a hindrance than a help to tuning.

into consideration; if it can be mounted with the plugs projecting horizontally from the panel and the axis of the coils horizontal, it will be obvious that gravity will not affect the movement of the coils; but if this method of mounting is for some reason undesirable, then a coil-holder which is not too free in movement or one which is adjustable in this respect should be

The station belonging to Mr. Herbert Hiley, of Rivercrest, Riddlesden, Keighley, Yorkshire (2IH), who, using 15 watts and an ultra-low wavelength, has been in communication with an amateur in Rio de Janeiro.

chosen. The question whether vernier control is needed or not is one which depends on the requirements of the individual; if, however, this control is required, absence of "backlash" in the movement is important, since fine adjustments are impossible unless the gearing or other device employed is accurately fitted.

Ebonite Mouldings

It may not be thought that valve-holders are likely to be a source of trouble; but, omitting questions of capacity between the legs or other points of the design, occasionally a holder is met with in which the sockets are not quite accurately spaced. This is not a common fault, but instances have come under the notice of the writer, so that it is a good plan to test a holder by inserting a valve and seeing that it can be put in without being forced; a fault in this respect is liable to damage the valve.

The advisability of making sure that ebonite panels are free from surface leakage, either by the purchase of guaranteed panels or by well rubbing down the surface of other ebonite, has been constantly reiterated in the Radio Press publications. Small parts made of moulded ebonite, such as coil-mounting plugs, should be carefully inspected, unless of known and reliable make. The writer once purchased such a plug of moulded "ebonite," and subsequently discovered that there was no insulation between the pin and socket at all. When this plug was cut in half, no obvious fault was visible to the naked eye; but the fact remained that the supposed insulating material between the pin and socket was actually an excellent conductor. This no doubt was an extreme case, but as a general rule it is wiser to buy plugs and similar small components cut from solid block ebonite, if sound makes in moulded ebonite are not available.

Inaccurate Construction

A further point to look for in connection with small components is accuracy of construction. Few experiences are more annoying than to buy, for instance, several control knobs, and later on to find that one or two of them have their threads tapped eccentrically, so that they mar the appearance of the completed receiver.

Attention to Detail

To sum up, the chief desiderata in components for use in wireless sets are accuracy and careful workmanship. If the constructor wishes to get good results he should use only good materials; quality in electrical instruments is obtainable in a variety of ways, but if the constructor examines his selection of parts carefully, with due attention to detail along the general lines indicated, he should not experience much difficulty in finding good material.

The Canadian "Arctic"

The Canadian Government ship "Arctic," which left Quebec about June 27 on her annual trip this summer to the polar regions, was equipped with a transmitting set specially designed to keep the Canadian Government posted as to her movements.

The vessel holds the present record for receiving and transmitting radio messages from the point nearest the North Pole.

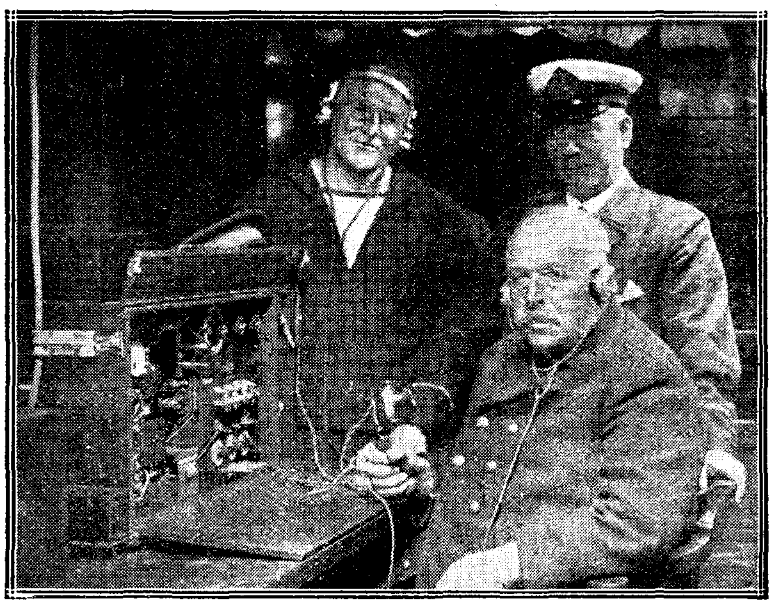
Last year the vessel continuously received messages from the Canadian Government transmitted from Station KDKA, Westinghouse Electric & Manufacturing Company station at Pittsburgh, Pa., on the short wave, and established the "farthest north" reception record when a message from KDKA was received at Cape Sabine, north of Peary's winter base at Etah, and within 11 degrees of the North Pole.

Larger Transmitter

Not all the reply messages sent from the vessel to the Canadian Government were received, however, and in order to insure uninterrupted two-way transmission this year, Commander C. P. Edwards, director of radio service of the Canadian Department of Marine and Fisheries, in collaboration with the KDKA engineers, is having a more powerful set built for the vessel this year.

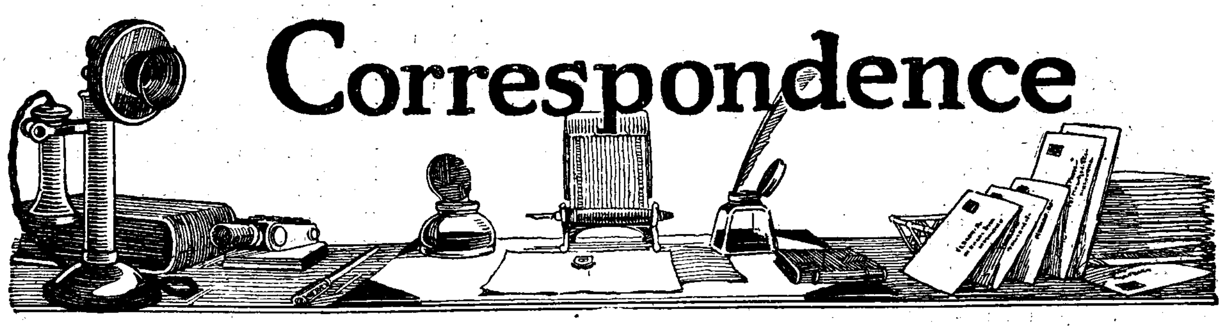
During the 1924 cruise the vessel passed out of range of other radio-sending stations long before reaching its northernmost point, but had no difficulty in picking up the short-wave messages from KDKA, which were relayed twice a week at a predetermined hour.

WIRELESS AND LIGHTSHIPS



Trinity House is gradually fitting our lightships with wireless telephony apparatus of the type shown above; taken on board Light Vessel No. 67 at Harwich.

Correspondence



A THREE-VALVE RECEIVER WITH SERIES-TUNED-ANODE

SIR,—Knowing that your readers' results with Radio Press sets interest you, I am writing you this after my first test of the "Three-valve Receiver with Series-Tuned-Anode," described by Mr. D. J. S. Hartt, B.Sc., in *Wireless Weekly* (April 1, 1925).

I am subscribing to *The Wireless Constructor*, *Modern Wireless*, and *Wireless Weekly*, and find great delight in studying all of them.

Regarding the construction of the above-mentioned set, I have followed the diagrams, but as the set is to be used as a portable one to be set up in one place or another during six weeks' summer holiday, I had to see to it that it was not too bulky.

The test began at 8.30 (British Summer Time) in the evening, and inside of two hours the following stations were identified:—Radio-Paris, Chelmsford, Hilversum, Brussels, Toulouse, London, Bournemouth, Aberdeen, Oslo (Norway), Malmö (Sweden), and two or three German stations. All of them were received at very good 'phone strength—Chelmsford uncomfortably so. The test was carried out on an outdoor aerial (single wire, 80 ft., 20 ft. above ground); as radio-choke coil a No. 400 was used.

The set is, as I have said, intended to be used with any sort of temporary aerial, and I have no doubt that it will bring in a very fair number of stations, English as well as others, on a very indifferent indoor aerial, wherever I shall be able to try it out.—Yours faithfully,

BJORN ABBEN.

Struer, Denmark.

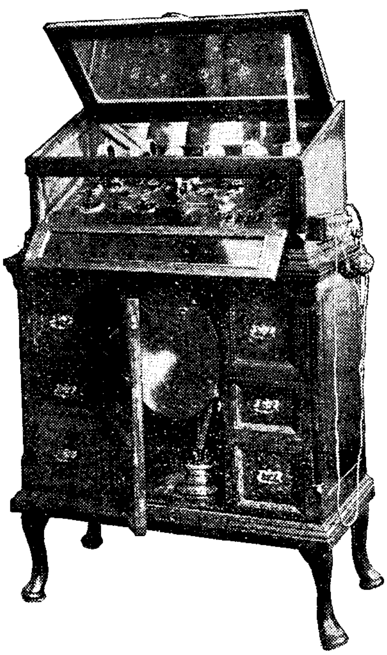
ENVELOPE No. 2

SIR,—The thanks of myself and every wireless person are due to you for the circuits and designs of sets so simply explained and published from time to time.

Myself and family (I am a joiner) have enjoyed ourselves more since making the "Family Four-Valve Receiver" (Envelope No. 2, by Percy W. Harris) than we have in the course of our 30 years of married life.

I made the four-valve set 16 months ago in a box with lid. Carrying it by the lid in mistake, I dropped it, which cost me over £2 for valves. The cabinet was the outcome of that disaster.

We have a lot of visitors, and they are all of one mind in stating they have never seen or heard of a better set. The cabinet is my own make and design, and the accumulator and H.T. batteries are kept in cupboards embodied in the cabinet. The mirror inside at the back reflects light from valves to condensers, etc. As regards reception, my aerial is only 15 ft. high; the set is in a front room and the lead-in from the aerial is 35 ft. long. However, we get Paris loud enough on the loud-speaker to dance to.



The handsome "Four-Valve Family" Receiver made by Mr. J. W. Offley.

I may state that this was my first attempt at set construction, and I had never soldered before.

The three-valve receiver, of which a photograph is also enclosed, is of Mr. Harris's design from the April issue of *The Wireless Constructor* ("A Powerful Three-Valve Set"), and is more powerful than the large set on Manchester at 20 miles. With two large loud-speakers (one upstairs) it has to be detuned, as the volume is so great. My deafness stops me from searching for distant stations, but I am quite satisfied with the stations I get, and if other amateurs were the same there would be a lot less disturbance and more pleasure.

Myself and friends would esteem it a favour if you think these photographs worthy of reproduction in your paper.

Again thanking you for very happy evenings.—Yours faithfully,

J. W. OFFLEY.

Adlington, Lancashire.

THE "TWIN-VALVE" RECEIVER

SIR,—I converted my two-valve set, H.F. and Det., into the "Twin-Valve" set described in the January issue of *The Wireless Constructor*. I most certainly congratulate Mr. Scott-Taggart on the design and general layout of this splendid receiver. I get good loud-speaker results from the Leeds relay station at 3½ miles on a large Sterling Audivox, and have also had Manchester at moderate strength on L.S. I, of course, used all the components possible from my previous set, although the panel arrangement is as described. It is a set to be proud of, and worthy of the splendid walnut-enclosed cabinet I have placed it in. My aerial is only moderate, twin style, and water-tap earth. I have not tried yet for any Continental stations, but on 'phones I received several transmissions, including Newcastle, Sheffield, Bournemouth and Cardiff. Altogether, the set is splendid. Wishing you every success.—Yours faithfully,

G. W.

Leeds.

Re 2OY

SIR,—Since I left England on February 27, 1925, I have received a large number of reports concerning transmissions by 2OY. They all concern dates after I sailed from Southampton, and it is impossible for me to forward the reports to the new owner of 2OY, as I do not know who he is. I enclose the last three (which arrived by last mail), as the new 2OY may care to send to you for them.

If you will kindly publish this letter in your valuable journals it may be of assistance to 2OY and avoid the delay which occurs in replying to experimenters.

I should also like to take this opportunity to thank the numerous experimenters who gave me valuable assistance when I was operating 2OY. When I return to England I hope to renew their acquaintance and once again obtain their kind co-operation in my experiments.—Yours faithfully,

E. J. HOBBS, Capt.
(Ex 2OY.)

Secunderabad, India.

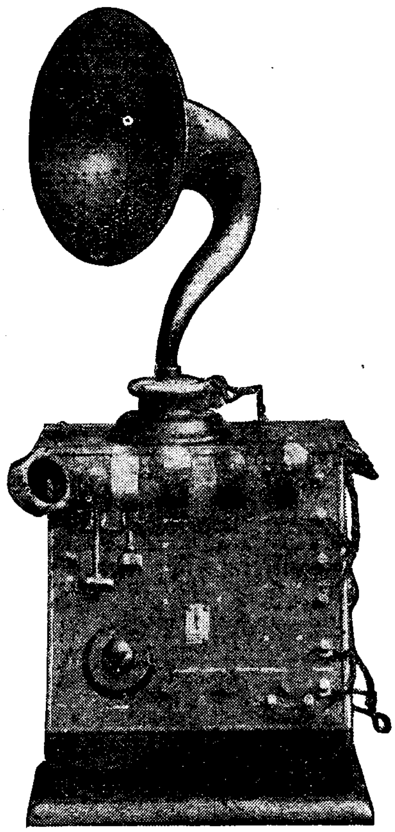
[If this should come to the notice of 2OY, if he will communicate with us, we shall be pleased to hand over the reports referred to in this letter.—ED.]

SUMMER INTEREST IN RADIO

SIR,—Radio in some quarters seems to suffer from a marked waning of enthusiasm during the summer months, and as the solution of this trouble appears to lie in the organisation of carefully-planned field-days, the writer would like to give details of a most successful outing promoted by the Eastern Metropolitan Group (R.S.G.B.), on Saturday, June 20 last.

In order to cater for all tastes it was decided to build two portable transmitters and two receivers to operate on 130 metres, special permission being obtained from the P.M.G. to use this wavelength. One of the stations was to be fixed and the other mobile. At Cuffley, where the fixed station was to be erected, arrangements were made for broadcast reception by those preferring something of a less serious nature.

Regarding the transmitters, these used the Meissner circuit with anode tap, owing to the ease with which adjustments can be made on greatly dissimilar aerials. Some



The "Powerful Three-Valve" Receiver which Mr. Offley has also built.

anxiety was felt for the safety of the valve filaments owing to some rough roads which were to be traversed. Fortunately, the General Electric Co. came to the rescue with the loan of Marconi T.100's and DET.1's as oscillators and modulators respectively.

The other difficulty was the provision of portable high-tension supplies. Here the M.L. Syndicate kindly lent two of their anode converters for operating off accumulators.

Tea arrangements were made at Cuffley Post Office, and all the apparatus was first conveyed there. The mobile apparatus remained on its car and proceeded to Welwyn. Transmissions were made to schedule, and provided tests for the large number who had brought their own short-wave receivers. Telephony came through so well that it was found unnecessary to use the key. As a final test, broadcast received on one of the other aerials was successfully relayed on the short wavelength *via* a loud-speaker and microphone.

The whole affair was so successful that the writer hopes that many more will follow suit, and trusts that these few details will prove of use to those contemplating a similar event.—Yours faithfully,

R. F. G. HOLNESS (2AQQ).

London, N.15.

RADIO PRESS SETS IN SOUTH AFRICA

SIR, — I enclose a photograph which may be of interest to you.

The sets in this photograph are all made by myself, with the valuable aid of *Wireless Weekly, Modern Wireless* and *The Wireless Constructor,* which papers I find of the greatest interest and assistance.

The short wave set is the "Low-Loss Tuner for Short Waves," described by Percy W. Harris in *Wireless Weekly* for November 19, 1924, and on this set I get direct reception of KDKA with excellent results and many other short-wave stations.

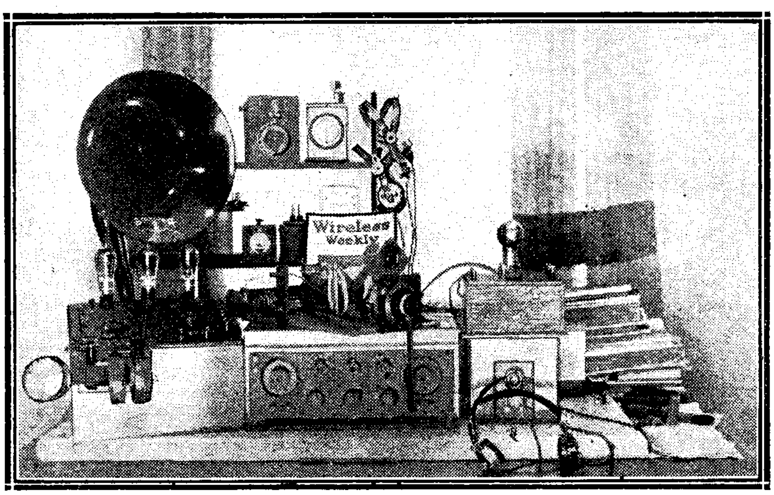
The other sets, and many not shown, I have also made, with the help of your papers, and these have all proved extremely satisfactory.—Yours faithfully,

F. C. WHITMORE.

Bulawayo, Rhodesia.

A POWERFUL 3-VALVE SET

SIR,—Having built up the Powerful Three-Valve Set as given in *The Wireless Constructor* (April, 1925, by Mr. Percy W. Harris), I thought you might be interested to know the results. The following are the stations I have received :—*Sheffield,* Hull, Nottingham, *Leeds, Manchester, 5XX,* London, *Newcastle,* Glasgow, Petit Parisien, all at good loud-speaker strength, and those in italics very loud. I have also had Aberdeen, Birmingham, Bournemouth, Belfast and Madrid, just at



A collection of Radio Press receivers made by Mr. Whitmore, of Rhodesia.

sufficient volume on the loud-speaker for a small room. But the greatest surprise came to me one early morning when I switched on to see if I could receive any transmission, when I heard a man speaking on charity. I waited patiently for the call-sign, and it came, WGY, America. As this set is designed for loud-speaker work on the local stations, it speaks well for the circuit. I have built it on the same size panel, but with Eureka transformers (1st and 2nd)., with a power-valve in the last stage, using 6 volts grid-bias. For filament control, for any person who requires a good set for local loud-speaker work, this one cannot, in my opinion, be beaten.

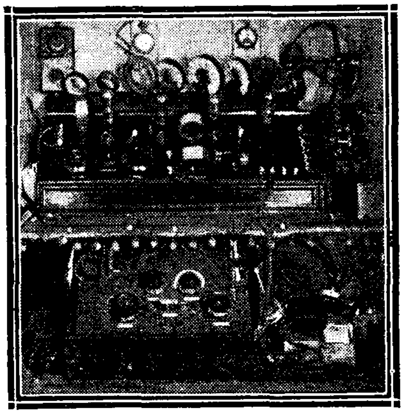
Wishing your papers continued and increasing success.—Yours faithfully,

HERBERT SKINNER.

Barnsley.

ENVELOPES Nos. 1 AND 2

SIR,—I have enclosed a photograph of the " Family Four-Valve Set " (Envelope No. 2, by Percy W. Harris, M.I.R.E.) and the ST100 (Envelope No. 1, by John Scott-Taggart, F.Inst.P., A.M.I.E.E.), which I have constructed from your two envelopes. The four-valve set has been in use since October, 1924. I can tune in all the B.B.C. stations at good 'phone strength on H.F. and Detector, and some at loud-speaker strength on the four valves. I have also heard eight different Conti-



The " Four-Valve Family" and ST100 receivers made by Mr. Patch.

nental stations. Last winter I received KDKA on many occasions after midnight. The ST100 needs no words of praise, for its performance is remarkable.—Yours faithfully,

J. PATCH.

Leyton.

THE THREE-VALVE DUAL RECEIVER

SIR,—A few lines in expression of my unbounded appreciation of the simplified " Three-Valve Dual " circuit as given in the March, 1924, issue of *Modern Wireless,* by Mr. J. Scott-Taggart.

I have just constructed this receiver with wonderful results. With the exception of mounting the components on a vertical panel, with valves behind, and given separate H.T. to each valve, with separate grid bias I have otherwise adhered strictly to your published specifications and lay-out.

Aerial—free end—from 36-ft. pole in garden to ridge of house; span and lead-in, 97 ft.; earth, 12 ft. double aerial-wire soldered to copper plate 3 ft. below surface, filled in with crushed coke and watered at intervals. We are rather low-lying, aerial span is in a line with ridge of roof, and screened on one side by a church.

I have used a Ferranti transformer in first stage, and a Eureka Concert Grand in second stage.

I have yet to find an instrument to equal this one. The volume and purity of tone leave nothing to be desired. I can get it much too loud for pleasant reception, but toned down to the requisite degree of strength it is just perfect, and capable of running two loud-speakers in different rooms.

I have no doubt about it picking up all the B.B.C. stations, although I have taken little trouble so far—the music has been too splendid to start "meddling." However, I have had Glasgow, Newcastle, Bournemouth, London, Cardiff, Petit Parisien on a loud-speaker, and one or two unidentified Continental stations. Bradford, seven miles away, and Manchester, 30 miles, of course are too loud.

I have, so far, had no difficulty in cutting out unwanted stations.

In conclusion, my unbounded appreciation is inadequately expressed in "many thanks" for what is, indeed, the "Super Three-Valve" receiver. With best wishes.—Yours faithfully,

H. ATKINSON.

Brighouse, Yorks.

TRANSATLANTIC V.

SIR,—Just a few lines to tell you that I have fixed up the "Transatlantic V." (*Modern Wireless*, June, 1924, by Mr. Percy W. Harris), and am most pleased with it. I am not as yet thoroughly conversant with the tuning of this set, but I find it extraordinarily selective, and the music I get on local broadcasting is the purest that is produced on any loud-speaker set in Bombay.

The power of the Bombay station is 100 watts, and when the L.S. is on music can be distinctly heard and recognised 250 yards away from the L.S. with all the noises caused by motors, etc., going on.

I have only plug-in transformers for 300 to 600 metres, and I can get shipping quite easily. I have had Alexandria working on 600 metres on the L.S. sufficiently loud to be heard and read 15 ft. away, and that at 6.45 p.m. Colombo comes in on the L.S. a little louder, and I received him at 4.45 p.m., whereas Bombay, with seven valves, I am given to understand, cannot get him on the 'phones till after dusk.

The gratifying part of the set is, that Bombay-Radio, with a seven-valve set, has repeatedly told ships that their signals are too weak to read, when I have received the same ships at good strength on 2H.F. and detector. I will wager there is not a set in India at present receiving more than the "Transatlantic V." I am anxiously looking forward to receiving matched transformers which will enable me to try for 5XX.

The aerial condenser has given me trouble, as the plates are touching. This interferes with the working of the set a lot, but with this handicap the results I have given you have been obtained, and that without a complete acquaintance of the set.

One more item. The R.M.S. *Narkunda*, when she was just under 600 miles away from Bombay, came in on the L.S. loud enough to be heard about 40 yards away and further. I had to get on to three valves, as I did not want her messages read by anyone passing by who knew morse.

I have now the set of my desire, and I look forward with keen anxiety and interest to receiving the transformers, which will enable me to get from the lowest to the highest wavelengths in a few moments.

With many thanks and all good wishes.—Yours faithfully,

FRANK H. HEBBERD.

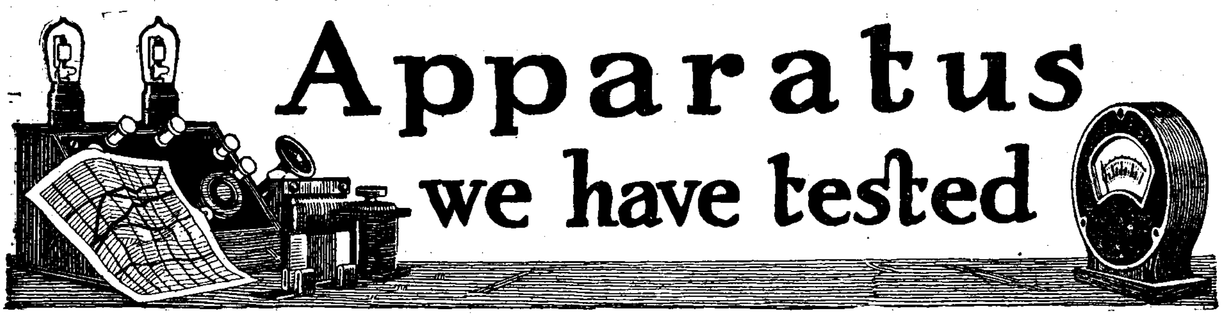
Bombay, India.

PROTECT YOUR VALVES AND TELEPHONES

SIR,—The method recommended is to use ordinary pillar-type terminals for the low-tension, telephone terminals for the telephones, and "Newey" clips, "Clix," or some such terminal for the high-tension. If, in addition, the ends of the leads from the accumulator are fitted with spade ends, the ends of the leads from the high-tension battery are fitted with "Newey" clips, and the telephone leads or extension leads are fitted with pin ends, the risk of a mis-connection is almost negligible.—Yours faithfully,

R. G. MARSH.

Woodford Green, Essex.



Apparatus we have tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

An H.T. Battery

Messrs. General Radio have submitted for a prolonged and searching trial two samples of their "Radiobat" 63-volt high-tension units. These are enclosed in a metal case, measuring about 1 ft. by 3½ in. by 2¾ in., and are tapped every 4½ volts. The test involved continuous use on a "family" type of receiver using power amplification and operated many hours a day. After lengthy usage, the voltage was found to have dropped, in the one case to 50 volts, from the initial value of approximately 60 volts, and but one sub-unit had fallen below 3 volts. The battery was still silent in use. Occasionally a very heavy current had been taken from it for experiments in power amplification with several stages.

It was noticed that in the case of one battery an end 4½-volt unit was already exhausted on arrival, presumably due to an accidental short-circuit in transit; it would be preferable if the extreme wander-plug socket were not placed so very close up against the metal case, as short-circuits were obtained at times during experiments due to this cause. It appears that this type of battery will give unusually good service for one that is not of the largest size, even with a fairly large set, provided that proper use is made of grid-bias in the low-frequency stages.

"Croxsonia" Radio Panels

From Messrs. Croxsonia Co. comes a sample of their "Croxsonia" radio panels, suggested as a substitute for ebonite at, it is stated, one-half the price. This is a black fibrous material, with a dull, somewhat rough surface; it is supplied in a great variety of stock sizes. The sample panel provided for our test showed smooth edges with sharp corners. On practical trial in the usual machining operations of the home constructor, with saw, file, drill, etc., it worked well, resembling more closely heavy millboard, or a rather soft wood, than ebonite. Some care was necessary in drilling it to avoid making an ugly tear at the back of the panel when the drill dropped through. The mechanical strength of the material appeared adequate. When new and quite dry, the insulating properties were excellent, and quite sufficient for any ordinary radio purposes.

C. & S. Dull-Emitter Valves

We have received from Messrs. Craik & Smith samples of their "C. & S." D.E. valves for trial. These are of the 2-volt class, taking approximately 0.2 amperes in the filament at this rating; the makers' figures are from 25 to 100 volts plate potential, and especial efficiency in detection of feeble signals is claimed.

On trial, the two specimens, which showed very similar behaviour, gave a maximum emission with high H.T. and ample positive grid bias of some 3.8 milliamperes with 2 volts on the filament, 2.4 milliamperes with 1.8 volts, and actually a fair emission at 1.5 volts, so that the valves can be operated successfully from a single 2-volt accumulator not in a freshly charged condition.

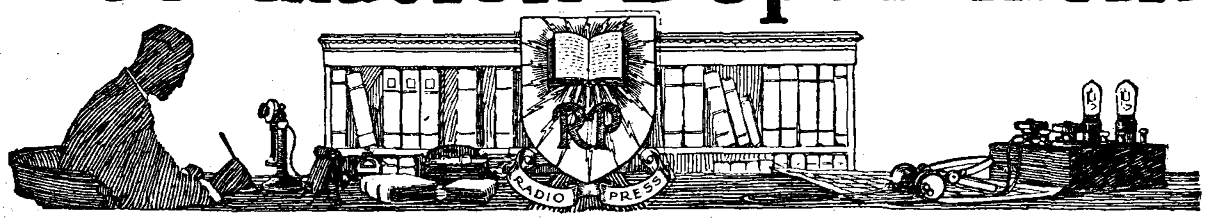
In a practical test, optimum conditions for detection of distant signals appeared to be (with a high value grid-leak) a plate-potential around 25 volts, and certainly not exceeding 40 volts. Extremely smooth reaction resulted. As an L.F. amplifier, a fair amount of energy could be handled with 100 volts H.T. and 3-4 volts grid bias, though the valve was a little overloaded on the local transmission as a first-stage L.F. amplifier. The characteristics showed a high amplification factor (around 12.5), which explains the excellent results obtained in detection; the valve should give satisfactory results in H.F. amplification with around 60 volts H.T. A moderately high mean A.C. impedance of 45,000 ohms was recorded.

At the modest price asked for these D.E. valves, the performance was distinctly favourable, judging from the samples, and they should give every satisfaction for general purposes, and for use in L.F. amplification if used with proper grid bias and on moderate signals.

A Lead-in and Earth Tube

An insulated lead-in with which is combined a safety switching device for earthing the aerial outside the house has been sent for our comment by Messrs. Auriol Supplies Co. This appears at first sight to be an ordinary type of lead-in tube, 6 in. long, but it carries two terminals at the outer end, and in place of the usual single terminal inside there is a control-knob and a terminal fitting. The aerial is to be connected to lateral terminal without, and a direct lead to an external earth is to be taken from the adjacent end terminal. The usual "aerial" terminal of the set is connected, as usual, to the point inside the room, a separate earth-lead, quite independent of this device, being also needed. Then, whilst the set is always left connected up ready for use, by turning the control knob as far as it will go to the right contact is made inside the tube to the external safety earth connection, effectively earthing the aerial against static discharges and lightning. To use the set, the knob is turned as far as it will go to the left, when this earth connection is broken. The stray capacity between aerial lead and earth is minimised by this form of switching device, but care should be taken to protect the projecting end of the insulator against rain, as there is less than ½ in. of exposed insulation surface here separating aerial and earth terminals. The insulation when dry, proved adequate on test, and the switch operated correctly. The device should offer a considerable measure of security in summer thunderstorms.

Information Department



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G. B. (BRISBANE) has obtained excellent results using the "All Concert" de luxe Receiver described by Mr. Percy W. Harris, in Radio Press Envelope No. 4, but wishes to use a power valve in the low-frequency stage and asks our advice as to the necessary alterations to use separate high tension on each valve and grid bias on the last. He states that he wishes to use one of the small power valves, now so popular, in the last stage and asks whether a separate high tension battery will be necessary.

The addition of separate high-tension to each valve in the "All Concert de Luxe" receiver, and also grid bias for the last valve, is a comparatively simple matter, and is carried out as follows. Referring to the wiring blue print enclosed in Envelope No. 4, first remove the lead from the centre right-hand contact of the "telephone loud-speaker switch" which runs to the long perpendicular lead from the moving plates of the .00025 μF condenser to H.T. plus. The lead which should be removed is shown as ending close to the figures .00025 on this condenser. Now bring a lead out from the centre contact of the "telephone loud-speaker switch" to a further terminal, which will become H.T. plus for the last valve. The next step is to remove the connection between OP and the long lead previously mentioned, and then to bring OP out to a further terminal which will now be the H.T. plus of your detector valve. The short connection from the left-hand side of the .001 μF condenser should now be removed from the long lead and taken to OP. The original H.T. plus terminal is now the high-tension supply to the H.F. valve. It is to be noted that the long perpendicular lead referred to is to be left intact.

It will be observed that using this arrangement, the 2 μF fixed condenser across the high tension is now connected across the supply to the H.F. valve only. If desired, two further 2 μF condensers may be used across the other two high-tension tappings. These will have one side connected to H.T. minus and the other sides to the two new H.T. plus terminals respectively.

Provision for grid bias is readily made by breaking the lead from the

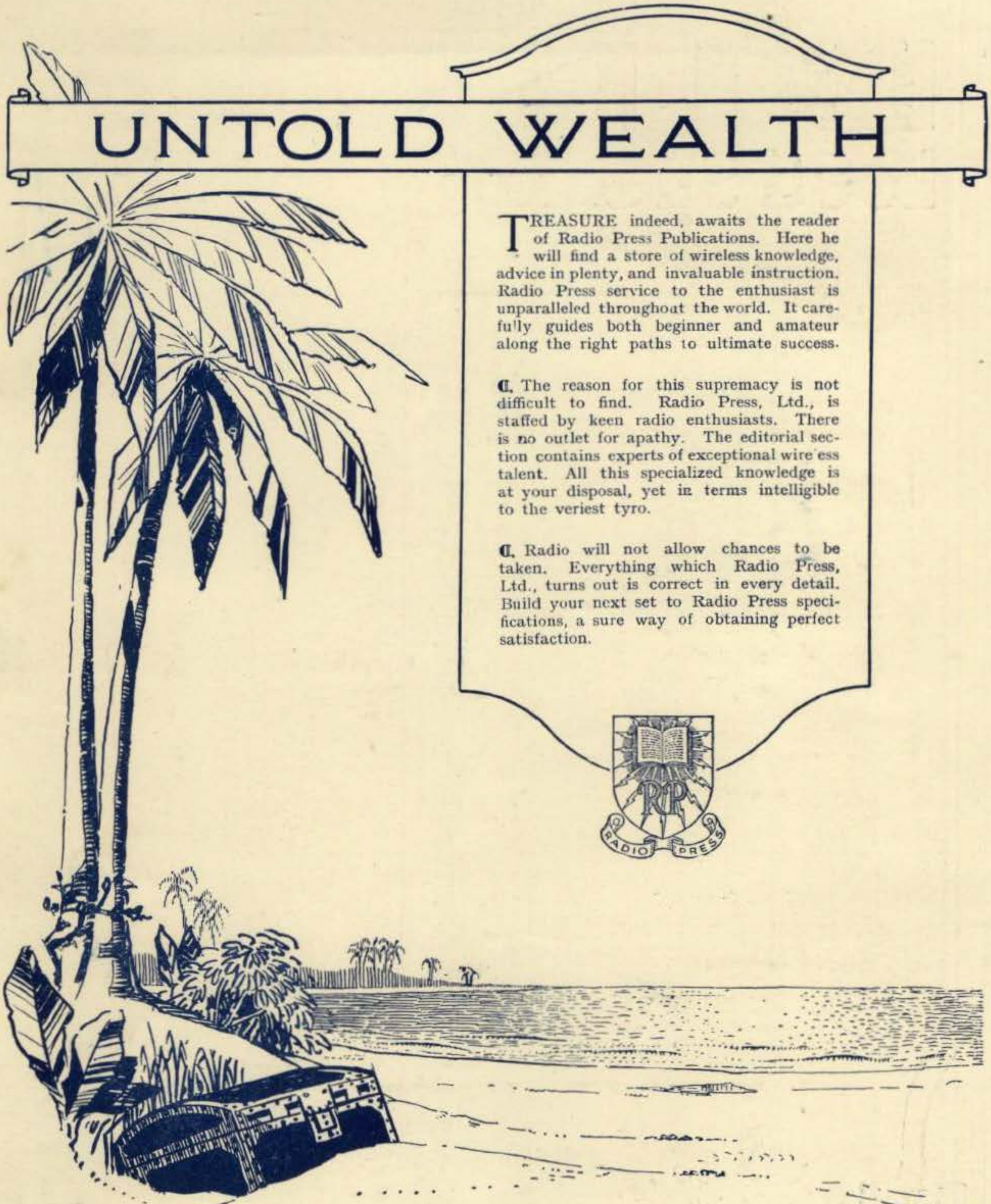
IS of the L.F. transformer to L.T. negative and bringing IS out to a further terminal which becomes grid bias negative. Grid bias plus is coincident with L.T. minus. Having carried out the above alterations, a power valve may readily be used in the last socket, and the same high-tension battery may be used for all valves, provided this is of a type using large cells. We would suggest that a 100 or 120 volt battery be obtained and that between 100 and 120-volts be used on the last valve. For grid bias a 6 or 9-volt grid bias battery tapped in 1½-volt steps will be suitable.

D. G. H. (WANDSWORTH) has constructed a set employing a detector and two low-frequency valves for loud-speaker work from 2LO. Excellent loud-speaker results are obtained from the London Station, provided that the set and loud-speaker are located in the conservatory. When, however, the loud-speaker is taken to any part of the house using twin-flex leads, an unpleasant humming is noticed which completely spoils reception. It is particularly desired to use the loud-speaker in a room somewhat distant from the set and, unfortunately, the disposition of the house and garden is such that the aerial and earth system must be arranged as at present. The effect of bringing the leads to the room in which it is desired to listen to the programme by various alternative paths has been tried, but the interference cannot thus be eliminated. The house is wired for electric light and the supply is alternating current. Our correspondent wishes to know whether there is any way out of the difficulty, since the conservatory is by no means an ideal place for listening when the cold weather approaches.

Our correspondent's difficulty is one of very pronounced induction from the alternating current supply and obviously is picked up by the long loud-speaker twin-flex leads. As alternative paths for taking the leads through the house have been tried, a somewhat more drastic remedy is necessary. We would suggest that in place of the present twin-flex, lead-covered twin cable such as is often used for electric-light wiring, be employed. This should be run by a course on which the minimum interference is experienced and the lead covering should be earthed. If by this means the interference is not eliminated we are afraid that little can be done.

P. F. (LYNTON) wishes to construct a 4-Valve Receiver, consisting of one stage of high frequency, a detector and two stages of resistance capacity low-frequency amplification, which must be simple to handle and yet more selective than the ordinary direct coupled type of set, since he is troubled with interference from shipping. He wishes for a complete design, for which blue prints are obtainable as he is unable to read theoretical circuit diagrams.

For a design which will admirably meet the above requirements we would refer our correspondent to *Modern Wireless* for June, 1925. In this issue a four-valve "Tri-coil" receiver is described. This set uses the "Tri-coil" system of coupling which, although quite easy to handle is more selective than the ordinary arrangement. In this particular design a system of plugs and jacks is used which gives either two or four valves as desired. The set should give excellent service, and we do not think our reader will experience the slightest difficulty in constructing it from the diagrams and photographs given in the previously mentioned article.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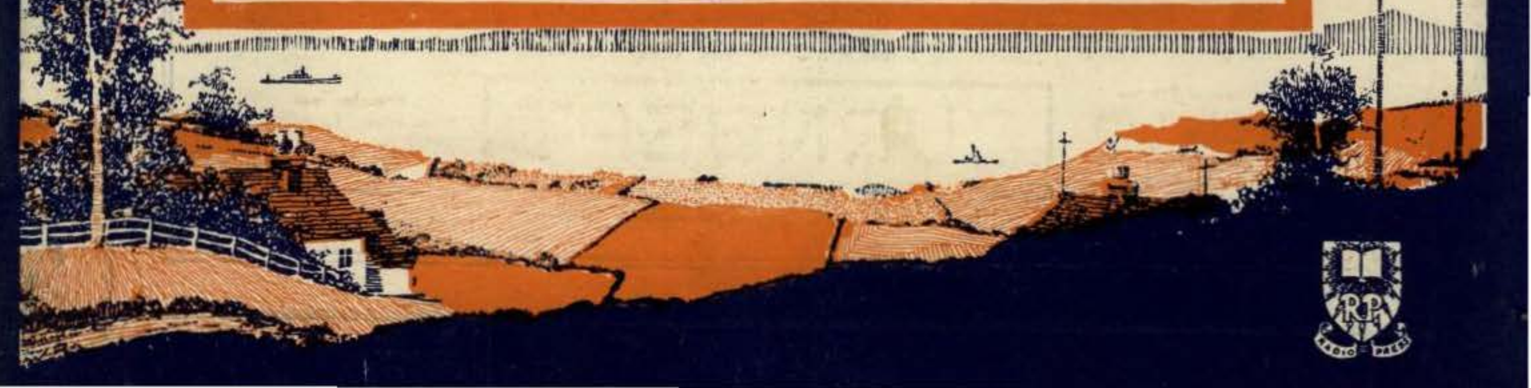
Wireless Weekly, 6d. Net. Wednesday July 15th, 1925

Wireless Weekly

Vol. 6. No. 15.



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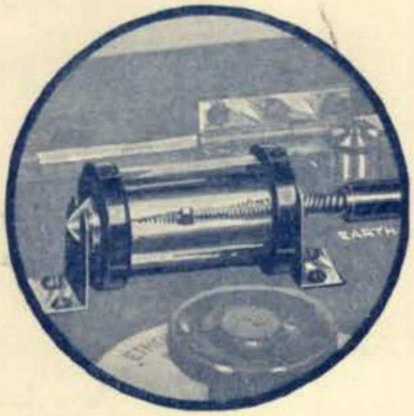

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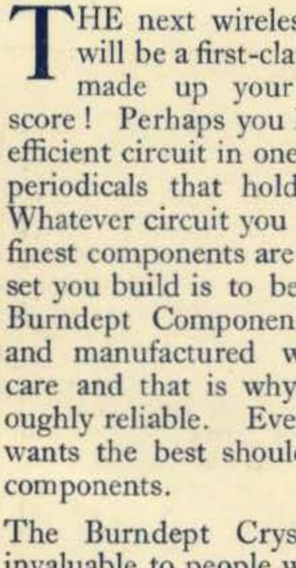

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EDITED BY JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

A Fruitful Field for Experiment

UPON a later page the reader will find an article upon a subject whose value as a fascinating field for experiments is as yet scarcely realised. Interest in the possibilities of the shorter wavelengths below 20 metres is growing rapidly, and it is by no means improbable that the coming winter will see some remarkable developments in this field, especially when it is remembered that wavelengths of five metres and others even shorter still are being made available for amateur communication in the United States.

It has been somewhat the fashion until quite recently to regard the use of these ultra-short wavelengths as being very much a matter for the expert, requiring expensive laboratory apparatus, and presenting very great difficulties in practical use. However, it has now been realised that although the difficulties are admittedly considerable, no expensive or elaborate apparatus is required, and given a reasonable amount of patience no serious experimenter need hesitate to embark upon such work.

The difficulties are, as we have said, admittedly considerable, but they are largely based upon the very different way in which things happen upon wavelengths of the order of five or ten metres, so that one of the first steps which should be taken by the experimenter who wishes to explore this field is to familiarise himself with those peculiarities which are not present in any noticeable degree upon the longer wavelengths.

For example, many experimenters have noticed that even upon the broadcast band peculiar phenomena of an absorptive nature may result if a tuned circuit such as that of a wavemeter is placed closely adjacent to a reaction receiver. This is one of the phenomena which are extraordinarily prominent upon the very short wavelengths, and it is no uncommon thing to find that when a circuit is adjusted to, say, five metres, the presence anywhere within the same room of a wavemeter circuit tuned to that wavelength will stop the receiver from oscillating. Many other peculiar observations will be made by anyone who commences experimental work upon these wavelengths, and therefore the experimenter must regard this process of acquiring familiarity with them as a necessary preliminary to any serious work.

Developments upon these short wavelengths are confidently expected in many quarters, and therefore it behoves those of us who wish to assist in maintaining our present position in the field of experimental communication to learn something of this new sphere. Much can be done along the lines of the simple laboratory experiments described in the article to which reference has been made, and until the Post Office grant licences more freely for transmission upon the shorter waves, the activities of experimenters must naturally be confined largely to work of this nature.

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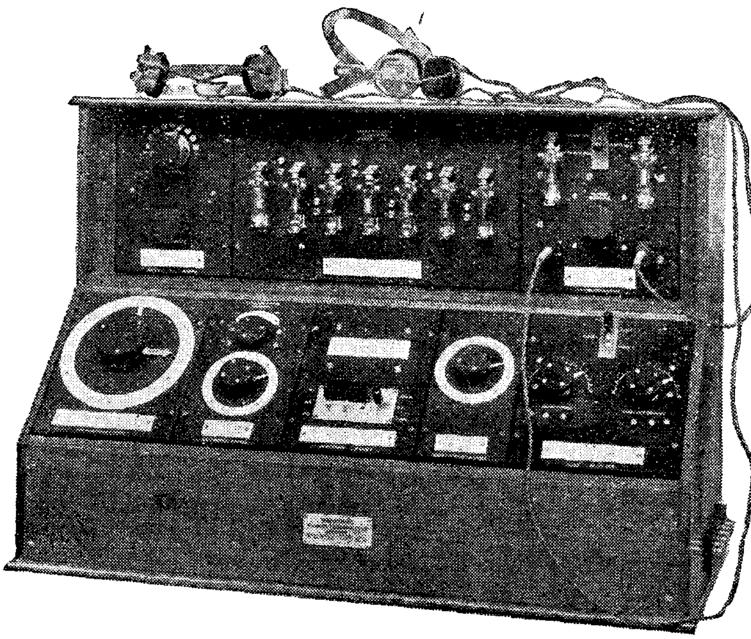
The Post Office D.F. Service*

By
J. H. REYNER,
A.C.G.I., B.Sc., D.I.C.



The Marconi type 12a direction finder in use at Niton and Cullercoats.

A RADIO direction-finding service may be provided in two ways. The first method is to provide all ships with directional apparatus and to erect, on the shore, a series of beacon stations which send out distinctive signals at periodic intervals. The second method is to equip suitable shore stations with D.F. receivers, and to give the bearing of any ship upon request.

Type of Service Adopted

Each system has its advantages and defects. Apparatus on shore is capable of giving more accurate results, partly because the equipment can be designed more advantageously, and partly because the operators can more readily be trained to become proficient since they are giving a large number of bearings each day, as against a comparatively small number on board ship. With the apparatus on board ship, on the other hand, the ship can obtain as many bearings as she pleases, and is, to a great extent, independent.

* Abstract of a paper read before the Students' Section of the Institution of Electrical Engineers.

The pros. and cons. were considered, and it was decided to install D.F. apparatus at one of the existing coast stations and to give it an extended trial. The station chosen was Niton, in the Isle of Wight, and the trial lasted

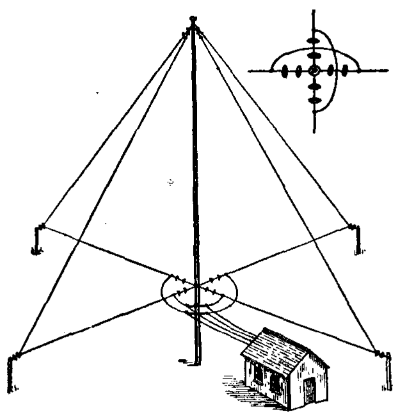


Fig. 1.—Layout of the Bellini-Tosi loops, showing the cross-over at the top and the lead-in arrangements

18 months, during which time bearings were given free to any ships that asked for them.

At the end of this time it was decided that the provision of a D.F. service on such lines would be satisfactory, and the equipment of other stations was put in hand. The Cullercoats station followed shortly afterwards, and arrangements are in hand for the provision of stations at Wick, Grimsby, the mouth of the Thames, and South Wales. There is already an Admiralty station at the Lizard, which is giving a D.F. service in that region, so that the whole of the coast line will be served by this chain.

Description of Apparatus

The essential apparatus required for direction finding is

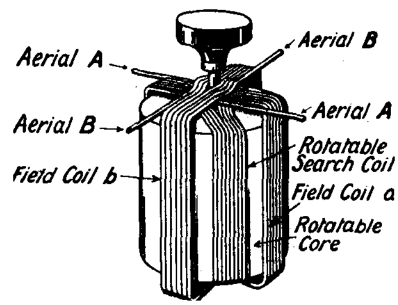


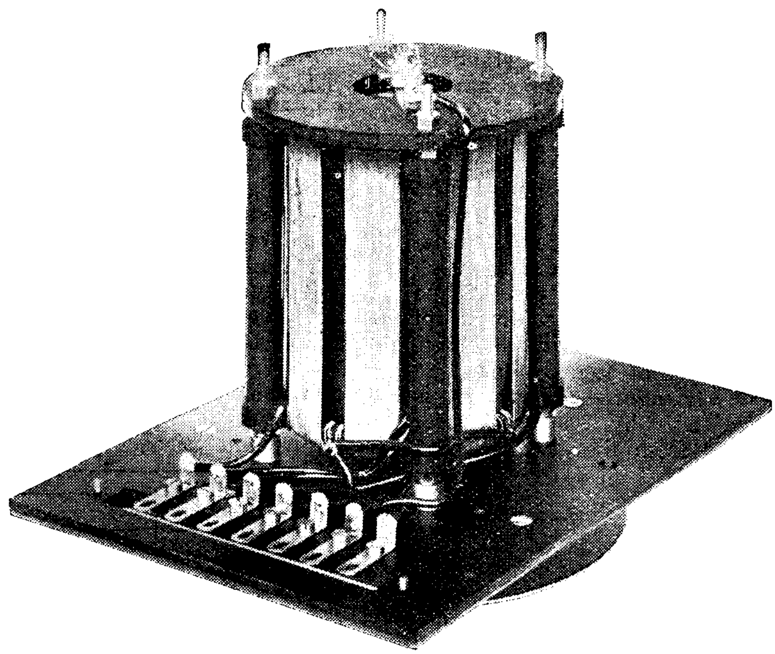
Fig. 2.—The arrangement of the radiogoniometer coils.

simply a frame aerial, which is rotated until the signal strength is zero or a minimum. As is well known, the frame is then at right angles to the direction of propagation of the wave, i.e., the bearing of the station. The apparatus employed at the post office stations is of the Bellini-Tosi type, in which the simple rotating frame is replaced by a system of two large frames at right angles, the rotation being effected electrically.

Aerial System

Two triangular loops, 70 ft. high and having 140 ft. bases, are erected accurately and symmetrically at right angles, as indicated in Fig. 1. The leads from these loops are connected to the field

Some notes on the first two stations equipped by the G.P.O. with apparatus for providing a regular Direction-finding Service, giving an interesting account of the precautions that are taken to ensure accuracy.



A view of a radiogoniometer, illustrating the actual construction.

coils of a " radio-goniometer " (radio angle measurer). This instrument comprises two field coils mutually at right angles, with a rotating search coil in the centre. Fig. 2 illustrates the construction of the instrument.

Operation of Radiogoniometer

Each of the large loops will pick up signals as a simple frame; any electric wave passing the system will thus induce currents in both the loops, the relative values depending on the direction from which the signal is coming. These currents, in turn,

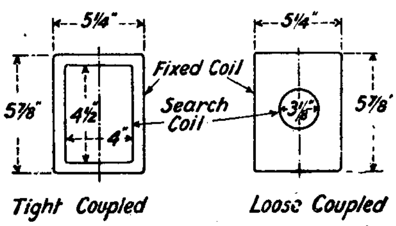


Fig. 3.—Dimensions of radio-goniometer

will pass round the field coils of the goniometer, and will induce currents in the search coil inside.

Now it will be clear that if the search coil is rotated, the extent to which it picks up from the field coils will vary, the more it is affected by one coil the less being the effect of the other.

Zeros Produced by Electrical Rotation

There will be a position where the effects of the two field coils cancel out, and there will also be a position where the effects are additive. Consequently, as the search coil is rotated the signal strength will vary from a maximum to zero. Actually in a complete rotation there are two zeros 180 deg. apart, and two maxima in between the two zeros.

Moreover, it will be obvious that the position of the search coil in the zero positions depends on the relative values of the currents in the field coils, and this has been seen to depend primarily upon the direction from which the signal is coming.

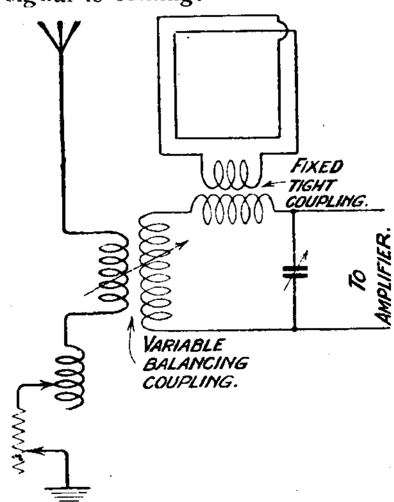


Fig. 4.—The circuit for obtaining a " sense " balance

Hence the rotation of the search coil has the same effect as the rotation of one of the large loops, thus obtaining the signal strength due to the large loops without the unwieldiness which would accrue if the loop were mechanically rotated.

Tuning Arrangements

When this system was first produced by Bellini and Tosi (whence the name) the two loops were each tuned, and the search coil, which was also tuned, was only coupled very loosely. This system has now given place to the untuned system which is both simpler to adjust and less liable to errors caused by mistune, or the swinging of the loops in the wind, and such-like causes.

In the untuned system the loops themselves are untuned, and the search coil is tightly coupled to the field coils, being nearly as large as the field coils themselves. Fig. 3 gives an idea of the dimensions of the two types of goniometer. The untuned system requires slightly more amplification, but this is not a serious disadvantage.

The search coil circuit is tuned and coupled to a " jigger " circuit, which is also tuned, the voltage on the condenser of this circuit being applied to the input of the amplifier. This extra tuned circuit is inserted to improve the selectivity of the set, and is very necessary at coast stations where the jamming is heavy during a busy period.

Amplifier

The amplifier is a standard Marconi type 55 amplifier having six stages of untuned high-frequency amplification, only three of which are normally required, and an anode rectifier. The intervalve coupling is in the form of a resistance wound transformer: the two windings, which are wound one on top of the other, are of 1,300 turns of 47 S.W.G. Eureka wire, and have a resistance of 30,000 ohms.

The transformer coupling is augmented by a condenser coupling from the anode of one valve to the grid of the next. This condenser has a value of .001 μF. Following this amplifier are two optional stages of note magnification. Fig. 5 gives the complete circuit.

This system of amplification gives uniform amplification over a fairly wide band of wavelengths, in this case from 300 to 3,000 metres. The amplification per stage is of the order of 1.5 or 2, which is good for an H.F. system. All the selectivity required is obtained in the preliminary tuning circuits.

Determination of "Sense"

It has been seen that the signal strength is zero when the frame is at right angles to the direction of propagation of the wave. Obviously, however, there are two positions of the frame, 180 deg. apart, in which this condition will be fulfilled. Consequently, a ship at 45 deg. will give a bearing of either 45 deg. or 225 deg., and it may be impossible to say which of these readings is the correct one.

It is thus necessary to determine the "sense" of the bearing in some convenient manner, and for this purpose the well-known *heart-shaped diagram* is employed.

It has been seen that in addition to the two minimum positions there are two maxima midway between the zeros. Now it will be obvious that although these maxima are of equal strength, the direction of the current at any instant depends upon which side of the frame the transmitting station lies.

The current in an open aerial, on the other hand, is independent of the direction of the wave. If, therefore, the secondary circuit is coupled both to the frame and to the aerial, as shown in Fig. 4, the two effects can be made to cancel each other out in one direction, while for a position 180 deg. away the frame current will be in the opposite direction and the two currents will combine to give a maximum.

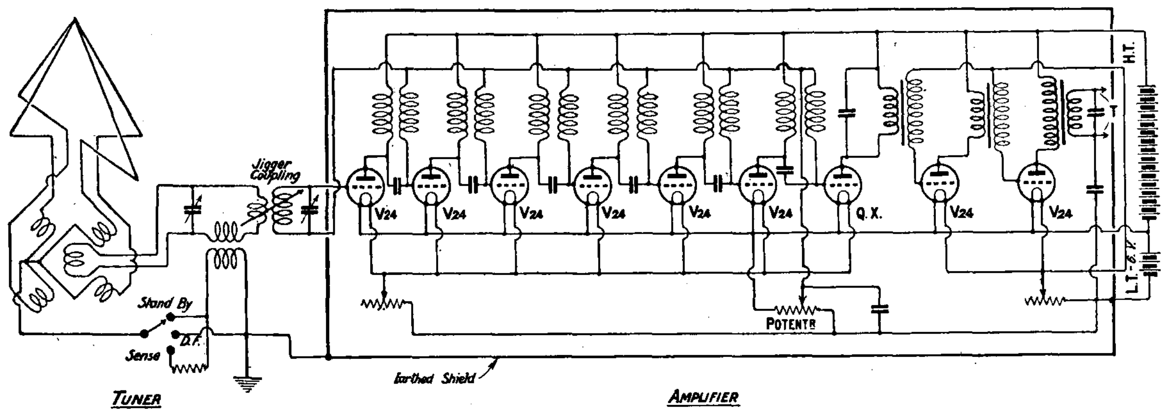


Fig. 5.—Circuit diagram of the complete equipment. Note that the amplifier is enclosed by an earthed shield.

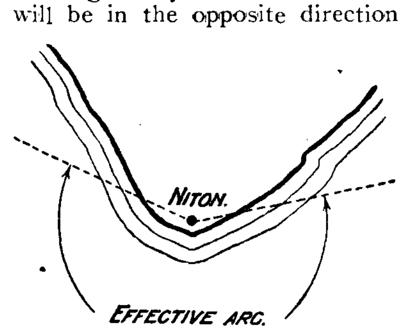


Fig. 6.—Illustrating effect of coast line on the effective arc.

"Sense" Pointer

In this way a definite "sense" indication is obtained. It will be observed that this minimum is obtained with the frame in the maximum position. An auxiliary pointer is therefore added at right angles to the main pointer in such a direction that when the balance is obtained this "sense" pointer indicates the region of the true bearing.

The circuits are adjusted once for all to give a rough balance when the instrument is first manufactured. The minimum obtained is not sharp, but is quite definite enough to discriminate between the two possible directions 180 deg. apart.

Switching Arrangements

It will be seen later that to avoid errors due to vertical reception the middle points of the frames (actually the mid-points of the field coils on the goniometer) are earthed. The four loops lumped together in this manner constitute a good aerial, and are used for obtaining the "sense" balance.

The instrument is fitted with a three-position switch, the positions being as follows:—

(*a*) *Standby.*—The aerial is coupled to the secondary and swamps the frame effect so that the set receives equally well from all directions.

(*b*) *D.F.*—Here the mid-points of the loops are connected direct to earth, and the bearing of the station is obtained by means of the goniometer.

(*c*) *Sense.*—On this position the aerial is coupled to the secondary as with position (*a*), but a resistance is inserted. This reduces the strength on the aerial to the same order as that on the frames, and the "sense" balance previously described is obtained.

The complete circuit is given in Fig. 5, while a view of the instrument itself appears at the head of this article.

Direct and Vertical Reception

Any direct reception of the signals on the amplifier will cause signals to be received irrespective of the position of the goniometer, and this will destroy the sharpness of the minimum in the zero positions. To avoid this effect all the tuner and amplifier circuits are mounted in separate copper-lined compartments, the screens being earthed.

Vertical reception is the aerial effect referred to above, to avoid which the mid-points of the field coils of the goniometer are earthed. Any currents picked up by the frames acting as aerials then pass through the two halves of the goniometer in opposite directions, and so the effects cancel out. If any " vertical " is present the two minima obtained on the goniometer are not 180 deg. apart, and this constitutes a ready check on the accuracy of a bearing.

Method of Taking a Bearing

To take a bearing, the set is tuned in to the signal, and the radiogoniometer is rotated rapidly to note the approximate zero points. The " sense " of the bearing is then obtained, as previously described, after which the actual zero points are obtained accurately by taking small swings on either side of the minimum point, noting the readings at which the signals are of equal strength. The mean of the two readings is the actual zero. This method has to be adopted because the zero itself is indeterminate over several degrees.

As well as the true bearing, the reciprocal bearing (180 deg. apart) is observed in the same way, and 180 deg. added or subtracted as required. The two bearings constitute a pair, and should agree to within 2 deg. A greater discrepancy indicates the presence of " vertical," and the bearing is not considered accurate.

Careful Training Essential

As many complete pairs as possible are taken in the time available (usually one minute), and the final bearing is taken as the mean of the whole. It will be appreciated that the taking of a bearing requires a certain skill, particularly in the presence of jamming, which is nearly always stronger on one side of the zero than on the other. This renders the gauging of equal strength very difficult, but a well-trained operator will obtain remarkably consistent results even through heavy interference. The operators are trained for about three months before the station is opened for commercial working.

Calibration

From economical considerations it is desirable that the direction-finding service shall be carried on simultaneously with a ship and shore service.

The majority of the existing stations, unfortunately, are not ideally situated from a direction-finding point of view.

The requirements for a good D.F. site are flat country, free from trees and shrubs in the immediate vicinity, and the coast line in the neighbourhood should be regular and, if possible, convex, as indicated in Fig. 6, which shows the position of Niton.

Bearings are not reliable if they make an angle of less than 20 deg. with the coast line; hence if the coast line is at all concave the effective arc is very small.

In other respects Niton is a poor site, the land being steeply shelving and generally hilly, while there are many trees in the neighbourhood. Moreover, the radio station is next to a coastguard station, which has several flagstaffs, iron bridges, and other objects which cause interference.

It was decided, therefore, to make a careful calibration of the D.F. gear over the whole of the effective arc. A ship was employed to steam round the arc and bearings were taken every few degrees. At each point the true bearing was obtained by visual observation with a theodolite, so that the error of the D.F. gear could be obtained.

Results Reliable

It was found that the error curve, though somewhat irregular, was constant, and a correction chart could be drawn up, showing the true bearing for each apparent bearing given by the D.F. set, and the corrected bearing has been found by experience to be correct to within 1 deg. in the majority of cases.

A similar result was obtained at Cullercoats, near Newcastle. Here, again, the site was not ideal, but a calibration was effected with the result that the

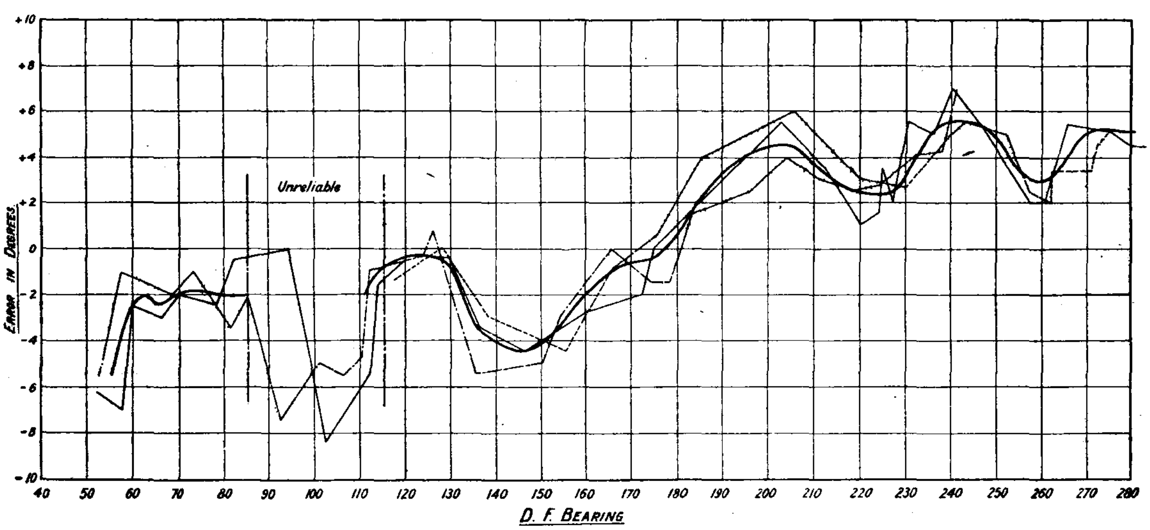


Fig. 7.—The error curve at the Niton D.F. station.

station is now giving a reliable service.

Analysis of Error Curve

The actual correction curve for the Niton station is shown in Fig. 7. It will be observed that within 20 deg. of the coast the error is large and variable. Over the effective arc, however, the difference between any point and the main curve does not exceed 1½ deg.

It is also interesting to note that the several "humps" on the curve can all be explained with reference to the local conditions. There is a comparatively large main error which varies between −4 deg. at 145 deg. and +4 deg. at 235 deg. This error, being alternately positive and negative each 90 deg. or quadrant, is termed a "quadrantal" error, and is due to the main aerial of the station, which, although disconnected, still has a slight effect.

In addition to this, there are several minor deviations, which are due to objects in the vicinity.

Fig. 8 is the error curve obtained at Cullercoats. It will be seen to be of the same form as that of Niton, viz., a main "quadrantal" error with minor deviations due to local interference.

The fact that the curves can be explained in this manner is further evidence that the deviations may be considered as remaining constant. Practical experience indicates that this is true, and the calibration may be taken as reliable. In order to ensure accuracy, however, the calibration is re-checked every six months, thereby providing a sound and reliable D.F. service.

Coast Refraction

In the case of Niton, the reliable sector finishes, on the eastern side, at about 110 deg. This leaves a somewhat large sector, viz., 50 deg. to 110 deg., in which D.F. bearings cannot be given. This sector, moreover, includes the entrance to the Spithead, an area in which bearings would be useful in time of fog.

This sector, therefore, was further examined, and it was found that the bearings again became reliable in the region of 80 deg., so enabling the calibration curve to be extended for another 30 deg.

This extra portion, from 50 deg. to 80 deg. is subject to a more or less constant error due to *coast refraction.* The waves in this case have to cross the coast line in order to reach the radio station, and in so doing are slightly deflected.

An Analogy

The phenomenon is analogous to the well-known refraction of light. If a pencil is placed, at an angle, in a glass of water, the pencil appears to bend at the point where it enters the water, due to the refraction of the light waves.

It should be observed, however, that the bearings are not reliable until the waves definitely cross the coast line. While they run along the coast at any angle within 20 deg., the errors are large and variable.

Conclusions

These results give rise to two important conclusions:—

(1) An apparently poor site may be capable of providing a reliable D.F. service if suitable precautions are observed.

(2) An apparently good D.F. site may contain unexpected sources of error. These errors may be, and usually are, small, but a calibration over the effective arc is essential if a reliable service is to be provided.

The author desires to thank the Post Office authorities for permission to publish this information.

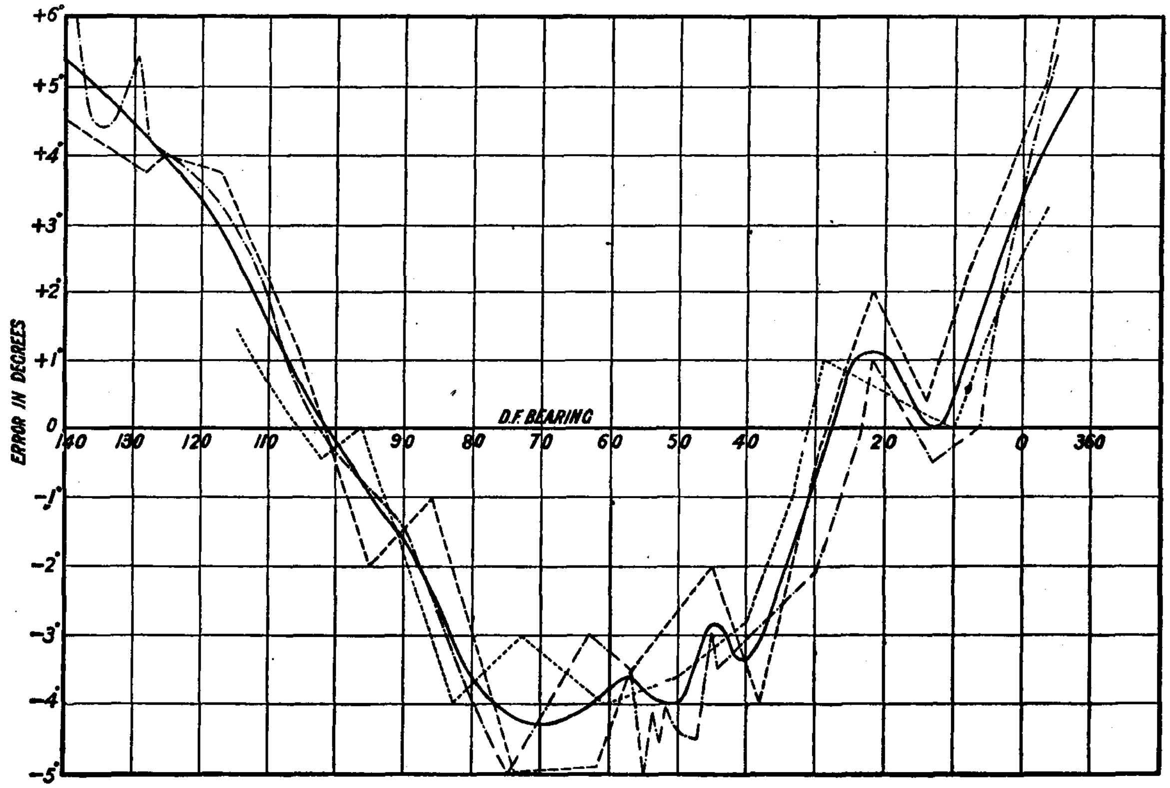
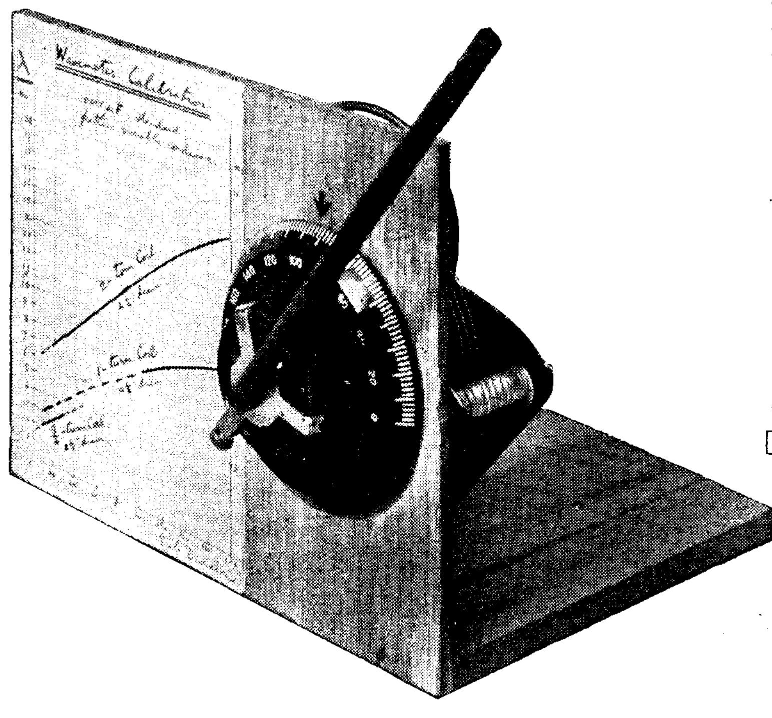


Fig. 8.—Error curve at the Cullercoats D.F. station. Compare this with Fig. 7.

Experimenting with the Ultra-High Frequencies

By A. D. COWPER, M.Sc., Staff Editor.

An article describing the author's experiments with an adaptation of the Hartley circuit in a receiver for the ultra-short wavelengths.



The wavemeter used by Mr. Cowper in conjunction with his experiments described in the text.

MUCH amusement and some useful instruction can be gained by experiments with the very short wavelengths which, experience shows, can be actually reached with great ease. All honour must be given to the amateur pioneers who first explored this field and tackled successfully the many unexpected difficulties met with; but actually it is absurdly easy, given a little patience and ordered

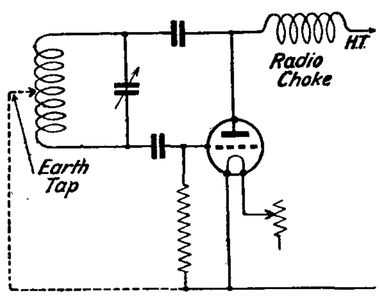


Fig. 1.—When valve and tuning capacities are additive, it may be difficult to maintain a favourable L/C ratio when small coils are used.

imagination—together with the usual resources of the experimenter's "junk-pile" and apparatus cupboard—to make a valve oscillate on well below 12 metres wavelength. Actual power transmission is, of course, a different story (and requires, in any case, the regular official licence), and there are not any transmissions of particular interest to the average broadcast listener to be picked up on these wavelengths. There are, however, many laboratory experiments which can be tried on low power, of an interesting and often very surprising nature, and without any regular aerial or earth connection which might constitute a regular "transmitter," and therefore might fall under the official ban.

The writer showed recently (*Wireless Weekly*, Vol. 6, No. 8) how a receiver, which could be made to oscillate to receive C.W. signals by the autodyne method, could be readily set up, available for well below 20 metres. A

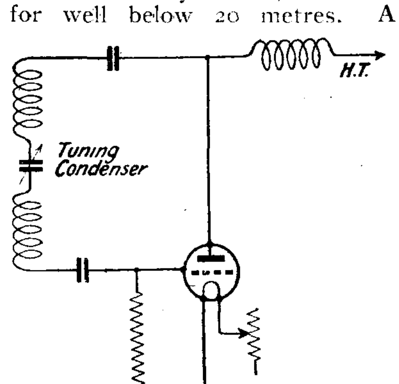


Fig. 2.—The insertion of the tuning condenser in the middle of the inductance results in greater ease of oscillation.

Reinartz type of circuit was used, with (for 20 metres) a six-turn coil, with middle earth-tap, of No. 14 bare copper wire, about 4 in. diameter; or (for down to 11 or 12 metres) a coil of four turns with middle tap can be used conveniently. With a D.E.5B (of high M value), or a small power valve of the L.S. type, such a circuit oscillated with great ease if given ample H.T.

Reduction of Casual Valve Capacities

But to get very much lower than 12 metres it appears desirable either to reduce the casual capacities in the valve by removing the cap, or by using special valves; or alternatively to reduce the *effective* tuning capacities by using a series tuning condenser in place of a parallel one across the whole or part of the inductance. In the normal Hartley or modified Reinartz type of circuit (Fig. 1) valve capacities are directly added on to the other capacity, so that it is difficult to maintain a favourable inductance capacity ratio when using the small coils of 1-4 turns needed on these ultra-short waves. With a series condenser inserted in the middle of a Hartley inductance (Fig. 2), conditions are much more favourable, and the circuit will oscillate, with the powerful direct reaction-effect characteristic of the original Hartley circuit, with the greatest ease and with a very small tuning inductance. This general type of modified Hartley circuit has been used with considerable success by American experimenters in the 5-metre belt, and is officially recognised for amateur transmission in America, in a slightly modified form and under the name of the "Hartley-Reinartz" circuit. Various modifications of it have been described by Reinartz recently.

Simple Apparatus

One fascinating feature of extremely short-wave work is the great simplicity and economy of the apparatus that is necessary, or even expedient, to obtain results. Thus all that is necessary to set up the ultra short-wave circuit (with dimensions corresponding roughly to one of Reinartz's recent 5-metre transmitting circuits, but suitable both for reception and for such laboratory experiments as those suggested here), shown in Fig. 3, is a valve-holder, a D.E.5B or small power valve, 60 to 120 volts H.T., one fixed .0001 μF, and one variable .0001 μF condenser with ebonite ends, a low-capacity double condenser or alternatively a two-plate condenser with wide spacing and very low minimum, a few feet of bare No. 12 wire, and some thin wire for radio-chokes, together with a gridleak and a few odds and ends from the "junk-pile."

Construction

No elaborate mounting is necessary; the bare wire 2-turn inductances are mounted in close coupling directly on the condenser terminals, all connections being made as short as physically possible. Thus the grid condenser itself forms a major part of the grid connection to the lower inductance; the inductances stand up in the air above the tuning condensers, the latter being, of course, provided with extension handles. The baseboard type of "hook-up" is called for in such work; a cabinet is both unnecessary and harmful. The wavemeter, if used (though without elaborate work in calibrating this by the harmonic method from a short-wave heterodyne wavemeter, which becomes increasingly difficult and precarious so low down; or by the physical laboratory method of the "Lecher Wires," results will be only comparative) is simply a single turn of thick copper wire, about 4 in. diameter, mounted on the terminals of a low-minimum .0003 or .0005 μF tuning condenser.

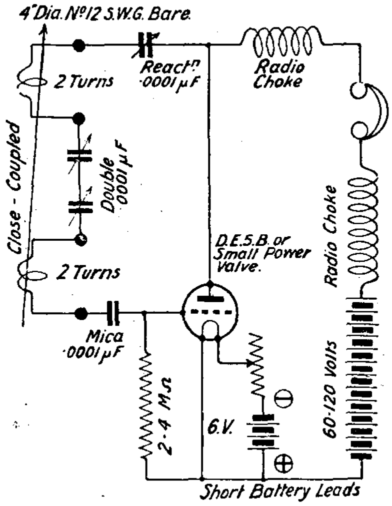
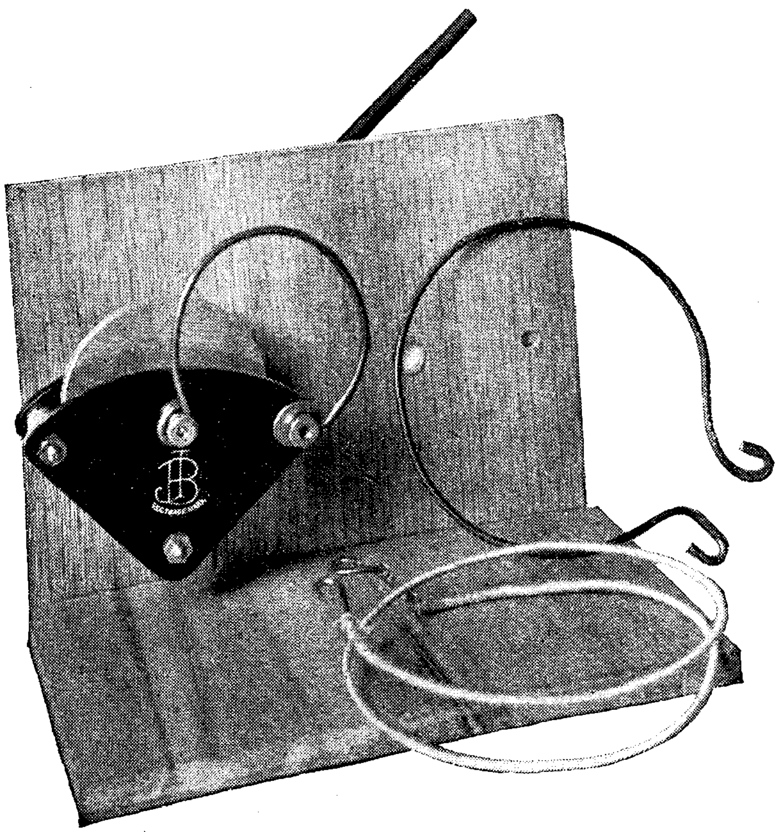


Fig. 3.—Giving the details and values for a receiver, designed to operate in the region of 5 metres.

Short Leads and Radio Chokes

Very short leads are necessary for battery connections; if these are of any length, radio-chokes should be inserted in each, and in any case in the 'phone connections. These chokes are merely small inductances made up with minimum distributed capacity by winding a long narrow solenoid of any fine wire on a convenient former—the American experimenters use largely a common lead pencil as former, with a score or two of turns of fine wire, single layer. An ordinary honeycomb type of large inductance is useless for this purpose. Generally, a radio-choke is specified in series with the gridleak for transmission, but for such small-scale experiments it does not appear necessary.



The wavemeter coils are mounted directly on to the terminals of the condenser, as shown, and are used for wavelength bands below 17 metres.

Results of Experiments

A rough hook-up, just as indicated here, gave powerful oscillation both with a D.E.5B. and a P.V.5 D.E., on 60 to 120 volts H.T. Reaction control was as smooth and easy as in a broadcast Reinartz receiver; tuning was, of course, extremely sharp on the series (double) condenser, and hand-capacity and hand-absorption effects were prodigious. The apparatus must be well isolated from casual absorption circuits, and metal objects in general. It was noticeable, when listening on the minimum wavelength, that the powerful interference experienced on 20 metres and around 12 metres from automobile ignition circuits (in particular from omnibuses and heavy lorries) was entirely absent here.

Further Interesting Tests

The type of experiments which can be tried—many others will suggest themselves to the experimenter—are (with the receiver oscillating) trying the effect of the "wave-meter" held in the hand at different distances and positions (at 2-3 feet a click should be heard when it is tuned), the effect of a loose coil of a dozen turns of bare copper wire held in the hand near the tuning inductance (when a foot or more away scratches and clicks should be heard on handling this), stretching copper wires of different lengths near, either vertically in the plane of the tuning-coils or horizontally above the latter (a six or eight-foot length of No. 12 completely stopped oscillation when brought within 2 ft., when near the minimum), and if a second circuit is available, either on the same frequency or on a close harmonic, the effect of tapping or disturbing the tuning elements of the latter can be tried, when at some feet away. Further interesting experiments can be tried in still further cutting down the inductance value of the tuning coils. A simple receiver of this type will afford, in fact, a very great deal of interest, and the lessons learnt as to the effect of casual couplings and capacities may be of great value when returning to normal broadcast waves. The experience will also serve to place in its right perspective the relative merits of the ultra-short waves for practical broadcast reception by the million.

An Illustration

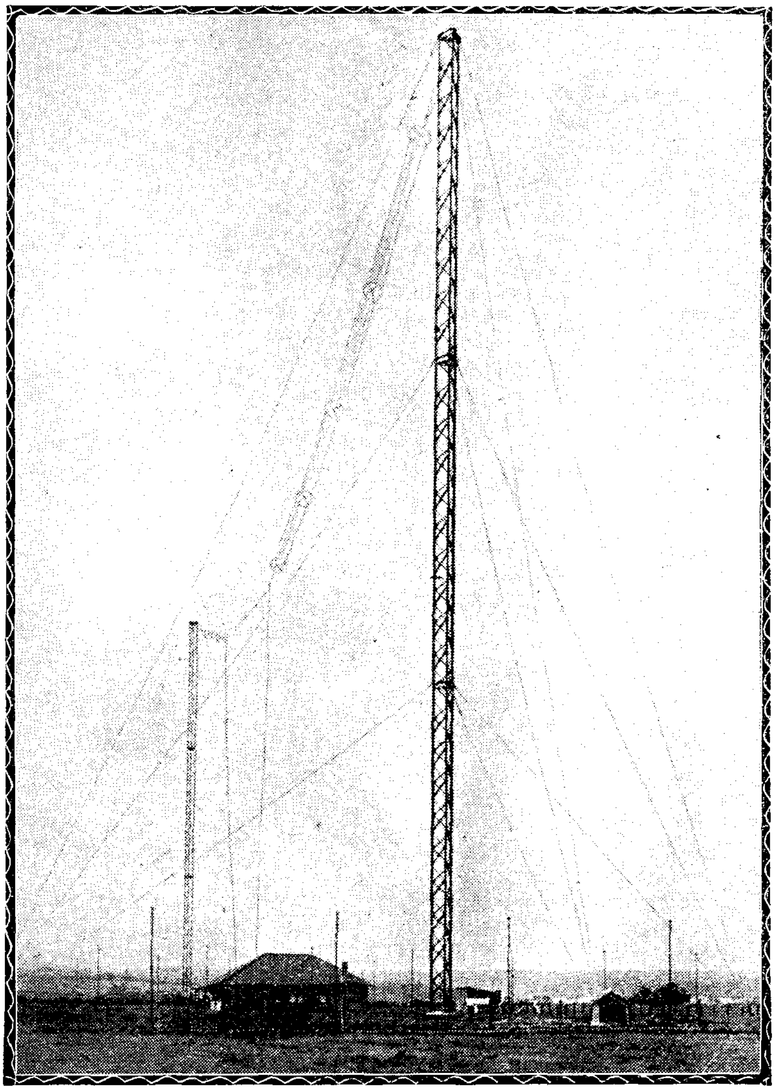
Perhaps the most vivid possible illustration of what is meant by "wavelength" is afforded by this experiment: with the circuit just oscillating at the minimum wavelength, a metal tape-measure is held in the hand whilst standing on a chair close by, and the tape is slowly paid out so as to hang near the tuning inductance and in the same plane, until the valve suddenly stops oscillating, showing that resonance has been reached. A plate milliammeter is desirable for this and other similar experiments, though the click in the 'phones serves as some indication in its absence.

The Manchester Station

A special Irish programme has been arranged at Manchester for Monday, July 27. Two Irish artists, Mr. Jerome Murphy and Miss Mollie O'Callaghan, will contribute a miscellany of serious and humorous Irish songs, and a background of typical Irish music will be provided by the 2ZY orchestra.

A programme of music, that is both good and popular has been arranged for Wednesday, July 29. On the orchestral side, pieces such as Liszt's "Hungarian Rhapsody No. 1," and Tschaikowsky's "Chanson Triste," are included.

BROADCASTING IN AUSTRALIA



The masts and aerial equipment at Braybrook used in transmitting the programmes from 3LO, Melbourne, Australia.

Aerials for Portable Receivers

By A. V. D. HORT., B.A.

Some suggestions for making up simple portable aerials which will be found compact, light in weight, and extremely easy to erect or dismantle.

PORTABLE broadcast receivers form a popular, and for many people nowadays even a necessary, addition to the day on the river or the motoring picnic. The man who is in possession of a portable superheterodyne receiver, such as that described by Mr. G. P. Kendall, B.Sc., in the July issue of *Modern Wireless,* knows that he can expect to pick up the broadcast programmes anywhere with only a small frame aerial. But this article is intended to assist those who are less fortunate in this respect—those who find a superheterodyne set beyond their means and who must perforce content themselves with two or three valves. Perhaps many hesitate over the construction of any portable set when they come to consider the difficulties of erecting a suitable aerial out in the country.

Results Obtainable

As a matter of fact, a portable aerial which will give excellent service can be easily constructed by anyone. The chief points to be borne in mind in the design are light weight, compactness when packed for carrying, and the necessity for easy erection and dismantling. Obviously, unless a car or a large party of willing helpers is available, masts more than a few feet long are out of the question. But quite low aerials will give good reception at a reasonable distance from a main transmitting station. At a picnic or on the river one does not usually desire to obtain a very large volume of sound from the loud-speaker; what is required is good reproduction at pleasant loud speaker strength, or, possibly, only sufficient strength for comfortable reception with head telephones. Such results should be easily obtained with any of the aerials to be described.

An excellent aerial system, which is light and compact enough to be carried anywhere, is made up as indicated in Fig. 1. Here the "masts" are telescopic camera tripod stands; these should preferably be made of wood, though no very great loss of efficiency is likely to result through the use of metal stands. To the top of the "turntable" of each stand is bolted a porcelain bobbin insulator. The ends of the aerial wire are permanently secured round these insulators, a few feet of the wire being left over at one end for the "lead-in." The wire, whose length may be the full permissible 100 ft., with the bobbins attached, may conveniently be carried separately from the stands, and secured in place when required by means of the bolts on the turntables. The legs of the stands should be pushed into the ground to a depth of an inch or so to make the structure steady; if the ground is too hard to permit this, or if a gusty wind is blowing, and this precaution is not sufficient, a peg may be driven into the ground immediately under each stand, and a cord tied tightly from the top of the stand to the peg.

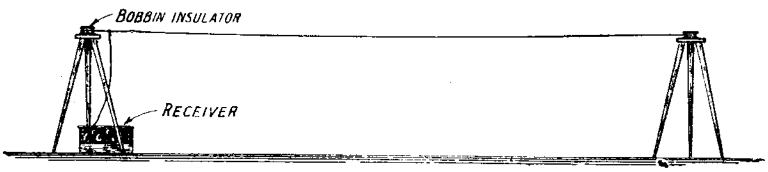


Fig. 1.—The use of two camera tripods as masts provides an easily erected aerial system.

When the aerial has been erected, it is a good plan to place the set, as shown in Fig. 1, between the legs of the tripod, in order to minimise the risk of accidental damage.

Trees as Masts

Very often it will be sufficient to provide one tripod only, the far end of the aerial being attached to a fence-post or a convenient tree. In the former case fences with iron posts should be avoided, unless the free end of the aerial is slung by a cord and insulator well away from the fence. When a tree is utilised, a cord "tail" should be similarly provided, in order that the end of the wire may come outside the branches and leaves, as shown in Fig. 2. The tree end of the aerial should be attached as high up as possible, though quite good results may be anticipated even if it is secured only a few feet from the ground. It is advisable, though not essential, to take the lead to the re-

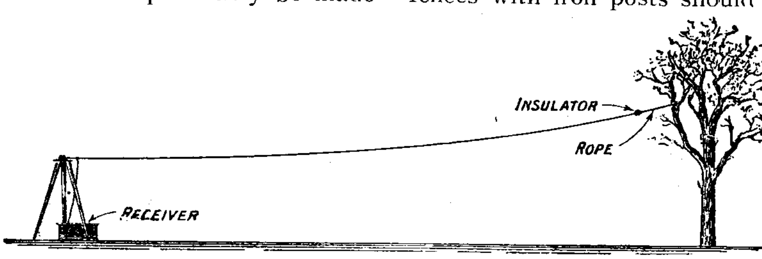


Fig. 2.—It is often convenient to make use of natural supports to obtain greater height

ceiver from the lower end of the wire, that is to say from the tripod end, in order to obtain the best results.

Alternative Masts

Another form of aerial "mast," which provides greater height than the camera tripod, while retaining the desirable feature of portability, is a jointed fishing-rod. The type of fairly stout rod used for "spinning" is most suitable, as such a rod is not too flexible at the tip for the purpose; it is convenient to use a rod which has a detachable blade or spike at the butt, as this renders easier the erection of the aerial. Any rod over about 8 ft. in length should be fitted with light cord stays a few feet longer than the rod; each of these may have a small wire hook at one end to attach it to the top ring, while the other end is to be tied to a wooden peg in the ground. To ensure perfect steadiness of the mast three stays should be provided; one, the "line-stay," is to be pegged out in line with and in the opposite direction to the aerial wire, to take the strain imposed on the rod by the weight of the wire; the other two, the "wind-stays" as they are called, are to be placed at right angles to the aerial.

If two such masts are employed, the quickest method of erection is as follows:—Fit to-

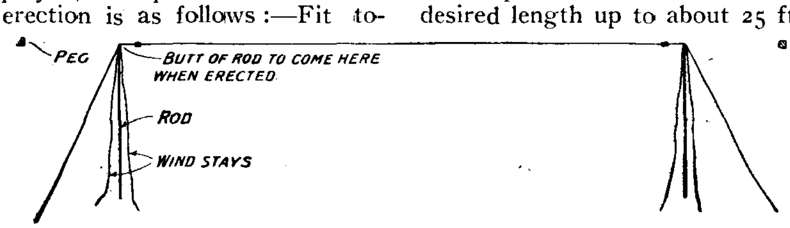


Fig. 3.—Illustrating the method of laying out the rods and aerial wire ready for erection. The wind stays are tied down the rods to avoid tangles.

gether the rod sections and attach the three stays to the top ring of each. Then lay the aerial wire out straight on the ground in the desired direction, and attach its two ends to the rod tips by means of a few inches of cord and suitable insulators, leaving a few feet loose at one end for the lead-in.

Erecting the Aerial

Tie the free ends of the wind-stays temporarily to the butts of the rods, so that they will not become tangled when the rods are raised, and drive two pegs into the ground in line with the aerial, and 8 ft. or 10 ft. beyond the end of it, as in Fig. 3. One person now takes hold of each rod, lifts it up, and places it in such a position that the wire is fairly taut; the strain is kept off the tips of the rods by pulling on the line stays. These stays are now secured to their pegs, after which the pegs for the wind-stays can be driven into the ground and the stays fastened to them at leisure. A plan view of the completed aerial is given in Fig. 4. To provide a steady structure the line-stay pegs, the rods and the aerial wire should all be in a straight line; a well-erected aerial of this type can be exposed to a heavy wind without collapsing.

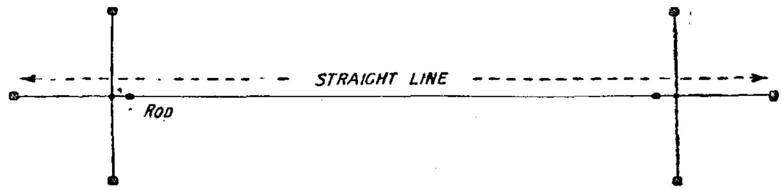


Fig. 4.—A plan view of the completed aerial system. Accurate setting of the pegs ensures a sound structure.

Greater Height

If the extreme portability and compactness of the devices described is unnecessary, aluminium mast sections, each an inch or so in diameter and 2 ft. or 3 ft. long, can be used to build up excellent masts of any desired length up to about 25 ft. Each section fits into the end of the next, overlapping it by about 4 in., or, alternatively, the sections are made to screw together, each section having a thread turned on one end and a tapped hole in the other. Metal plates, with eyelet holes in them, placed in between the sections at suitable points, provide an anchorage for the stays. Masts of this type must be well stayed to prevent buckling; if they are over about 10 ft. long when assembled, stays should be fitted half-way up as well as at the top of the mast. For reception on the shortwaves below the broadcast band, and even sometimes on the broadcast wavelengths when close to the transmitting station, a single metal mast will suffice, without any aerial wire. In this case the base of the mast should rest on a block of ebonite or even on a thickness of soft rubber, insulated stays holding it steady; the receiver is then connected to a terminal at the lower end of the bottom mast section.

Aerial Wire

For the aerial wire of the different aerial systems described, ordinary 7/22 stranded phosphor bronze can be used; but it is rather heavy for the light masts, and is frequently awkward to erect and pack up, owing to its propensity for forming loops and kinks. A more satisfactory wire is light or medium-weight rubber-covered flexible cable; this wire has the further advantage that in emergency the rubber will form quite an efficient insulator, if it is required to tie the wire direct to a tree or fence. Any insulators used should be light; a suitable type is that known as the R.A.F. ebonite insulator, which is obtainable from any dealer in surplus stores. If preferred, adequate insulation can be provided in a simple manner by drilling two holes 2 in. or so apart in a strip of ebonite, and securing the aerial wire and its supporting cord to opposite ends of the strip.

Earth Connections

A few notes on suitable earth connections may be helpful. If a river or pond is close by, an excellent earth can be ensured by connecting a length of bare wire to the earth terminal of the set and throwing the free end into the water. When this is not possible, even such a small contact surface as that provided by a knife blade pushed into the ground will often prove satisfactory. If it can be conveniently carried, a copper earth mat, which consists of a strip of fine copper wire netting about 2 ft. wide and 15 ft. long, gives as good an earth connection as can be desired; it will usually be found that the best position for the mat is immediately under the aerial, but experiments should always be made with regard to its position relative to the aerial, as this may have a considerable effect on reception. If a copper mat is not available, a length of fine-mesh galvanised iron netting may be used; but this has the disadvantage of being less flexible and not so easy to roll up into a small compass for carrying about.

Choice of Site

In selecting a site for the aerial, groups of trees and blocks of houses should be avoided if possible, especially if they are close to the aerial and situated between the receiver and the desired broadcasting station. The possibilities of directional effects, too, should not be overlooked, and the aerial should preferably be arranged so that its free end points directly away from the station from which reception is required.

Interference between Broadcasting Stations

All the chief wireless stations were represented at the International Radiophone Conference, which met at Geneva recently, under the presidency of Admiral Carpendale.

A sub-committee was formed to study the question of the redistribution of wavelengths and the various forms of telegraphic interference with broadcasting wavelengths. They are also to examine the question of securing uniformity of wavelength measurements by a systematic transmission at definite times of standard signals from selected European stations.

The conference decided that the sub-committee should be guided in its task of rearranging wavelengths by the principle that the stations which have been the longest in existence should suffer the minimum disturbance.

At present there are about sixty stations in Europe all working within wavelengths of between 300 and 500 metres. There are a number of instances of the same wavelengths being now used by several stations having a limited radius.

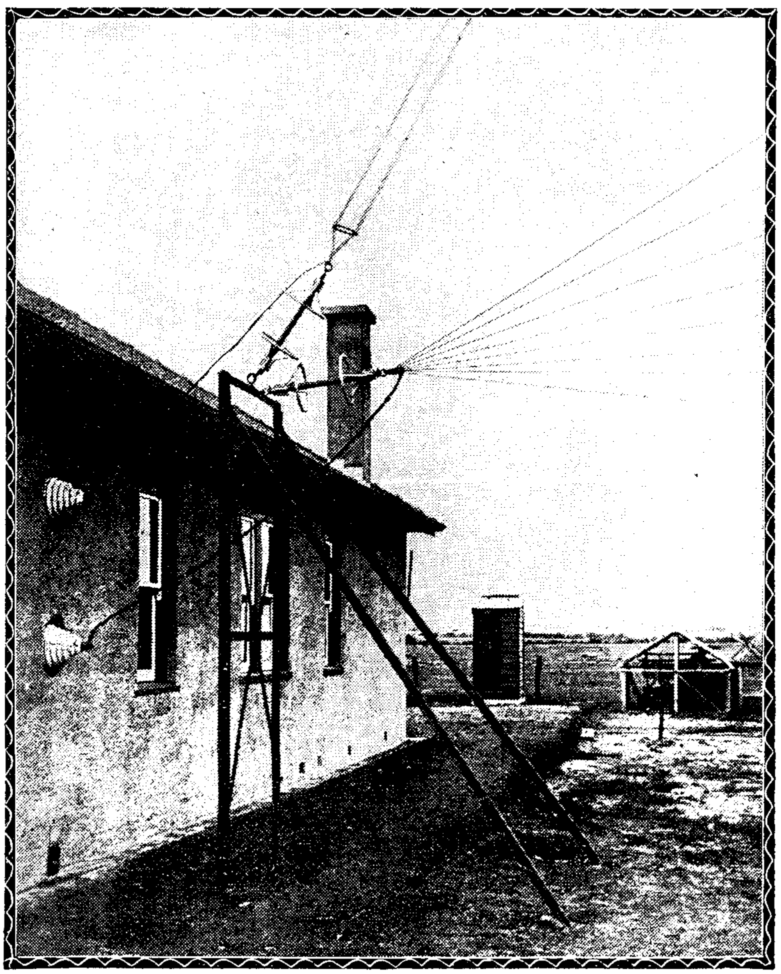
* * *

We understand that the German broadcasting station at Munich will, as from July 15, increase its transmitting power from approximately one to ten kilowatts.

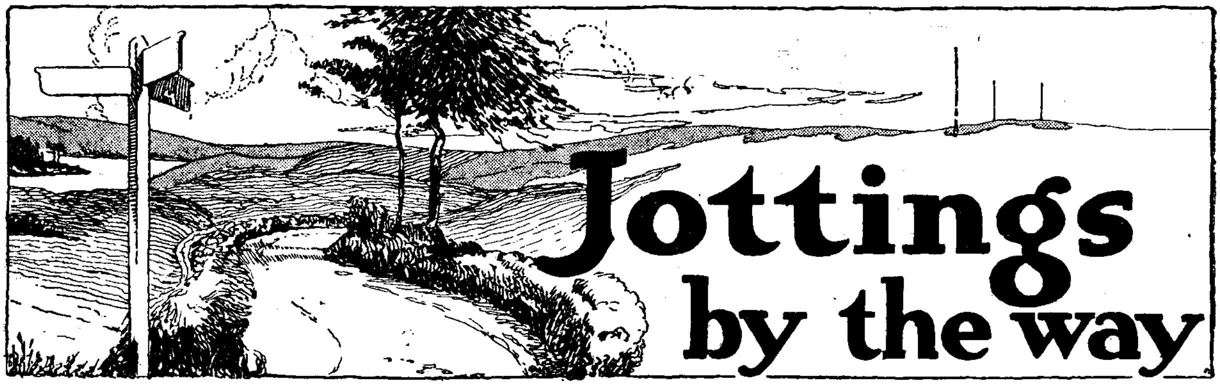
Here is the beginning of what may quickly develop into a difficult problem affecting the whole of Europe's broadcast services, unless some proper understanding can be arrived at.

* * *

Mr. E. W. Mathias, the Marconi engineer in charge of the construction of the new beam wireless station at Dorchester for communication with North and South America, has stated that there are at present five masts at Dorchester in a straight line at right angles to the direction in which communication is to be established—namely, New York. The masts are 277 ft. high, each having a cross arm at the top measuring 90 ft. from end to end. The weight of the masts is approximately 45 tons each, including the cross arm, the stays being half a ton each, and 180 cubic yards of concrete were used for each of the masts. The station would be in direct communication by land line with Radio House, the telegraphic office of the Marconi Company in London, and would be operated from there. The receiving station would be similarly connected to Radio House, so that the outgoing and incoming signals would be transmitted from and received at the same table, giving true duplex working. An important factor was that only stations situated within the angle of the beam were enabled to receive the signals.



The lead-in of the aerial and the counterpoise earth at Braybrook, where the transmitting equipment of the Melbourne Station, 3LO, is situated.



Jottings by the way

Mr. Bugsnipp Again

I TOLD you some time ago, if you remember, a little about that ancient man, Mr. Bugsnipp, who performs the process known as "doing" in my garden. In a word, it is the hand of Mr. Bugsnipp that provides my table with peas and asparagus, and new potatoes, and other "veges" of the season; it is the hand of Mr. Bugsnipp that smites well and truly the predatory slug; it is the hand of Mr. Bugsnipp that itches to twist the neck of every feathered songster that approaches the strawberry bed.

Mr. Bugsnipp straightened his back and pointed aloft with one stubby forefinger.

When I say that Mr. Bugsnipp furnishes my table with the leguminous delicacies, I am speaking of the theory rather than of the actual facts of the matter. If the truth be known, though these things should come from the garden, most of them are really showered upon me by Mr. Bugsnipp's aunt's first cousin, who keeps the greengrocer's shop just down the road, and upon whom I in my turn must shower, willy-nilly, good coin of the realm in that unfair exchange which approximates to robbery. Still, I think that Mr. Bugsnipp does his best, though sometimes I remonstrate with him gently, as I did just the other day for not enacting more copiously—or should I say more cornucopiously?—the part of Flora.

The Pointing Finger

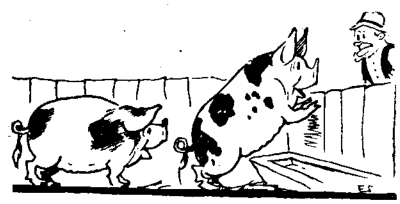
"Bugsnipp," I said, more in sorrow than in anger, "tell me: How is it that your asparagus is ever nipped in the bud or has no bud to nip? How comes it that your pea vines decline into the sere and yellow leaf before they have time to produce their delightful fruit? Why should your potatoes suffer always from some fell disease that cuts them off in their prime?" Mr. Bugsnipp said nothing. He merely straightened his back, made a curious noise in his throat, and pointed aloft with one stubby forefinger. My eye travelled up the finger and followed its line. I continued to raise my gaze higher and higher until my neck, which is not provided with mountings like those of an anti-aircraft gun, went on strike. Then I came to earth once more. "If," I said, "you are referring to the sky, it is, so far as I can see, the same sky that has always acted as a welkin to Little Puddleton. It is true that Mr. Poddleby and Mr. Snaggsby have made it ring of late with their howls, but so far as I can see even they have failed to crack it. It is a perfectly good sky."

Eerials

Mr. Bugsnipp shifted his quid of tobacco from the right cheek to the left, hoed his throat once more, and spake. "I'm not a-talkin' abaht the skoy," he remarked, "I'm a-talkin' abaht that there eerial." I became interested at once. I have never heard a discourse upon wireless by Mr. Bugsnipp, and it struck me that a little talk from him upon aerial efficiency might be most instructive. "Well," I said. "Well, what about it?" "Yus," returned Mr. Bugsnipp gloomily, "wot abaht it?"

And Weather

"Ever since that there thing's been stuck up, this 'ere gardin's been ruined. Ruined, that's wot I say. We shan't 'ave no crops so long as that there thing's where it is." "But," I asked, "how can one slim mast and one thin wire spoil your gardening operations, Bugsnipp? Surely the shade that they cause is of no account, and you can hardly say that they suffice to keep rain, when it does rain, off your asparagus bed, your peas or your potatoes." Mr. Bugsnipp again



". . . Them pigs of mine . . . Puffeckly 'ealthy they was . . ."

shook his head; he is fond of doing this. With considerable lingual agility he changed his quid from the left cheek to the right. "Wot can you expect," he inquired, "with all this 'ere wireless knockin' abaht? Fair shrivels things up, it does. Pizens the grahnd. And weather; 'ow can you expect to 'ave any weather with all this 'ere wireless knockin' abaht? That's wot I say."

And Pigs

"Jes look at them pigs of mine. Puffeckly 'ealthy they was till that young limb of mine Edward goes and rigs up an eerial. And then they goes and dies." "But," I said, "I have always heard that your pigs died because they ate the rat poison that you had put down." "Ay," answered Mr. Bugsnipp, "that's so, but they never thot o' eatin' rat poison till that there eerial was put up. Fair bewitched 'em, it did. And then there's my roomatics. Hadn't felt a twinge for months till that there eerial was put up, and then I were all fair twisted up wi' twinges."

And Tempers

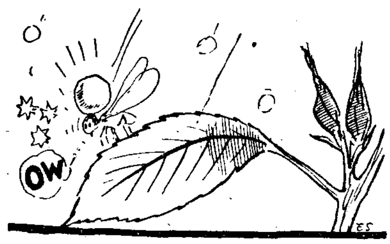
"Dear, dear," I said, "you seem to have been having a bad time. Now do you know, Bugsnipp, since you mention it, I believe there is something in what you say. This broadcasting is responsible for many things. Before it came along, for example, there was not an aerial in the place, and now just look at them. There's *one* thing that it has done. And then, you know, General Blood Thunderby used to have a beautiful temper, except, of course, when it was roused by something that happened only about half a dozen times a day. Now his sunny nature is but a memory of the dim past, and his temper, I fear, is becoming daily worse owing to his struggles with his wireless set. Possibly you have noticed it?" Mr. Bugsnipp, I should say, also does the General's garden. Shifting his quid from the right cheek to the left, he informed me that he had noticed it, and that it just showed you.

An Expert's Opinion

"But what I really want to know more about," I said, "is this question of the weather. I have seen heaps of letters in the papers showing that wireless cannot possibly influence the weather, and heaps of others proving that it does. You, Bugsnipp, who see more of the weather than I do, can help me to settle this question in my own mind once and for all." Mr. Bugsnipp performed once more his quid-shifting trick—in case you have lost count the bulge was now in the right cheek—dabbed his fork viciously into the "pizened" ground, and having once more got his throat into a perfect condition proceeded to dilate upon wireless and the weather. "It is like this 'ere," he began,

Even Green Fly

"Since all this 'ere broadcastin' started we 'aven't had no weather. It rains when we don't want it to, and when we do it don't. We 'aven't 'ad a decent frost this winter, and wot abaht 'ail?" "Ale," I said. "Well, it's rather weak, of course, since the war, but they seem to drink it all



". . . 'Ail's good for gardens. Knocks the green fly on the 'ead . . ."

right." "Nah," said Mr. Bugsnipp, "I don't mean hale; I mean 'ail. We 'aven't 'ad one decent 'ail storm this summer. 'Ail's good for gardins, 'ail is. Knocks the green fly on the 'ead, so to speak. Jes look at them roses." I looked. It was obvious that the green fly had not been knocked on the head. "But," I said, "I provided you with a most efficient squirt affair, Bugsnipp, and gallons and gallons of a particularly deadly solution. Have you not squirted?" "Reminds me," remarked Mr. Bugsnipp—it was in the left cheek

". . . General Blood Thunderby's sunny nature is but a memory of the dim past . . ."

by now—"that there s'ringe 'as broken down all along o' this 'ere wireless. Won't squirt no-'ow."

An Earth Choke

I picked up the syringe and with a pin removed a chunk of soil from its spout. "It seems to me," I said, "that the earth rather than the aerial is responsible for this break-down." Mr. Bugsnipp offered no comment.

Unseasonable Weather

"And then about the weather," I went on. "Last summer we had lots of rain, and you said you wanted fine weather. This year we have had any amount of fine weather, and you say you want rain. Last year, when we had hail, you told me that that was why there was no fruit on my apple tree. Last year, when we had frosts, you said that one could not expect to have early peas with that kind of weather. This year, when there have been no frosts, you ask me how the ground can be sweet without them. Bugsnipp, I fear that you are a fraud.

The Diehard

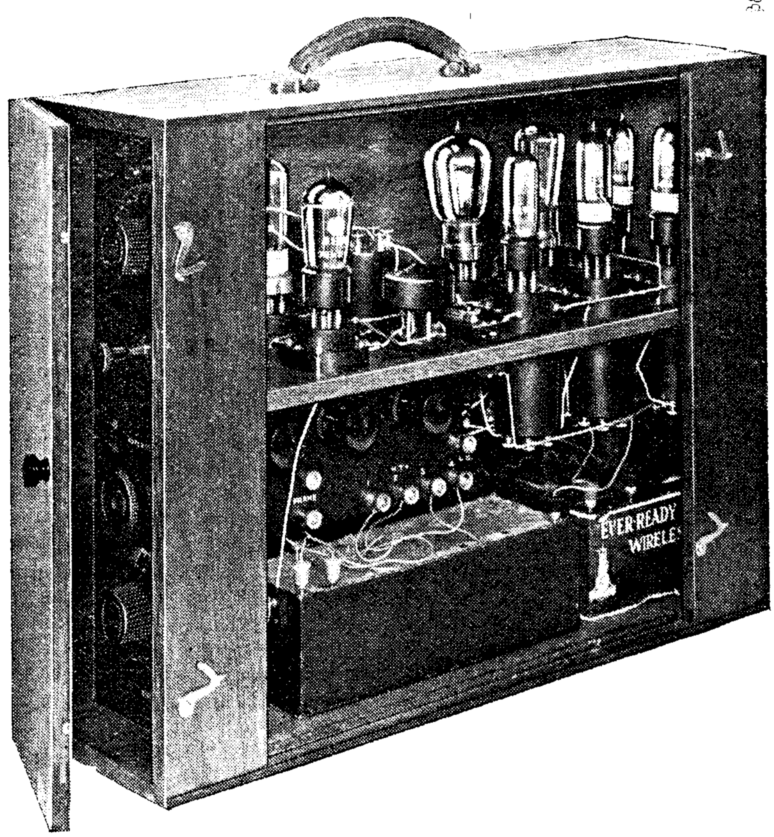
"If we had for one season the most ideal weather for gardens and beautiful crops you would shake your head and say, 'Ah, yes, it's all very well *now*, but it's ruining the plants for next year.' You would put it down once more to all this wireless." Mr. Bugsnipp annihilated a snail, and went on with his digging without further remark. "Oh-er, by the way," I said, "you know that when this new Insurance Act is passed the General and I will have to deduct fourpence, or ninepence, or something of the kind from the wages that we pay you in return for the rare and refreshing fruits with which you provide us." Mr. Bugsnipp shrugged his shoulders philosophically. He changed his quid from the right cheek to the left and looked me full in the eye. "It's all along o' this 'ere wireless," he said.

WIRELESS WAYFARER.

Getting the Most from a Super-Heterodyne

By **G. P. KENDALL, B.Sc., Staff Editor.**

Some concluding notes and hints written in an endeavour to clear up the difficulties which the operator of a super-heterodyne receiver may experience.



An eight-valve portable super-heterodyne receiver designed by Mr. Kendall and described in the July, 1925, issue of "Modern Wireless"

It may be remembered that I concluded my notes last week with a consideration of some of the general points to which attention should be directed to secure satisfactory functioning on the part of the separate oscillator valve used with many super-heterodyne receivers.

There is, however, another general type of super-heterodyne circuit in which no separate oscillator valve is used, but wherein the first detector carries out also the duties of the oscillator. A circuit in which such an arrangement is used, and which has achieved a certain measure of popularity, is that known as the Tropadyne, a form of which is illustrated in Fig. 1. Here it will be seen that the first detector includes in its circuit arrangements for producing self-oscillation, namely, a tuned grid circuit inserted between the grid of the valve and the usual grid condenser C_3, and a reaction coil coupled to this circuit which produces self-oscillation in the ordinary manner. The exact arrangement of the self-oscillating circuit and its connections to the frame circuit were devised with a view to eliminating interference effects between the tuning of the frame and the adjustment of the oscillator condenser, and the exact functioning of the circuit will no doubt be familiar to anyone who is in a position to make a practical use of these notes.

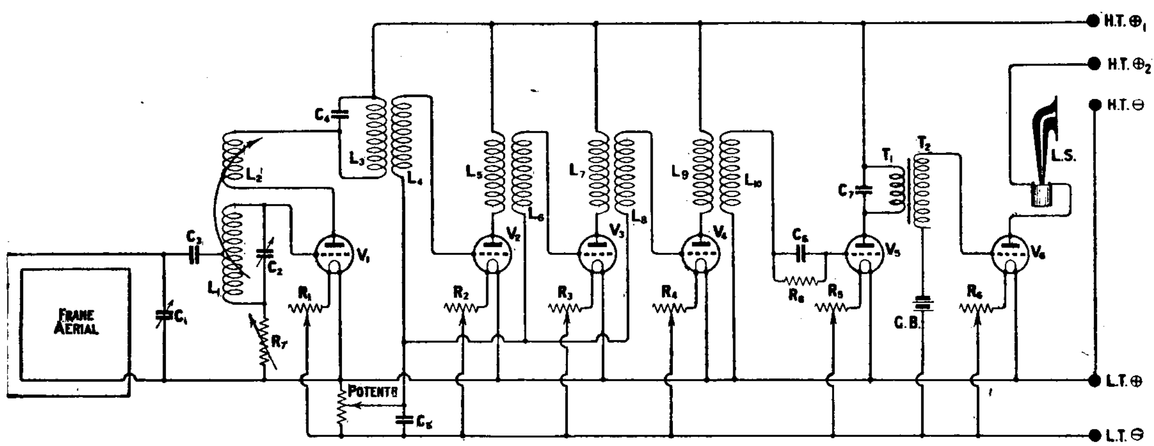


Fig. 1.—A six-valve super-heterodyne circuit in which a form of the Tropadyne oscillator is incorporated.

Adjustment of the First Detector Valve

The conditions which must be satisfied before good results will be obtained are somewhat different in such a circuit, since we must so adjust matters that the first detector shall be able to generate sufficiently strong local oscillations to produce the best results, and yet at the same time we must not unduly impair its efficiency as a detector. In most receivers employing the Tropadyne circuit the magnetic coupling between the coils L1 and L2 which produces the necessary reaction is adjustable, and proper manipulation here goes far to ensure satisfactory results from the whole set.

The Best H.T. Voltages

With every type of valve I have yet tried as the first detector in a Tropadyne circuit, the best results have been obtained by the use of a very considerably higher anode voltage than would be used if the valve were acting as a simple detector. With the smaller types of dull-emitter valves of the general purpose variety taking .06 ampere filament current, 70 to 80 volts is an average figure, while for bright emitters an improvement may be noted upon raising the voltage to 90 or 100.

With so high an anode voltage the best adjustment of the reaction coupling is usually that which only just suffices to maintain steady self-oscillation over the whole range of the oscillator condenser C2, and this adjustment should be ascertained by methods which will readily be devised after reading my next article upon testing the different types of oscillator for the presence of self-oscillation. Clicks should be heard upon touching the grid of the first detector valve in a Tropadyne receiver if the valve is oscillating, and the click will be found to be considerably louder than that which is heard with the separate oscillator type. Similarly, the chirps heard upon turning the oscillator condenser when the long wave side is oscillating may be used as an indication, but their strength will depend very considerably upon the actual layout of the set. The adjustment of the filament current of the first detector in this circuit is not critical with most valves.

Advantages of Variable Grid-leak

The grid-leak of the first detector in the Tropadyne circuit is almost always a variable one, and a certain amount of adjustment is needed to obtain the greatest convenience in working, as apart from actual best results. The variation is not very critical so far as signal strength is concerned, in my experience, but adjustment of the leak undoubtedly helps considerably in securing what is sometimes described as a " balance " about the centre tapping to the coil L1. Unless this centre or nodal point is fairly accurately located, the first detector will stop oscillating when its grid circuit L1 C2 comes into tune with the frame circuit, and this is a most annoying state of affairs in practice. Once the centre point of the winding has been located with sufficient accuracy to ensure that the set only stops oscillating over a very narrow band on the oscillator dial, say one or two degrees, the final " balance " can usually be achieved by careful adjustment of the grid-leak.

The " Second-Harmonic " Principle

Another circuit in which the first detector performs also the function of an oscillator is that known as the " second harmonic " super-heterodyne, and a simple version of this is given in Fig. 2. The general layout of this circuit considerably resembles that of the Tropadyne, but it will be observed that no steps are taken to ensure that the connection from the frame aerial is made to a nodal point upon the coil in the grid lead to the valve. The necessary independence of tuning of the frame circuit and the circuit L1 C2 being secured in another manner. This circuit is arranged to oscillate at some wavelength which forms a suitable multiple of the one which it is desired to receive, and the valve is adjusted to generate strong harmonics, one of these being used to produce the necessary beat. Usually the second harmonic is used, and hence the name by which this circuit is commonly known.

Although the circuit arrangement resembles that of the Tropadyne, I have found that in the particular arrangement of the circuit which I tried, and which I think can be regarded as a fairly general example, the adjustments of the valve differed considerably from those of the former type of circuit. As before, the anode voltage should be high, but the adjustment of the reaction coupling between the coils L1 and L2 will usually require to be fairly tight, and certainly should be increased to a point considerably beyond that at which self-oscilla-

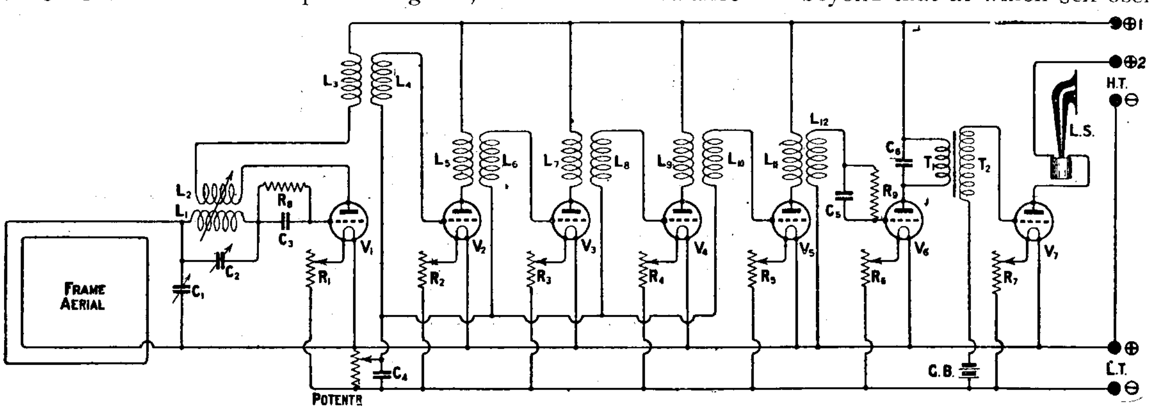


Fig. 2.—A circuit embodying the " second harmonic " principle; here, as in the Tropadyne arrangement, the first detector also functions as the oscillator. The winding L3 is often shunted with a fixed or variable condenser.

tion starts. Further, the filament current of this valve is more critical, and best results may be obtained in some cases by dulling the filament somewhat, but I do not think it possible to make a general rule regarding this point. Experiments conducted upon actual signals should be the test.

The experiment should also be tried in this circuit of taking the return lead from the grid circuit to first the positive and then the negative end of the filament, noting which arrangement gives the best results. With some types of valves I have found this point to make a considerable difference to results, and it appears to be particularly important in the case of the general purpose dull emitters of the .06 type.

The notes which I have given upon the adjustment necessary to secure proper functioning on the part of the oscillator valve in a super-heterodyne receiver by no means exhaust the subject, but I fear that it is not possible to give further details in a general article of this nature, which is intended to prove of assistance in the case of widely differing receivers. Turning now to the other sections of the receiver the first to claim our attention is the long wave amplifier.

In this part of the circuit the procedure to be adopted in making the necessary adjustments will depend to a large extent whether dull or bright emitting valves are used. In considering this part of the receiver I propose to assume that the long wave amplifying circuits are of some form employing a tuned or semi-tuned intervalve coupling, and that a sufficient number of stages is employed to ensure that the long wave amplifier will be capable of oscillating when the stabilising device is suitably adjusted.

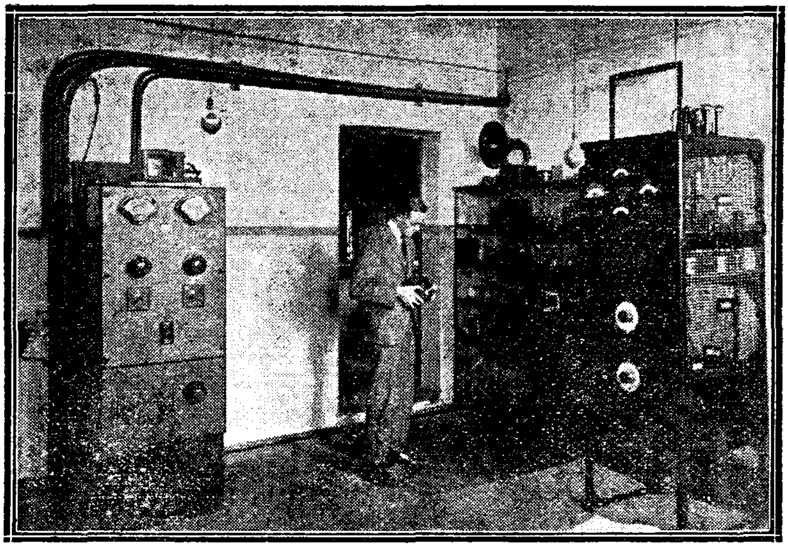
Stability of Long-Wave Amplifier

This assumption is usually justified, and in super-heterodynes of this type the adjustment of filament current and high-tension voltage upon the valves constituting the long wave amplifier is generally of considerable importance. When bright emitters are used the adjustments are not, as a rule, so critical, but in the case of dull emitters of the .06 amp. type careful experiment is usually required; with such dull emitters good results will usually be obtained by using about 60 volts on the anodes of the high-frequency amplifying valves, and adjusting the filament current with some care. In such super-heterodyne receivers as I have tried it has proved advantageous to run the filaments of these valves somewhat above the normal brightness.

In many super-heterodyne receivers a separate terminal is provided for the application of a special high-tension voltage to the anodes of the two detector valves, and when dull emitters are used, careful adjustment here will often make a considerable difference to the results. Using the general purpose .06 ampere type, with 60 volts upon the anodes of the intermediate frequency amplifiers, a potential as low as 30 volts will often prove the best for the two detectors, in circuits where the separate oscillator system is used. I am afraid, however, that it is not possible to give any really helpful definite guidance upon this point, since the procedure must vary so much in different receivers, and I must content myself with urging the reader to adjust the high-tension voltage and filament supply to the intermediate frequency amplifying valves and the first and second detectors with great care whenever dull emitters are used. These adjustments can really only be carried out effectively when actually receiving fairly weak signals, and a tip which may be found useful is to detune the *frame* circuit a little when receiving a fairly distant station and then to try and bring its signals up in strength once more by making the adjustments we have been considering.

Some Further Important Points

In these notes I have endeavoured to devote attention to those features of the adjustment of a super-heterodyne which are common to the majority of such sets, and more particularly to those which cannot be considered in much detail in a constructional article. The subject has by no means been exhausted by the preceding notes, since I have not touched upon many important points, such as the correct adjustment of the potentiometer of the long-wave amplifier for maximum signals without undue sacrifice of quality, taking advantage of the directional properties of the frame in reducing spark jamming, adjusting grid leak values, and so on. These points are more directly concerned with the actual *operation* of the receiver, after it has been correctly adjusted in the ways we have considered, and I hope to deal with them in a later issue of this journal in connection with some of the aspects of the working of the set, methods of searching for signals, and so forth.

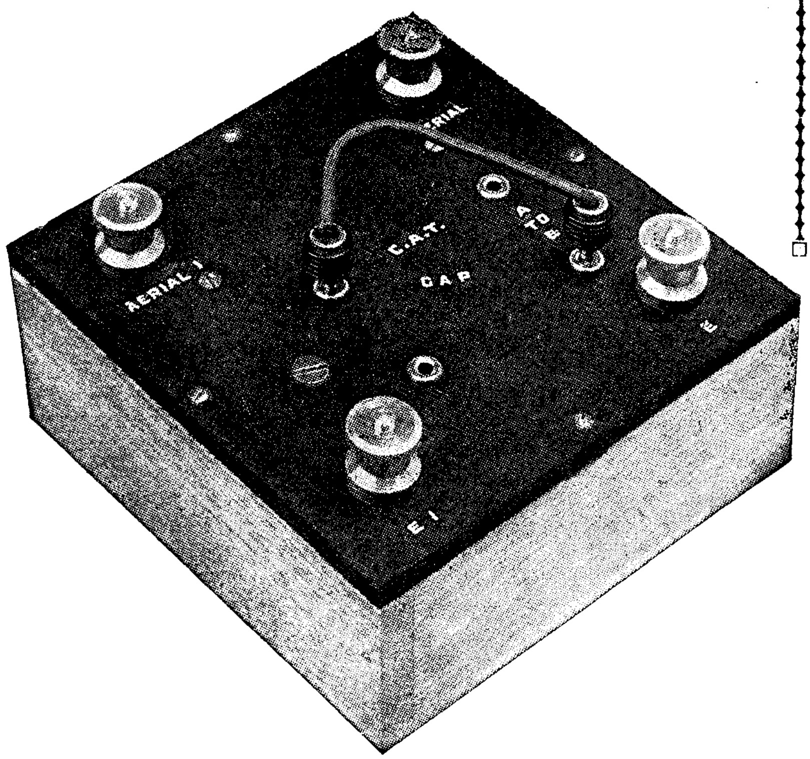


The assistant station engineer, Mr. J. N. A. Ray, of the Johannesburg Broadcasting Station, adjusting the transmitter with the aid of a wavemeter.

A Simple Protective Device

By E H. BERRY.

Some form of protective device is desired by many set-owners, in order that the aerial may be earthed during a storm. The unit described will fill the need.



The instrument, which measures only 5 ins. by 5 ins., will be appreciated by those who fear any damage to their sets during electrical disturbances.

IN these summer days, when many of the minor so-called "heat waves" terminate in a thunderstorm, the set-owner's mind is directed to a means of protecting his set from injury due to static discharges while in use during disturbed atmospheric electrical conditions, and also to the protection (by earthing the aerial) of his set during a storm or while not in use.

Here it may be emphasised that aerials are not a source of danger, and, in fact, if efficiently earthed are more likely to act as a safeguard.

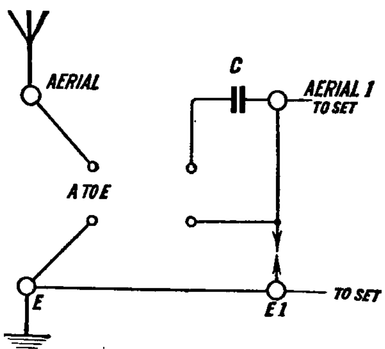


Fig. 1.—The connections used. The arrows above the point E1 indicate the spark gap.

Uses of Panel

The unit described in this article has three useful functions, two of which are of a protective character. By the simple means of two Clix terminals, it is possible (1) to earth the aerial, (2) to include a safety gap, (3) to include a safety gap and constant aerial tuning.

Components

From the circuit given in Fig. 1, it will be apparent that the components required are few. Those actually used are given in the following list, and although the make is indicated, there are other components, of course, which may be used with equal satisfaction.

One box ; 5 in. x 5 in. x 2 in. deep (Camco).
One ebonite panel, 5 in. x 5 in. x $\frac{1}{4}$ in. (Paragon).
One .0001 μF fixed condenser (McMichael).
Four 2 B.A. terminals.
Two Clix and four sockets (Autoveyors, Ltd.).
One sheet of mica, 2 in. x 2 in. (.002 in. thickness).
Two $\frac{3}{4}$-in. brass washers, 1-16 in. thick.
Radio Press panel transfers.
Square wire, screws, flex, etc.

Construction of Gap

The construction of the gap is simple. One of the washers is mounted on the screw, but prevented from making contact with it, as shown in the section drawn in Fig. 3, and this washer forms one of the electrodes of the gap, and a lug is therefore needed for soldering a connection to it, as in

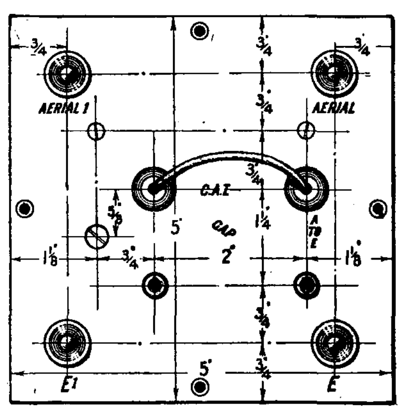


Fig. 2.—The drilling is carried out as shown. Panel transfers may be used as the lettering indicates.

Fig. 3. In this case the washer was recessed, and the lug soldered in the recess, but a lug may

be made and drilled with a hole the same diameter as the washers so as to fit over the bush. The first method of construction is neater and more satisfactory. The 2-in. square of mica is cut into four square pieces of 1 in.

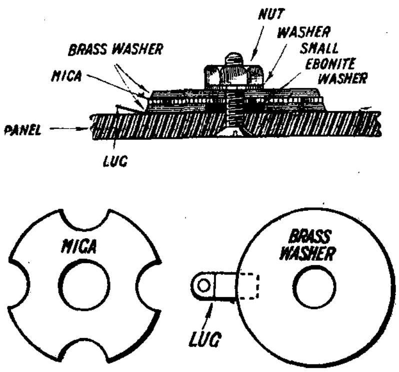


Fig. 3.—The upper drawing shows the assembly of the spark gap, while the lower one indicates details of the mica and brass washers.

side each, and one of the washers is placed on top, and the mica is then cut coincident with the washer. The mica circles are now to be punched. This was

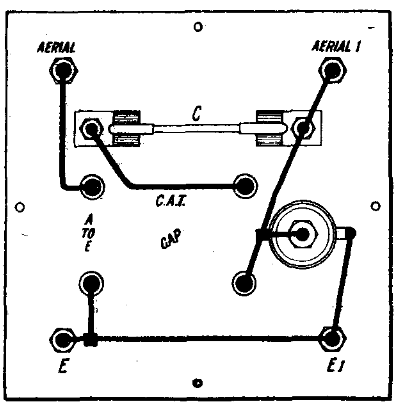


Fig. 4.—Care should be taken when soldering the connections to the spark gap contacts.

done with an ordinary punch, as used in offices for punching papers to be filed, but other means can, of course, be adopted. The mica separators (all four of which are cut and punched, as shown in Fig. 3, in one operation) are then also pushed on to the screw on top of the first washer. The top washer is now put on, and, to make good contact with this, the second electrode of the gap, a small washer is put on, and the whole then tightened up with a nut. The lug now forms the connection to one electrode, and the screw the other. The method of assembly is shown in section in Fig. 3.

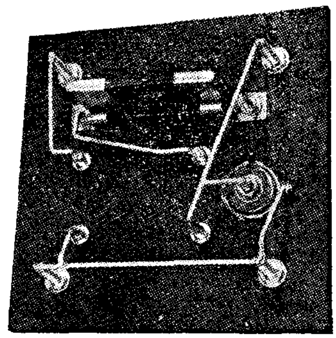
Drilling and Wiring

The drilling diagram (Fig. 2) gives the drilling centres for the holes for the necessary components; it also shows the transfers and their positions.

The wiring is extremely simple and should be carried out as clearly shown in the wiring diagram (Fig. 4). It is useful to "tin" the various points of connection before actually attaching the wiring. When the wiring is complete the panel may be screwed on to the box, and the unit is then ready for use, or, if desired, it may be attached to the wall or put in any other convenient position, and so made a permanent fixture.

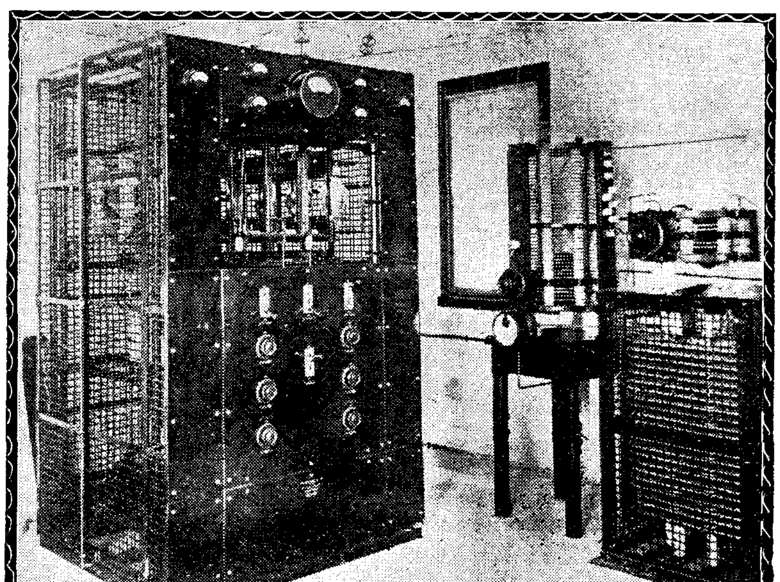
Connecting Up

The aerial lead should be connected to the terminal marked "Aerial" and the earth to the terminal marked E. A lead is then taken from Aerial 1 to the aerial terminal of the set. Another lead is taken from E1 to the earth terminal of the set. The two Clix plugs are connected together by a short piece of substantial flex, and are then used for joining any pairs of sockets as required. On connecting the two top sockets marked C.A.T. the set is protected by the arrester gap in parallel with the set, and the .0001 μF condenser is in series with the aerial, utilising the well-known constant aerial tuning system. On joining the two corner sockets, marked "Gap," diagonally, the aerial is connected directly to the set without the constant aerial tuning, but the set is still protected by the arrester gap in parallel with



The unit is extremely simple to construct, as this view of the wiring shows. Note the spark gap on the right.

it. On connecting the two sockets marked A to E the aerial is connected direct to earth, and there is then no connection to the set. From the foregoing it will be apparent that this small and compact unit fulfils a definite need, and will well repay the small amount of time and money spent in its construction.



Part of the apparatus in use at the Melbourne station. Note the closed circuit tuning inductance and the main tuning condenser on the right.

MODERN TENDENCIES IN TRA

By W. K. ALF

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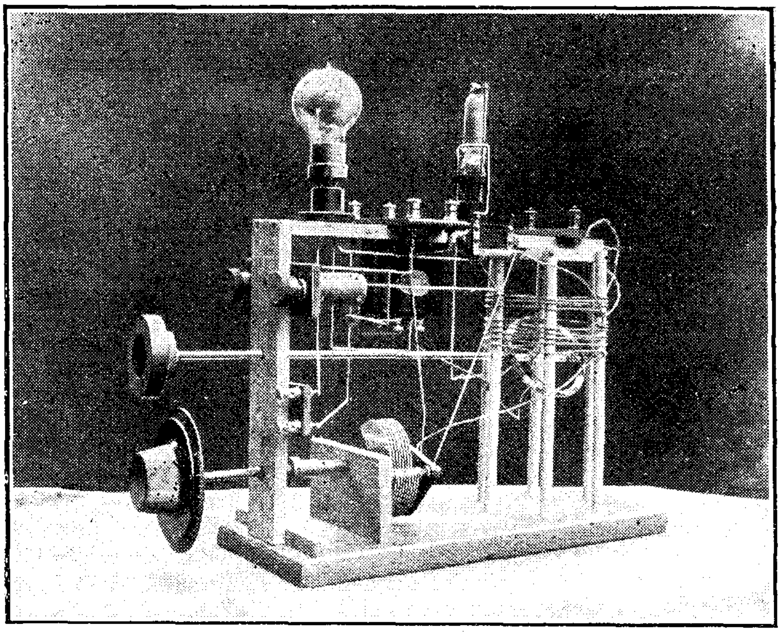
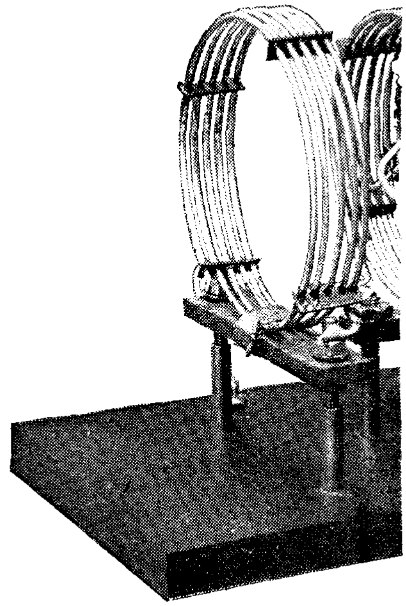


Mr. Alford's ultra-short-wave receiver. Note that the grid and anode clips have been removed from the V24 socket, the wires making direct connection with the " pips " on the valve.



Coils for medium short wave-length receiver illustrated

THE peculiarities of short waves have been mentioned previously. The outstanding facts are that wavelengths of 20 metres or so travel better by day than by night, and that signals are stronger at a greater distance from a transmitting station than nearby.

These surprising characteristics bring us down to the necessity for a simple consideration of the theory of the Heaviside layer, and the proposed amendments which have been put forward to explain the new and curious phenomena mentioned.

The Heaviside Theory

That radio waves are reflected from the Heaviside layer is, and has been, generally accepted, but no necessity has arisen until these short waves were developed for any modification of the old ideas.

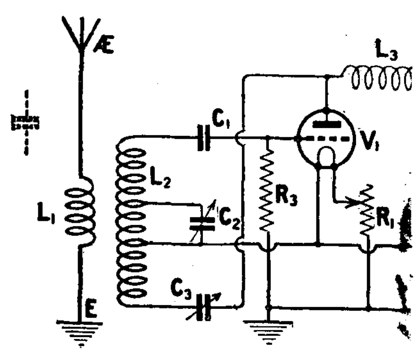
The general basis of the Heaviside theory assumes that the further one gets from the earth's surface the lower the atmospheric pressure becomes, until a height or layer is reached where the atmosphere becomes a good conductor of electrical energy.

Effect of the Sun on Ionisation

Now a good conductor is always a good reflector, and in daylight the sun's rays bring about ionisation of the air, which has the net effect of reducing the height of this reflecting surface, whereas at night less ionisation is taking place, which virtually means that the layer becomes further from the earth's surface.

These considerations bring one to the assumption that the Heaviside layer does not surround the earth in a symmetrical form, but is " egg shaped," with the " big " end towards the sun.

The whole theory has been investigated very fully in a practical way by that well-known American experimenter, John Reinartz, and he puts forward



A typical receiving circuit for sho in the text, a range of 17 t

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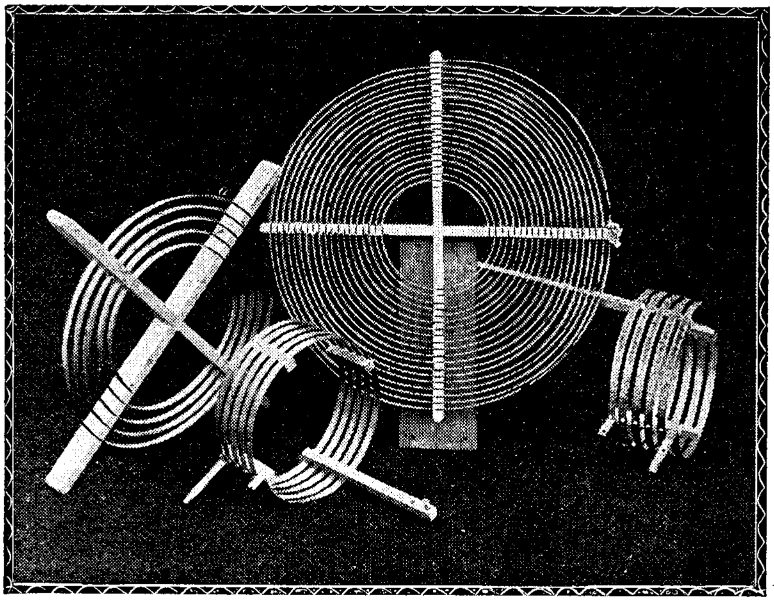
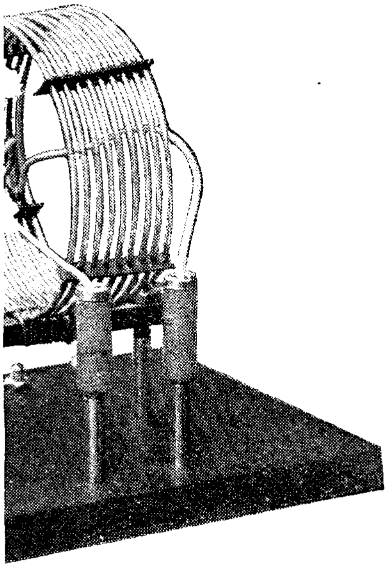
perimental radio is to the vaves, and those who have eriments are here given culties encountered.

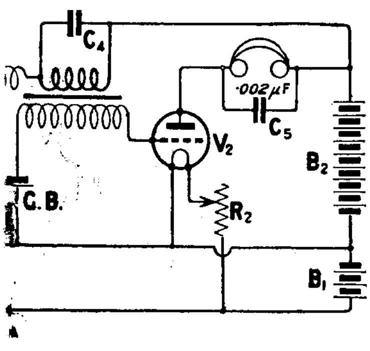


Other types of short-wave coils which have been used by the author during his experiments.



as as used in conjunction with the on the next page.

the very interesting point that waves of different lengths penetrate the Heaviside layer to varying extents, and that thereby their reflection takes place in very



rt waves. Using the values given o 50 metres is obtained.

different ways, and may be such as will permit of the reflected ray from, say, a 40-metre station being heard at a certain distance away from the transmitter, whereas a 20-metre signal which penetrates further into the layer, and therefore is reflected at a different angle, may miss the same receiving station, and yet be heard after a second reflection at a very great distance.

The Direct Ray

It is interesting to note that the direct ray from a short-wave transmitting station, i.e., a ray which is not reflected from the Heaviside layer, only travels an extremely short distance, and outside this region there is what is known as a " dead region " in which no signals can be heard. Since no reflected rays strike the earth, the size of the dead region is naturally controlled by the power of the transmitting station and the effective range of the direct ray.

Comparative Signal Strengths

As an example of the extraordinary behaviour of these short wavelengths, it may be stated that the writer happened to hear recently a well-known British amateur transmitter communicating with an equally well-known Australian experimenter. The British transmitter was situated about 27 miles from the writer's receiver, and yet his signals were very roughly the same strength as those of the Australian at upwards of 11,000 miles distant. In other words, the direct ray from the British station produced the same strength of signals as the reflected ray from the Australian station which had travelled perhaps 20,000 miles or more.

If the amendments to the theory of Oliver Heaviside are backed up by further evidence, it would seem that the most effective way of carrying out long-distance communication by day and night lies in the use of varying wavelengths for each period, but a very great deal of work must be done before any definite statements can be made of a specific nature.

Receiving Equipment

We now pass on to the more interesting and tangible matter, of the means employed for receiving the short wavelengths. Strangely enough, and contrary to general belief, the usual radio circuits are perfectly easily adaptable to this purpose, and work very well indeed. Simplicity seems to be the keynote, combined with the very popular "low-loss" applications.

Every effort must be made to see that the electrical losses are kept at a minimum, and the mechanism of components, especially variable condensers, must be carefully looked into.

By far the most popular form of receiver for short-wave reception is a straight circuit employing a rectifier valve, followed by one stage of low-frequency amplification, and it is with a receiver of this type that most of the very wonderful amateur work has been done during the present year.

A typical example of a receiver on these lines is shown in the photograph below, while the circuit is seen on the previous page.

The general construction is clearly shown, and a "close-up" photograph gives a clear idea of the construction and mounting of the inductances which should be made as closely as possible to the specified dimensions.

Range, 17-50 metres.

L_1 = Four turns 16 S.W.G., 3 in. diam.; spaced 1 diam.

L_2 = Ten turns 16 S.W.G., 3 in. diam., tapped from grid end at 3, 6, and 10 turns.

C_1 = Grid condenser, .0002 μF (Igranic).

C_2 = Tuning condenser, .0003 μF (Igranic).

C_3 = Regeneration condenser, .0003 μF (Igranic).

L_3 = H.F. choke, 100 turns 30 S.W.G., d.s.c., on $1\frac{1}{4}$-in. tube.

R_3 = Grid-leak about 2 Ω.

C_4 = .002 μF.

C_5 = .002 μF.

V_1, V_2 = V24 (MO) or DEQ and DEV.

The set is very easy to operate, the control of oscillation by means of the regeneration condenser being very pleasing.

As stated previously, practically any of the well-known "straight" circuits will operate satisfactorily right down to 20 metres or less, but up to the present H.F. amplification has not been found worth while, although the addition of a suitable stage often enables one to obtain a condition of oscillation more easily although the extra amplification one may gain is practically nil.

Adapting the Super-Heterodyne

The writer has recently investigated the possibilities of adapting the super-heterodyne to these ultra short wavelengths in order that the very beautiful control and selectivity of the instrument might be used to advantage.

It seems, at the moment, that the super-heterodyne goes very "crazy" below about 15-18 metres, and loses all its previous docility.

Above this wavelength it operates perfectly with all its desirable characteristics, which are so strikingly apparent on more ordinary wavelengths.

As regards the transmission of the short wavelengths, there have never been such great difficulties met with before—especially as far as the amateur is concerned—which may be tabulated as below.

(i) Valves running hot.

(ii) Difficulties of producing "harmonic" excitation of the aerial.

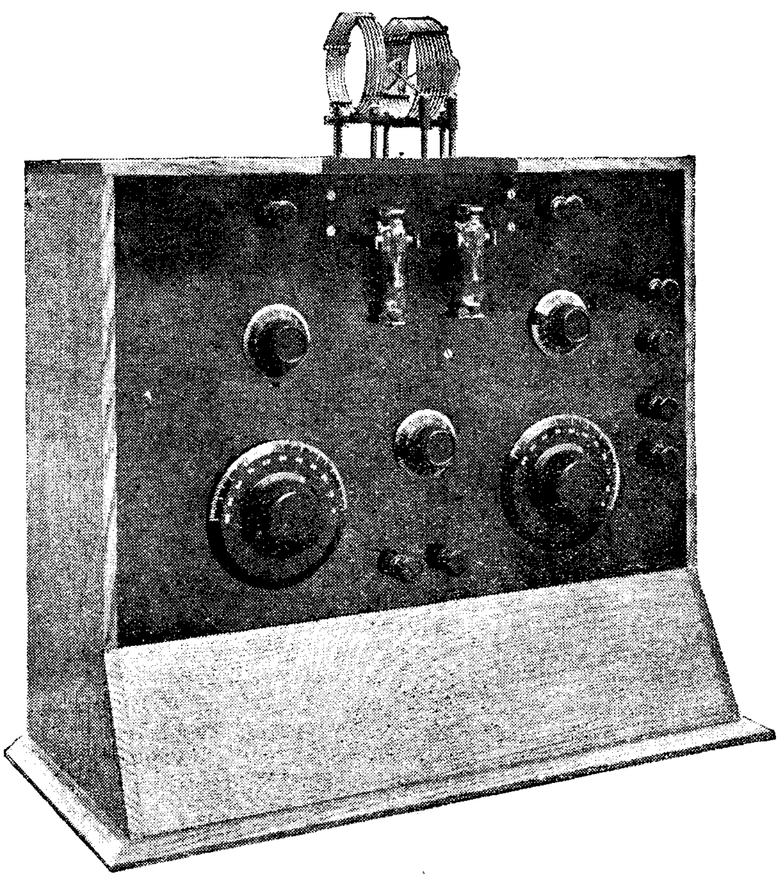
(iii) Heavy grid currents.

(iv) The impracticability of making a satisfactory heterodyne wavemeter.

(v) The extreme difficulty of producing a pure C.W. note.

(vi) Insulation difficulties in view of the very high frequencies used.

These points have been mentioned in order that the "receiving" experimenter may know of some of the difficulties which his "ally" is burdened with.

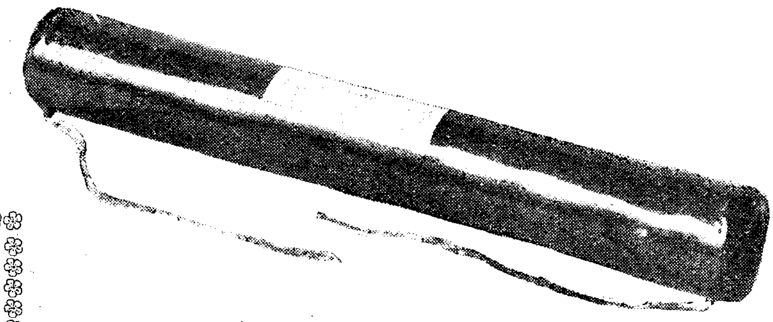


The receiver which is used by the writer for wavelengths between 17 and 50 metres. A separate photograph gives a nearer view of the coils.

Loud-Speaker Circuits for the Local Station

By A. JOHNSON-RANDALL,
Staff Editor.

Some practical hints to assist those who desire full volume loud-speaker reproduction of good quality.



A commercial form of wire-wound anode resistance suitable for use in L.F. amplifiers.

THE problem of the best combination and number of valves to use for loud-speaking from the local station is apparently a constant source of worry to the enthusiast, if one may judge from the queries received by the Radio Press Information Dept.

"I am situated A miles from 2LO. How many valves, etc., would be required to work a loud-speaker efficiently in order to permit dancing in a small hall? . . ."

This is a type of query often received, and while it is essential to treat each one on its merits, according to the particular circumstances, a few hints on low-frequency amplifier circuits in general may be of interest.

In the first place, it should be borne in mind that to work a loud-speaker well means to work it clearly and distinctly—that is, to reproduce the transmitted speech or music with as little distortion as possible. Any departure from this will result simply in a "noise," and in many cases a most unpleasant one. The general tendency seems to be a desire to economise in the number of valves used—a perfectly natural desire; but my advice is, don't overdo it, or you will inevitably get distortion. Since this article is dealing only with circuits suitable for loud-speaking in what may be termed the "crystal radius," high-frequency amplification has not been considered, except in one special case.

The most difficult problem is that of the listener who is situated within a radius of 10-15 miles from his local main station, and who wishes to operate a loud-speaker or a number of loud-speakers to fill a small hall. In these cases it is often found that the conventional arrangement employing two stages of transformer - coupled low-frequency amplification does not give sufficiently loud signals. To add another stage, utilising a similar method of coupling, will, except in rare cases, cause violent distortion and probably low-frequency howling of a severe nature. Three stages are, in general, only successful in the hands of an expert, or where a complete design has been arrived at after much careful experimenting in the arrangement of parts and in the choice of transformers.

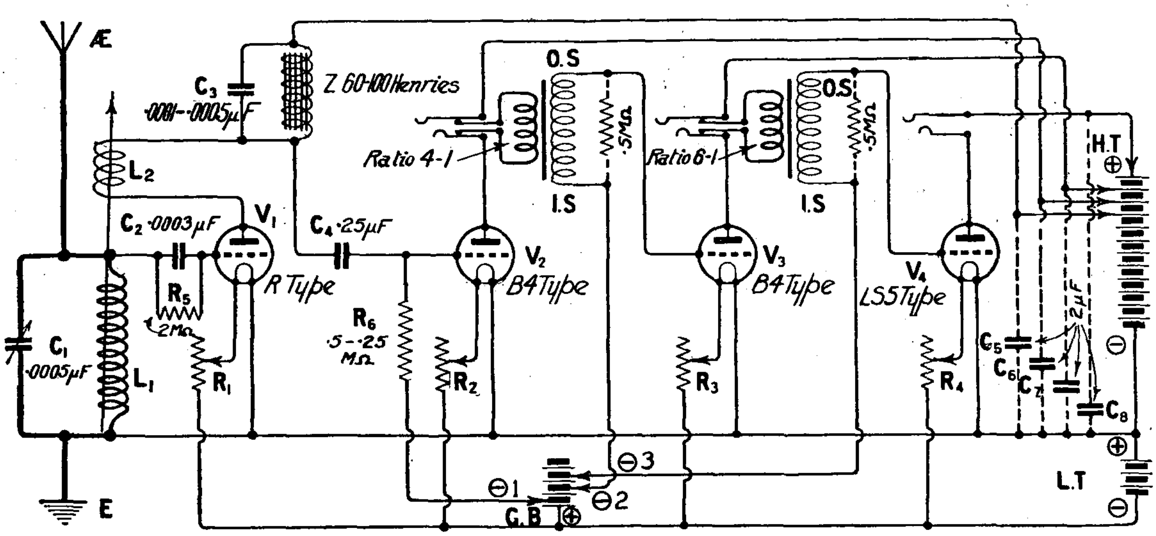


Fig. 1.—A circuit suitable for use within 15 miles of the local station, where great volume is required.

I would recommend the enthusiast to experiment with a combination of choke-capacity and transformer coupling on the lines of the circuit shown in Fig. 1. The aerial tuning system can be any convenient method, and that shown is the popular arrangement of a plug-in coil tuned by a .0005 μF variable condenser connected in parallel.

Valve Impedances

The position of the choke Z may be queried. I suggest

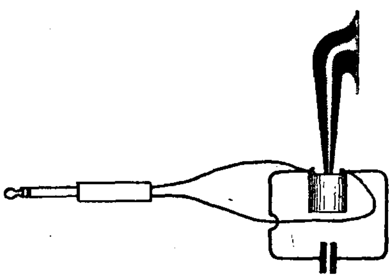


Fig. 2.—Showing the simplest method of connecting the loud-speaker to its plug.

using it in the *first* stage in preference to a transformer on account of the relatively greater ease of obtaining pure reproduction by this method. In *Wireless Weekly,* Vol. 6, No. 1, I pointed out that for distortionless amplification it was necessary for the primary winding of a low-frequency transformer to be designed with a high impedance, especially when following a valve of the "R" or similar type.

An average value for the impedance of an "R" valve is about 30,000 ohms, and taking into consideration all types of general purpose valves, it may be said that the value will be, in general, between 16,000 and 40,000 ohms, depending upon the particular type used. Since the detector valve in most cases will belong to this class it will simplify matters if we use the choke in the first stage and transformers in the second and third stages where low - impedance valves are used. If then we employ a choke having a value of between 60 and 100 henries good reproduction should result.

Values of Components

There are at present on the market a number of good chokes, and those who have in their possession a spare transformer may find that the secondary winding is quite effective as such. A small by-pass condenser C3 of between .0001 and .0005 μF should be shunted across the choke if reaction is employed. Its value should be no larger than that required for adequate reaction control. The value of the coupling condenser C4 is not critical, and a value as small as .006 μF can be used; .25 μF, however, is a good value. The grid-leak R6 may have a value of between .5 and .25 megohm, the lower one being safer. For the second and third stages transformers should be employed in conjunction with low - impedance valves of the small power type.

Valves to Use

In the various figures I have specified certain types of valves, and it should be noted that this indicates that any make of valve with a similar characteristic to that mentioned will be perfectly satisfactory. For maximum amplification I would suggest first-class transformers with a fairly high ratio. Quality may in some cases be improved by the addition of a .5 megohm leak across one or both of the secondary windings. Lower values will tend to improve quality still further, but volume

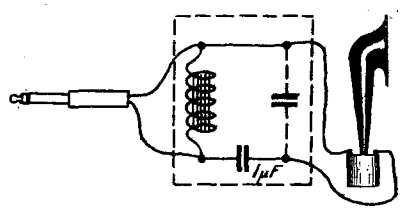


Fig. 4.—Here the insertion of the plug introduces a filter in conjunction with the loud-speaker.

will be correspondingly decreased. The valve in the last stage should be one of a class designed to deal with large inputs, since the grid swing may be very considerable. An L.S.5 type, used with an anode voltage in the neighbourhood of 200 and the proper grid bias, would be suitable. Although separate H.T. tappings are shown in the figure, a common voltage of 120 could be employed for V2 and V3, with a common negative grid bias of 6 volts. These

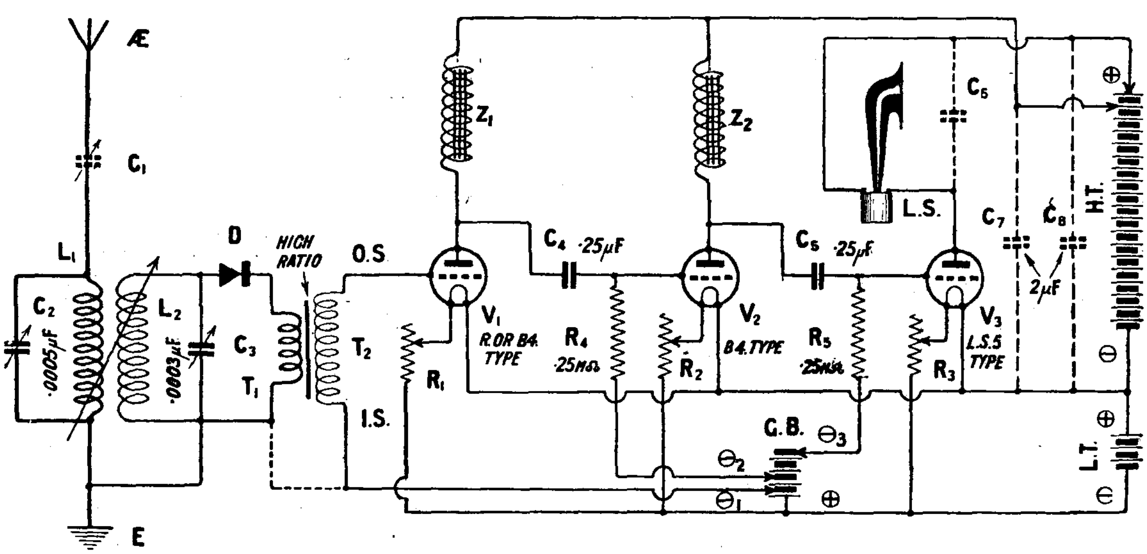


Fig. 3.—Very loud results may be expected from a circuit of this type. A high-ratio transformer can be used for the first stage of amplification, owing to the comparatively low impedance of the crystal.

values, however, should in all cases be adjusted in accordance with the manufacturers' instructions for operating the particular valve chosen.

Loud-Speaker Connections

The plug and jack method of switching is convenient when used, followed by a high-ratio L.F. transformer. Owing to the comparatively low impedance of the crystal, good reproduction is often possible with a ratio as high as 8—1. The chokes may be of the same type as that specified in Fig. 1, although if low-impedance valves are used

Eliminating Interference

The L.S.5 type of valve requires with an anode voltage of 200 a grid bias of 12 volts negative. It will be seen that a loose-coupled circuit is shown, but, of course, any convenient method of aerial tuning would give satis-

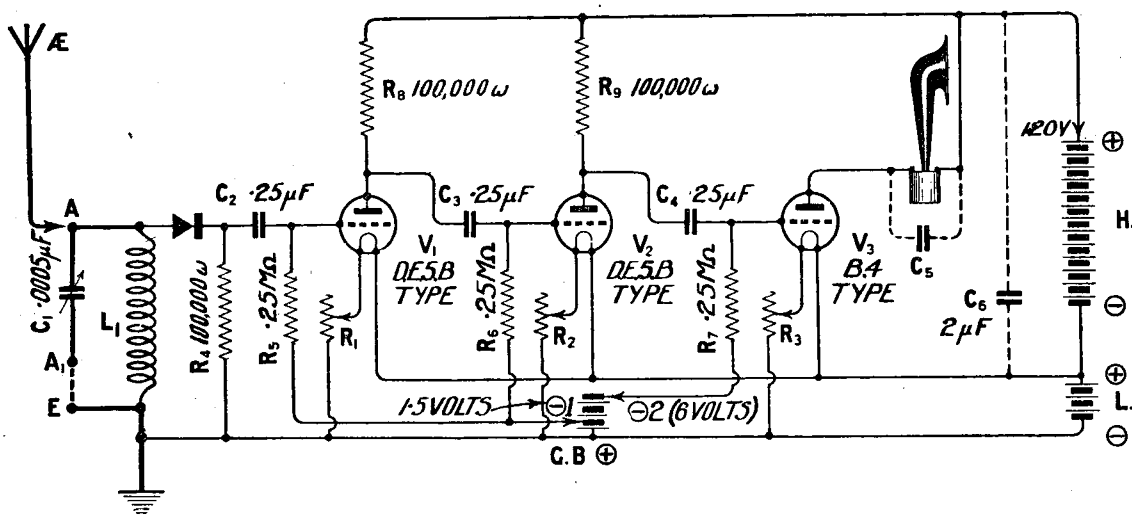


Fig. 5.—Exceptional purity of reproduction is obtainable with this circuit arrangement.

transformer coupling is used, and the separate diagrams indicate how the loud-speaker should be connected to the plug, in one case directly and in the other in conjunction with a filter circuit.

For very loud results at a distance of 5-10 miles from a main station, the circuit shown in Fig. 3, which is a combination of choke and transformer coupling as before, may be tried. In this case a crystal rectifier is throughout their impedance may be slightly lower. The remaining values may be as given in the figure. With a common anode voltage of 120 applied to V1 and V2, a common grid bias of 6 volts would be suitable, but with an "R" valve in the first stage with the same anode voltage, 3 volts negative bias would be a good value, a second tapping then being used for V2 with 6 volts grid bias as before.

factory results. A loose-coupled tuner, with a coil-holder permitting really weak coupling, will, however, be found a great advantage in the elimination of interference. Whether the extra skill entailed in manipulation is compensated for by the increased selectivity is a matter for the individual to decide. Some districts are singularly free from interference when receiving the local station, in which cases direct coupling is adequate.

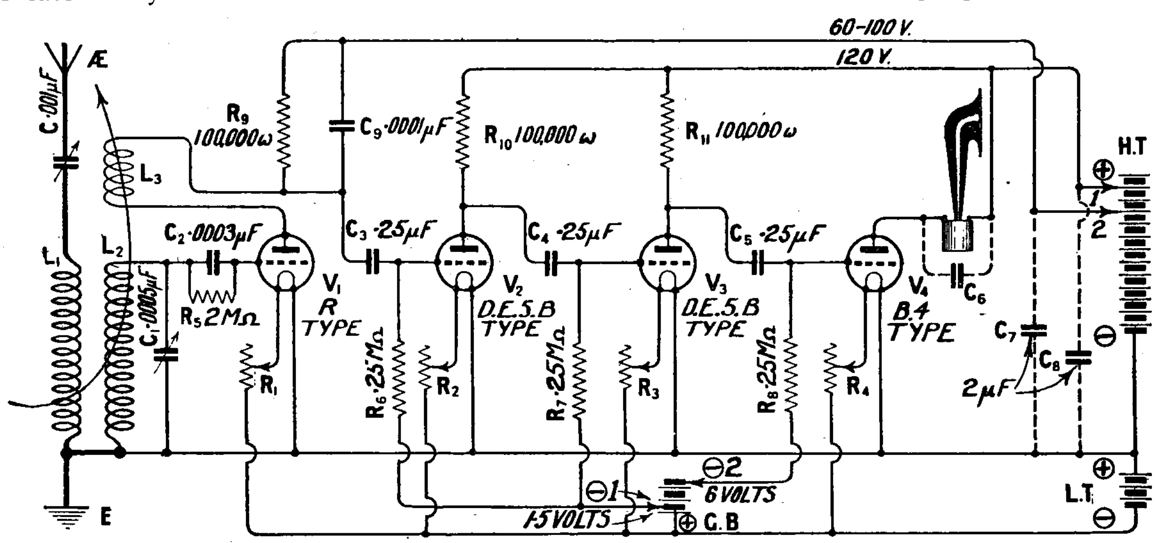


Fig. 6.—A circuit in which selectivity is studied, while ample volume and excellent quality are ensured by the three stages of resistance-capacity coupling.

Resistance-Capacity Coupling

Turning now to resistance-capacity coupling, as I pointed out in my previous article, in a well-designed resistance amplifier there should be no distortion, since the impedance of a pure resistance is the same for all frequencies. In Figs. 5 and 6 are shown two circuits employing this method of coupling, a crystal rectifier being used in one case and a valve detector with reaction in the other.

Resistance coupling does not give the same amplification, valve for valve as transformer coupling, and the volume will therefore not be so great as that obtainable with the combination of chokes and transformers already described. The quality, however, may be better, and in cases where the maximum output per valve is not required, I should prefer resistance coupling.

Anode Voltages

In constructing a resistance amplifier two things must be remembered. First, it is essential to use a good anode resistance designed to carry the steady plate current without variation. Secondly, in determining the anode voltage, the voltage drop across the anode resistance must be taken into consideration. With valves of the D.E.5B. type an H.T. voltage of 120-150 volts with a grid bias of 1.5 volts will give excellent results; but in cases where other types are used, in order to operate the valve at its proper working point, it may be necessary to double this voltage, the grid-bias in these cases being determined by the *effective* anode voltage—that is, the H.T. voltage minus the drop across the anode resistance. In general, better results will be obtained by the use of those valves intended for resistance amplification, since, apart from the question of anode voltage, the theoretical amplification per valve will be greater than that obtainable with those of the "R" type—the M factor of the former being in the neighbourhood of 20 as compared with 8-10 for the ordinary general-purpose valve.

Wire-Wound Resistances

For silent working it is necessary that the anode resistances should be constant, owing to the fact that any small variations in their value may cause a distressing "background" in the loud-speaker, in some cases completely spoiling reception. A resistance of the wire-wound type would seem to be the solution, but here we are faced with two difficulties. The first is that of winding a resistance to a sufficiently high value, preserving good insulation throughout, and at the same time keeping the bulk within reasonable limits; and the second, that of winding on the wire non-inductively. These difficulties, I am glad to say, have been overcome by a number of manufacturers, and really reliable resistances are now obtainable.

Improved Quality

In all the circuits given it will be noted that a fixed condenser is shown dotted across the loud-speaker. This condenser serves the purpose of a tone control and no definite value can be stated. It is advisable to try several preferably of the clip-in type, having values between .004 and .01 μF, until the desired tone is obtained. As the value is increased, a loss in certain of the higher frequencies will be observed, the resulting effect being a tendency to render music more mellow, until, as the value is increased still further, both speech and music will become muffled. Some loud-speakers will not require any condenser at all, while on the other hand others may possibly require one even larger than .01 μF if the best results are to be obtained.

I have recently been using the circuit given in Fig. 7. It will

(*Concluded on page* 480)

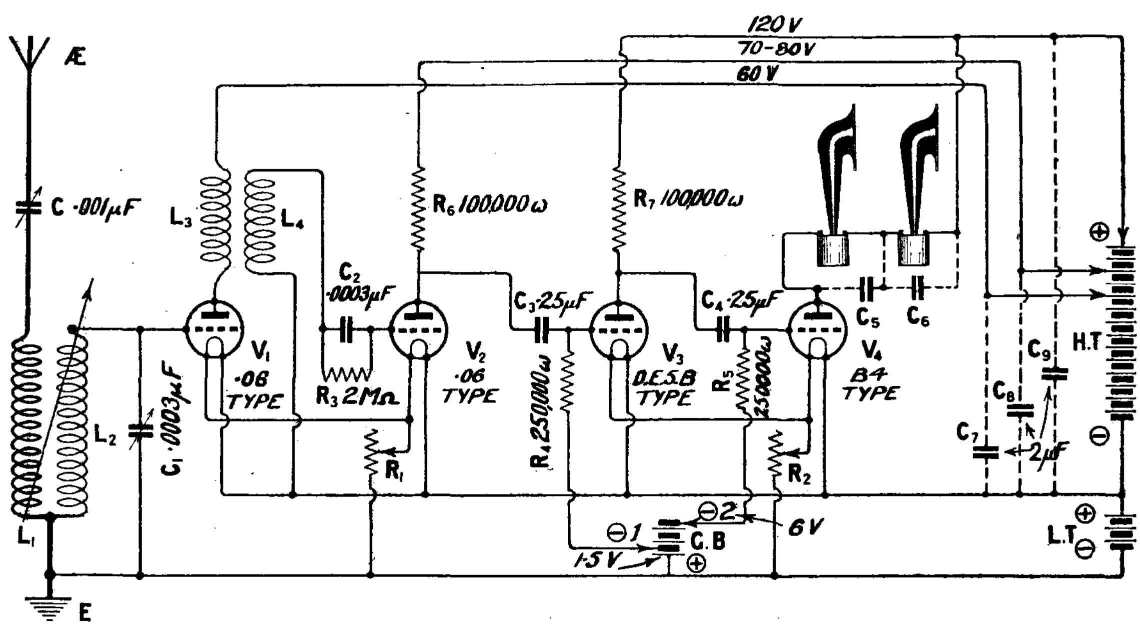
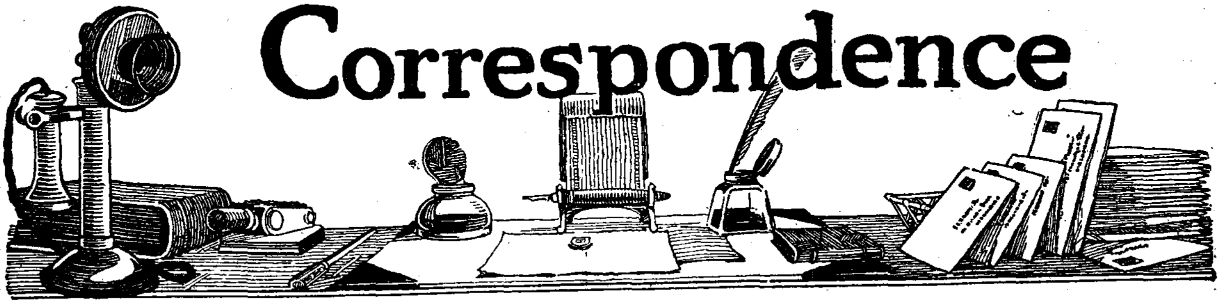


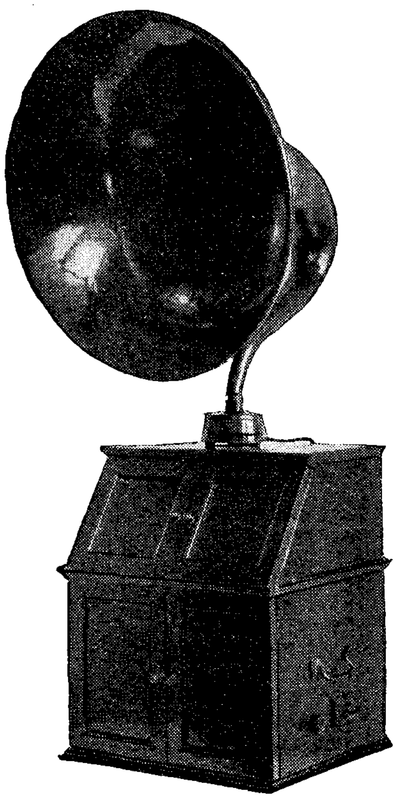
Fig. 7.—By this method of operating two loud-speakers together a pleasant blend in tone is often possible.

Correspondence



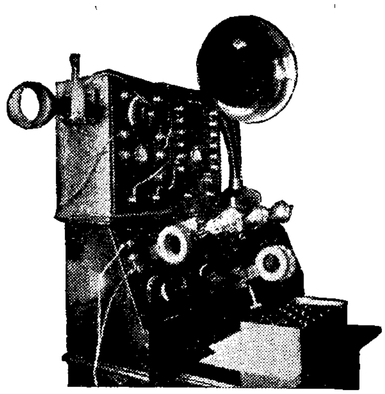
THE FOUR-VALVE T.A.T. RECEIVER IN S. AFRICA

Sir,—Having recently constructed the Four-Valve T.A.T., as described by Mr. John Scott-Taggart in the December issue of *Modern Wireless,* I thought you might care to know of the results obtained here in South Africa. My station is about 220 miles from JB (Johannesburg Broadcasting Station, 450 metres), about 350 miles from Durban (400 metres), and Cape Town (375 metres), 1,075 to 1,100 miles. Well, I can get JB and Durban every evening at loud-



Mr. Hawtin's ST100 is of attractive appearance.

speaker strength, Cape Town at good 'phone strength, using two pairs of headphones, when atmospherics are not too bad. We have a special brand out here; when they are on they are on, and no mistake about it. I heard the Prince of Wales's speech on June 3, 1925, relayed from the Marine Hotel by the Durban Broadcasting Station, and the speech was received "word perfect." I have made several sets before, all from *Modern Wireless.*



Two sets built by Mr. Potier from Mr. Harris' designs.

The Four-Valve T.A.T. tops the list for reception of distant stations. The set is as published in *Modern Wireless,* plus a master rheostat as an on-and-off switch, and the method of cutting out the H.F. valves as used in the Seven-Valve T.A.T. (January, 1925, by Mr. John Scott-Taggart).

Thanking you for the circuit and wishing yourself and staff every success.—Yours faithfully,

S. Davies.

Pilgrim's Rest, Transvaal, South Africa.

ENVELOPE No. 1

Sir,—Enclosed I am sending photographs of my home-constructed ST100, enclosed complete in mahogany cabinet.

All battery leads are at the back edge of the panel and are connected by taper plugs and sockets.

The earth and aerial connections are at the back and the loud-speaker plug on the left-hand side.

The G.B. and H.T. switches can be plainly seen in front, and there is a master H.T. on and off switch, together with a 15 ohms L.T. master rheostat outside the cabinet on the right-hand side.

The cabinet under the panel is lined on the bottom and four sides with sheet glass, and the panel rests upon crêpe rubber strips for the elimination of any tendency to microphonic noises when the valves are jarred.

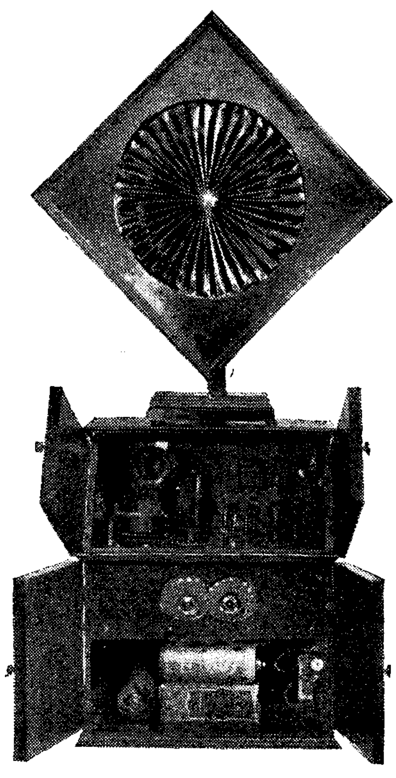
Wishing you every success.—Yours faithfully,

R. Hawtin.

Broughton, Manchester.

A READER'S TWO SETS

Sir,—I enclose you a photograph of two sets I have made to the directions of Mr. Percy W. Harris. The top set is the one-valve set as described in the December, 1924, issue of your excellent monthly, *The Wireless Constructor,* and the



The lower part of the cabinet of Mr. Hawtin's receiver accommodates the batteries and the H.T. and grid-bias tapping switches.

lower set is the Four-Valve Family Set (Envelope No. 2, by Percy W. Harris). You will notice I have added an amplifier to the one-valve set. Both sets work admirably, and I think it would be difficult to find better.—Yours faithfully,

C. Clifford Potier.

Peacehaven, Sussex.

THE "TWIN-VALVE" LOUD-SPEAKER RECEIVER

SIR,—It may interest you to know that, having had great success with the "All Concert" (*Modern Wireless*, September, 1923, by Percy W. Harris) and "Family Four-Valve" Receivers (Envelope No. 2, by Percy W. Harris), I decided to "hook up" the above receiver for trial purposes.

The results with only two valves have exceeded all expectations, as with the components mounted on a piece of old ebonite and with unsoldered joints and roughly constructed, I have had Leeds, Bradford, Manchester, Newcastle and Bournemouth at loud-speaker strength, enough to work a large Dragon type wooden Amplion.

My aerial is 70ft. long, 30ft. high, and on the 'phones I have logged all the B.B.C. stations, one French station, Hamburg, and another German station in addition, within an hour of commencing testing it on my aerial. The signals of the distant stations, Aberdeen, Birmingham, Bournemouth, Glasgow and the foreign stations were as loud as on any three-valve straight circuit set, and I am extremely pleased with my results at first attempt with a roughly wired receiver, and intend to stick to the circuit. I have also received KDKA, WGY, WBZ at exceptionally good 'phone strength, the receiver displaying remarkable stability. I have also had Petit-Parisien, Madrid and German stations (two) which as yet I have not identified. The B.B.C. stations (main) with a note magnifier all come in at good strength on a large Amplion.

The set is extremely selective. I live within 3½ miles of the Bradford relay station, and I can cut it out in 2 degrees on either condenser. Speech and music are perfect and free from distortion. The volume without reaction was not sufficient for the loud-speaker, but, of course, I am 40 miles from Manchester and Bradford is only a 200-watt relay station.

I trust that this report may be of some assistance to you and readers of your three journals, *Modern Wireless*, *Wireless Weekly* and *The Wireless Constructor*, and may I again thank you and also express my great appreciation of your journals and the excellence of the matter served up in each.—Yours faithfully,

MAURICE H. WILKINSON.
(Radio 2AVX.)

Shipley, Yorks.

THE ANGLO-AMERICAN SIX

SIR,—Early in January I constructed the Anglo-American Six Receiver (*The Wireless Constructor*, January, 1925, by Percy W. Harris). I have found the set very good and considerably more powerful than the Transatlantic Five which I had previously owned. The volume, however, was insufficient for my present needs, so I added another stage of resistance-coupled L.F. The set is used in a large room with an Amplion A.R.23 loud-speaker. Headphones are never used, but tuning can easily be accomplished without howling, provided reasonable care is taken.

I can get all the main and most of the B.B.C. relay stations. The German stations, Munster especially, come in well. Radio-Paris is considerably louder than Chelmsford, but the modulation, in my opinion, is not so good. Zurich, Oslo and Rome are received well, as are the Spanish stations. American stations do not appeal to me and I have never tried to get any. The wave trap helps a little in cutting out Morse interference, which is sometimes terrible in this locality.

Whilst the Anglo-American Six is the finest set I have tried, I should like something with more stages of H.F. amplification. I value purity far more than volume, but the combination of the two is desirable if the reproduction is to be entirely realistic.

Valves used: H.F.-Cossor or Fellows H.F. valves, Det.-D.E.5b, L.F.-two D.E.5b and one B4.

On the Transatlantic V I found that the use of D.E.5 valves in the H.F. stages increased the power considerably, but I have not tried these valves in the Anglo-American Six.

Thanking you for the design of such excellent receivers.—Yours faithfully,

R. H. CAREW (Major).

Waterford, Ireland.

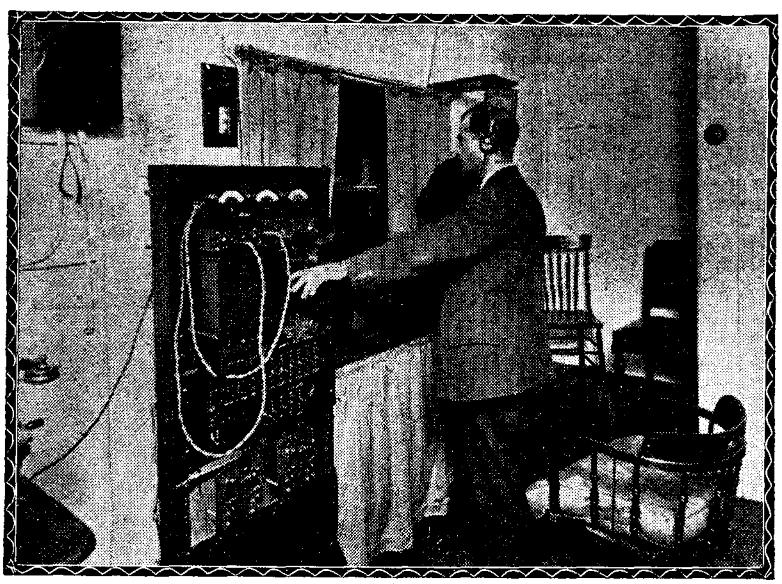
EXPERIENCES OF A JUNIOR READER

SIR,—I am writing to you with great pleasure to let you know some of the results I have obtained with the "Midget One-Valve" receiver, described by A. S. Clark in the May issue of *The Wireless Constructor*. I am using an Ediswan R valve with 60 volts on the plate, Nos. 35, 50 honeycomb coils (of my own make), and the following are some of my results:—Birmingham (5 miles) comes in at faint loud-speaker strength, with Bournemouth and Manchester quite plain on the phones. I also get London, Aberdeen, Petit-Parisien quite well any night. With aerial coil 150 and reaction 200, I receive Radio Paris, Chelmsford, and Eiffel Tower. Amongst many amateurs I get 5YS, 2QO (Hereford), 2KO. I have also received many other stations, but I was unable to get their call-signs owing to interference from Birmingham. I stayed up till 12.30 one night, and heard WGY (New York) quite respectably, and have received it many times since, as well as two other foreign stations.

Thanking you very much for designing such an excellent receiver, and wishing you and your papers most popular support.—Yours faithfully,

V. LADBROOKE.

Hall Green, Birmingham.



The control room of the Australian Broadcasting Station, 3LO, at Melbourne. The operator is adjusting the controls of the speech input amplifier and the telephone line switchboard.

ENVELOPE No. 2

SIR,—Some time ago I made up your Four-Valve Family Receiver

(Envelope No. 2, by Mr. Percy W. Harris), and in accordance with your invitation I am writing you a few lines *re* the results I have obtained.

I have had all the B.B.C. main and relay stations with the exception of Plymouth, most of the Continental stations, and several American stations. On one occasion WBZ was so strong on two valves that I tried the loud-speaker. He was plainly audible all over the room.

Most of the B.B.C. main stations come in on the L.S., and one or two of the relay stations. I have also received amateurs as far away as Liverpool and Woolwich.

I have made one or two slight departures from the original design. I have incorporated C.A.T., added an extra H.T. terminal, and substituted choke for transformer coupling in the last L.F. stage. Results, using transformers in both stages, were far from satisfactory, but perhaps I am over critical, as far as clarity is concerned. I might add that the distortion referred to was only experienced on the local station 5 IT, which is only 18 miles away, but the choke coupling undoubtedly made an improvement. I find the switching arrangements most convenient. Radio Paris comes in on one valve at comfortable phone strength, using aerial reaction, which I manipulate with the aid of an extra two-coil holder.

Thanking you for this splendid circuit and wishing continued success to your publications, to all of which I have subscribed since they were first published.—Yours faithfully,

A. G. WALTER.

Coventry.

H.T. FROM A.C. MAINS

SIR,—About nine or ten months ago you published in *Wireless Weekly* (Vol. 4, No. 23, October 8, 1924) an article on obtaining H.T. supply for the anodes of valve receiving sets direct from A.C. lighting mains. The apparatus described consisted of eight small rectifying cells containing a solution of ammonium molybdate, using aluminium and lead electrodes and followed by a smoothing circuit of chokes and large condensers. Since then I have not noticed any report from any of your readers, and I thought that perhaps my experiences with the apparatus might be of interest.

After about nine months' use I have nothing but praise for the way in which the rectifier works, so that I have definitely said "good-bye" to H.T. batteries. My supply is 220 volts A.C. 50 cycles. I do not know definitely what is the actual voltage of the rectified supply—there is, of course, a voltage drop due to the internal resistance of the cells and the resistance of the chokes—but I should imagine that it would be in the neighbourhood of 160-180 volts. I must confess I was very dubious about the result of applying this voltage to the plates of detector and H.F. valves before I tried it, but results are really excellent. Normally I use detector followed by one L.F. stage. Using a "Harris" low-loss X coil and no reaction, at 12 miles from 2LO really powerful loud-speaker results are obtained. An ordinary R valve for detector and a D.E.5 (or L.S.5) for the L.F. stage are used, and the full available voltage applied to each valve—about 8 volts negative grid bias being used on the last valve. For long-distance reception I use two H.F. valves (neutrodyne coupled) in front of this combination, and have obtained good loud-speaker results from most of the usual "distant" stations, the same maximum voltage being applied throughout to all valves. The A.C. hum is not, in my case, absolutely eliminated, but it can only be heard by putting one's ear right inside the trumpet of the loud-speaker; it is quite negligible when compared with the strong hum in 2LO's carrier wave. It may be that by applying this large voltage to all valves one does not get them working under ideal conditions, but for the average man who wants his set for listening to broadcast programmes this method of H.T. supply would, I think, be hard to beat. For convenience and economy it has the H.T. battery and the H.T. accumulator absolutely beaten. I should be glad to hear of other readers' experiences, especially as regards the effect of excessive plate voltage on detector and H.F. valves.—Yours faithfully,

A. W. Scott.

Carshalton, Surrey.

CHANGE OF WAVELENGTH

Sir,—Would you kindly give the following notice publicity in the correspondence columns of your valuable journal?

Will all amateur transmitting stations who have worked 6DD either on c.w. or 'phone, please take this as an intimation that in future that station will not operate upon the 150-200 metre band as a general rule, but will work upon shorter waves as follows:—'Phone—90 metres; C.W.—90, 45, 23 and 8 metres. As in the past, I shall be only too glad to co-operate with any amateurs for experimental purposes, but it is requested that any station calling should listen on 90 metres for a reply.—Yours faithfully,

Brockley. 6DD.

ENVELOPE No. 4

Sir,—Some two months ago I decided to construct the "All Concert De Luxe" with the aid of the Radio Press Envelope No. 4 (by Mr. Percy Harris). I might mention that I had had the original "All Concert Receiver" (*Modern Wireless*, September, 1923, by Mr. Percy Harris) working for nine months with success. In response to your request for reports of results obtained with "All Concert De Luxe," I give them here:—Location, 9½ miles north-east of Manchester; height and length of aerial, 30 ft. and 80 ft. respectively; number of stations, all B.B.C., and a number of Continental, also WGY, U.S.A.

I might say that it compares very well with the original for ease of tuning, but it is exceptional as regards distance and volume; the only alteration I have made is to leave out the filament switch and series parallel switch. I might also add that I had never handled a valve set before I made the original from the description published in "12 Tested Wireless Sets" (No. 14, by Mr. Percy Harris), and in less than an hour I had mastered it, thanks to the simplicity of the instructions.

With best wishes for the future progress of your invaluable publications is the earnest wish of—Yours faithfully,

Bury, Lancs. T. Kay.

A NEW CRYSTAL-VALVE CIRCUIT

Sir,—I recently constructed a set, using the new crystal-valve circuit described by Mr. J. Scott-Taggart, F.Inst.P., A.M.I.E.E., in the March issue of *The Wireless Constructor*. The components were mounted on separate panels, but despite this the set gave extraordinarily good results. All the main B.B.C. stations with the exception of Aberdeen came in at good strength on three pairs of 'phones. Aberdeen, unfortunately, was not readable. The others, however, were easily so, while Birmingham, Cardiff, Bournemouth and Newcastle were really loud. Hamburg and Berlin were also received at fair strength, the former being the best. Several French stations were picked up, but I did not identify them. I did not find the fixed condenser across the secondary of the transformer necessary, the set oscillating quite easily without it. I should add that I have an excellent aerial and earth.

I wish you every success with your publications.—

Yours faithfully,

Leslie P. F. Hubbard.

Hereford.

Apparatus we have tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

S.W.C. Jack Terminals

A type of jack terminal marketed by S. Wilding Cole that has some novel features has been submitted for our inspection. This terminal consists of five parts—a push-in terminal tag to be affixed to the flexible connecting wire, a socket to be fixed in the panel in the usual way, a back-nut for this latter purpose, a soldering tag which fastens under the back-nut and carries on it in addition springs which engage with the end of the terminal tag, and which, therefore, give an excellent direct, self-cleaning connection, between the wire and the internal connection, and finally a coloured identification disc, red or black in colour, which can be placed under the shoulder of the socket on the front of the panel. The socket is applied on the panel in the ordinary way, the only point to note is that the curved jaw and tag-piece is threaded on the back-stud before putting on the back-nut. Externally, all that is seen is the rim of the socket, the coloured ring, and the tag itself. On trial, the device was found to give a secure, electrically-perfect connection, whilst the tag could be easily released. It evidently provides possibilities of an exceedingly neat lay-out of connections and switching arrangements in a radio receiver.

Sterling " Lilliput " Headphones

Messrs. Sterling Telephone Co., Ltd., have submitted for trial a pair of their new " Lilliput " headphones of 4,000 ohms resistance. These are a moderate priced set of light-weight 'phones and are provided with the comfortable type of fixed leather covered double headband and sliding adjustment which is so popular amongst those who are compelled to wear the headphones continuously for any considerable period. The ear-pieces are on the small side, but the 'phones were, on trial, readily adjusted and unusually comfortable, whilst in practical reception they proved to be sensitive. A generous length of braided cord is provided, with the positive lead clearly marked. We are glad to see a firm of Messrs. Sterling's standing coming into line to meet the foreign competition with a really comfortable and reasonably priced head set, and can recommend this set with confidence, provided that reasonable care is taken to maintain the plate current in the last valve at a normal figure.

"Excell" Terminal Tags

A device which is of the utmost utility for the experimenter who has repeatedly to make and change connections, often when the time available is very short, is the "tie-clip" type of spring-grip terminal for affixing to lengths of flex connecting wires, which enable connections to be made and broken in a second without any fear of poor or noisy contacts. From S. H. Collett we have received samples of such clip connectors of a substantial size and giving a strong grip, provided with a neck which will, with a squeeze with a pair of pliers, give a hold on the end of any ordinary sized cable or flex, or on a number of wires. On trial, these clips were found to offer every convenience in experimental "hook-ups," for battery leads, tappings, aerial and earth connections, etc. They can be strongly recommended for this kind of service.

Fine-Control Two-Coil Holder

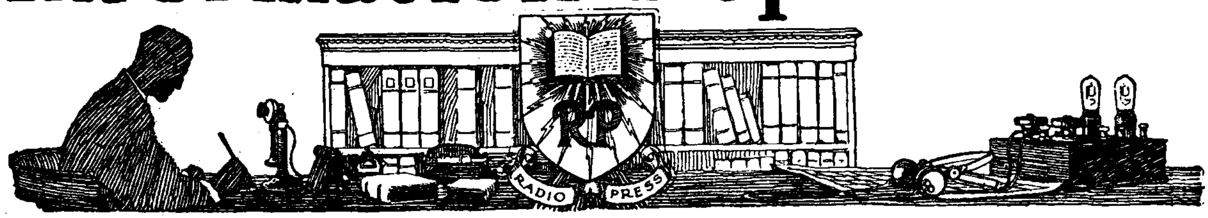
From Messrs. London and Provincial Radio Stores has been received a two-coil-holder in which special provision had been made to afford a smooth and fine adjustment of reaction and to minimise hand-capacity effects. The device has a one-hole-fixing arrangement of unusually neat design, and is provided with a handle 6in. long projecting in the front. The fixed coil is mounted parallel to the panel and about 1in. behind the latter; the moving coil-holder is pivoted, and has a worm wheel mounted at the centre, which wheel engages with a worm on the end of the spindle, a strong spring taking up any backlash. A very fine adjustment of reaction coupling was found, on trial, to result from this mechanism, whilst the device could handle large-sized coils with ease and certainty. The usual small terminal screws were provided on the coil mounts, with an additional pair of terminals on the frame to facilitate the fitting of flex connections to the moving coil. The insulation resistance was found to be excellent; the workmanship and finish were of a satisfactory order.

An H.F. Reactor and an H.F. Damper

From Messrs. L. McMichael, Ltd., come samples of their "M.H." H.F. Reactor and H.F. Damper, for use in conjunction with their barrel-type plug in H.F. transformers. The first device, for use in circuits where there is already enough damping to produce stability when critically tuned, consists in a small solenoid reaction unit adapted to slide right inside the barrel of the transformer. This has a coarse adjustment by sliding on pins which replace the usual two small screws in the end of the barrel, and a fine adjustment by a screw controlled by a knob. Flex connections are provided for the reaction circuit. Interchangeable coils are supplied for the reactor to cover the usual telephony ranges. On practical trial in a stable H.F. amplification circuit adequate reaction was readily obtained both on the short-wave stations and 5XX, together with smooth control.

The second unit is a device for introducing eddy-current damping in cases where instability exists, as the result of using light aerial coupling or where two stages of tuned H.F. amplification are in use. It consists in a cylinder, covered with metal foil, which slides inside the H.F. transformer just as the reactor unit does, but with a simple sliding adjustment. On trial, this was found to give the necessary stabilising effect in an otherwise unstable circuit, and close control over inherent reaction.

Information Department



SUPPLIED BY RADIO PRESS SERVICE DEPT., LTD.

Y. W. P. (SIDCUP) contemplates building a 2-valve receiver and asks our advice as to which is the best type to build for all-round work. He would like to work a loud-speaker, if possible, from the London station.

We think that our reader's needs would best be met by constructing a set using reaction and employing a detector followed by one low frequency valve. On a good aerial and earth system fair loud-speaker strength should be obtained from 2LO and a number of other stations received on the telephones at satisfactory strength. A set of this type is exceedingly easy to handle, the only controls necessary being that of the aerial condenser and the variation of the position of two coils. If a loud-speaker is used, we would suggest that separate high-tension tappings be provided for the valves so that a power valve may be placed in the low-frequency stage and a value of 100 to 120 volts applied, together with a suitable value of grid bias, in order that good loud-speaking may be obtained. A high-frequency amplifier followed by a detector valve would not be suitable, since a circuit of this type is not satisfactory for obtaining loud-speaking, although it would score on the reception of distant stations. Such an arrangement has usually one further control, making the manipulation of the set slightly more difficult than that of the first-mentioned type

A. P. H. (BAGSHOT) asks our advice on the subject of obtaining a good earth connection. He states that he is unable to make a connection to a water-pipe and that as the soil is sandy and very dry in nature, he will be unable to get down to moist soil in order to make the desired earth.

In such a case we think that it is best to resort to the simple expedient of burying wires underneath the aerial. Ordinary 7/22 aerial wire will be perfectly suitable for the purpose, and this should be buried directly under the aerial if possible and to the full length of it. In some cases several lengths buried parallel to those under the aerial, and on either side of it, may improve results. A symmetrical arrangement should be aimed at, and it will be found unnecessary to bury the wires deeply. An arrangement of this type usually works quite well in practice.

V. C. (PORLOCK) is using an Anglo-American Six Receiver and obtains excellent results on the 300 to 500 metre broadcast band of wavelengths. He asks our advice as to whether ordinary H.F. transformers will be satisfactory for the reception of 5XX and Radio-Paris, or whether he should obtain special neutrodyne units for this wavelength range.

In reply to our correspondent, we would advise that special neutrodyne units be obtained for the reception of 5XX, since although certain types of H.F. transformers do work well on this wavelength range, special precautions in design are necessary, and it is well worth while to obtain units especially designed for a set of this type.

A. L. C. (SKEGNESS) asks what is meant by "self-heterodyne" or "auto-dyne" reception.

Auto-dyne reception is a method of receiving continuous waves by using an oscillating valve set which is slightly out of tune with the station to be received, so that beats are formed with the incoming oscillations, thus giving rise to audible signals in the telephones. This method of receiving continuous waves does not require a local oscillator or "separate heterodyne."

Loud Speaker Circuits for the Local Station

(Concluded from page 472)

be seen that a stage of high-frequency amplification is employed and no reaction. The transformer L3, L4 is aperiodic, and for this reason the circuit is perfectly stable, although the actual amplification is probably only about 60 per cent. of that obtainable with a good tuned stage. Two stages of resistance-capacity coupled low-frequency amplification are used, the anode resistances being of the "Zenite" rod type. The values of the various components are as given in the diagram. Two large loud-speakers of different makes are connected in series, each having a suitable "tone" condenser across its terminals. By careful adjustment it has been found possible to obtain a blend in tone, and the reception of local broadcasting by this method is infinitely better than when either of the instruments is used singly. Listeners who are endeavouring to improve quality would be well advised to experiment on these lines. At a distance of 15 miles from 2LO the results with this circuit are all that can be desired, the volume being sufficient for dance purposes in a large room, while at the same time no distortion of any kind is apparent. In addition to this, with the aerial disconnected, the background is quite silent.

Wireless Measurements

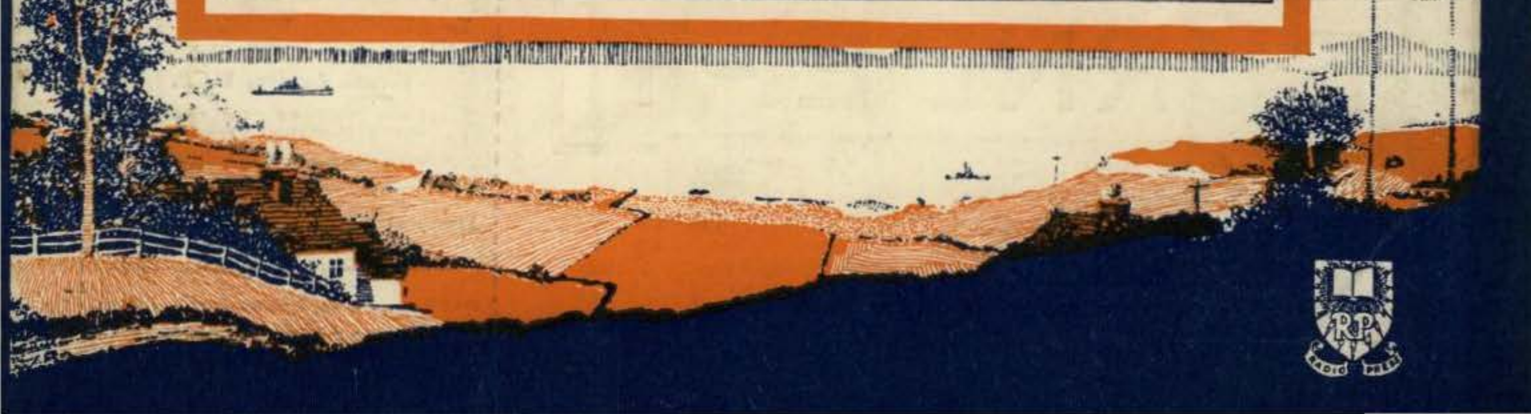
With reference to Fig. 8 in last week's article on this subject, it is to be understood that the thermo-couple used in this circuit is of the high-resistance type. When the heater element of the instrument is of low resistance it is connected in series with the circuit in which it is desired to make a measurement.

Printed for the Proprietors, RADIO PRESS, LTD., of Bush House, Strand, W.C.2 by THE AVENUE PRESS (L. Upcott Gill & Son, Ltd.), 55-57, Drury Lane W.C.2 and Published by the Proprietors, RADIO PRESS LTD., at Bush House Strand W.C.2, on Wednesday of each week. Address for Subscriptions and Editorial Communications:—Bush House Strand, London, W.C. Advertisement Managers:—BARCLAYS ADVERTISING, LTD. Bush House Strand London, W.C.2. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates:—32/6 per

Wireless Weekly, 6d. Net. Wednesday July 22nd, 1925

Wireless Weekly

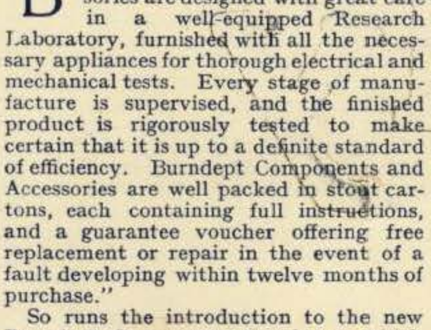
Vol. 6. No. 16.



Before you build another set, consult the special Burndept Components Catalogue

"BURNDEPT Components and Accessories are designed with great care in a well-equipped Research Laboratory, furnished with all the necessary appliances for thorough electrical and mechanical tests. Every stage of manufacture is supervised, and the finished product is rigorously tested to make certain that it is up to a definite standard of efficiency. Burndept Components and Accessories are well packed in stout cartons, each containing full instructions, and a guarantee voucher offering free replacement or repair in the event of a fault developing within twelve months of purchase."

So runs the introduction to the new Burndept Components Catalogue, which



No. 215. Crystal Detector, for panel mounting, in carton with screws and drilling template, **4s.**

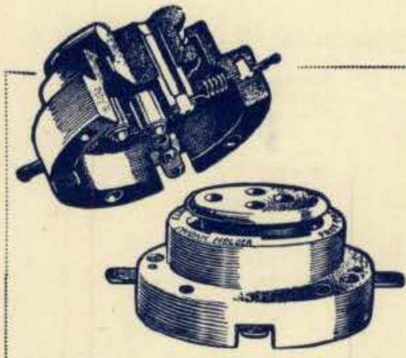
No. 216. Crystal Detector, for experimental use, as illustrated, **11s. 6d.**

has been prepared for the convenience of home-constructors. In a few words, it gives many facts which will lead builders of sets to buy Burndept products with the firm conviction that they are going to get full value for their money. Burndept Components are admittedly a little dearer than others; but that extra cost is more than justified when you have the satisfaction of getting perfect results with a minimum of trouble. It is very annoying to find that most of the time one has spent in building a set has been wasted just because some cheap components were not as efficient as they should have been. A penny saved at first may mean spending a pound later on, and the moral is: "Buy wisely before you start to build."

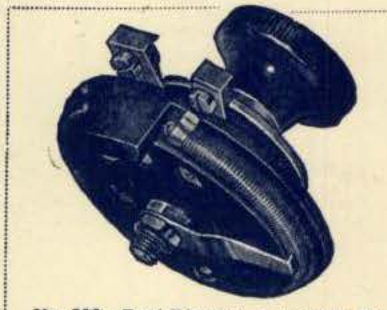
Every man who constructs sets should have the new Burndept Components Catalogue by him. It is a handy publication, and contains full particulars of some very interesting Burndept products, including components, loud speakers, batteries and sundries. The Burndept Crystal Detector, the Anti-Phonic Valve Holder and the Dual Rheostat are three components described therein, which every reader of *Wireless Weekly* will have noticed are frequently incorporated in sets described by Radio Press writers. The features of these Burndept Components will make an instant appeal to the constructor who wishes to make sure of good reception.

The Burndept Crystal Detector gives the best possible results obtainable by crystal rectification. The cat-whisker is controlled by a micrometer screw, working through a ball-joint. The movement gives very fine adjustment. All moving parts and the sensitive synthetic crystal are enclosed in a glass tube, protected from dust. This Crystal Detector is neat in appearance, and looks well on any panel.

The Anti-Phonic Valve Holder, which was the first component for the elimination of microphonic noises, is constructed of materials which are not affected by climatic conditions. There is no rubber



No. 401. Anti-Phonic Valve Holder, for panel or base mounting, in carton with screws, **5s.**



No. 222. Dual Rheostat, 5-30 ohms, for panel mounting, in carton with screws and drilling template, **7s. 6d.**

to perish, the valve-holder proper being supported by four springs which absorb mechanical shocks and vibration. The use of Anti-Phonic Valve Holders will not only prevent microphonic noises, but will also help to lengthen the life of valves. They are ideal for use in portable sets, and should always be used with dull-emitter valves. The construction of the Anti-Phonic Valve Holder is shown in the centre column.

The Burndept Dual Rheostat enables one to use a bright or a dull-emitter valve without altering a set in any way. The first half of the element is wound to a resistance of 25 ohms and the second half to a resistance of 5 ohms. The whole 30 ohms resistance is used to control a dull-emitter valve and the 5 ohms resistance a bright valve. The movement of the brush is practically noiseless, and contact is perfect. The windings cannot be displaced.

Send the coupon to-day

Send the coupon to-day for a free copy of the Burndept Components Catalogue. The loca Burndept Agent will be pleased to show you the actual components and give you any special information you may require.

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EDITED BY JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

An Unnecessary Society.

WE note with regret that the proposal to establish a separate Institution for the Radio Engineer in this country has once again sprung to life. It is suggested that a new society be formed, to be known as the British Institute of Radio Engineers, which could act as an association purely for professional radio engineers and which would arrange for the reading and publication of scientific papers on wireless matters, as does the Institute of Radio Engineers in the United States.

The qualification for admission to the Society is apparently to be solely a knowledge of wireless technique as distinct from any other qualification. It is suggested that a society such as this would give the radio engineer in this country a definite status, which is admittedly a very desirable object.

When this proposal was first mooted some years ago, the I.E.E., realising the undesirability of a duplication of societies, formed a Wireless Section, specifically for the purpose of dealing with such matters as would be dealt with by an Institute of Radio Engineers.

This Section has been admirably supported. Papers are read by the leading radio engineers of the day, and the meetings, which are frequent, are particularly well attended. Moreover, the Committee of the Wireless Section is a very representative and keen body of men, and (though this is not generally realised) is almost completely autocratic. It is true that it is nearly always the *same* keen body of men, but this is, for the present, beside the point.

The present arrangement, however, suffers from the following disadvantages:—

(1) The radio engineer has no definite status. At present any member of the I.E.E. who so desires can belong to the Wireless Section.

(2) Some people who possess good radio qualifications are unable to pass the A.M.I.E.E. examination owing to the inclusion of such subjects as languages and general engineering in the syllabus. This, however, is a matter affecting all branches of the electrical profession.

These difficulties could be obviated in the following ways:

(1) Only duly qualified radio engineers should be admitted to the Radio Section.

(2) Members of the Radio Section could be permitted to style themselves M.I.E.E.(Rad.) or A.M.I.E.E.(Rad.), or to use some similar indication of their qualifications.

(3) The proceedings should be published separately.

(4) The syllabus for the examination should be so modified as to admit genuine radio engineers who, however, are not capable of passing the present examination in its entirety.

It is, in our opinion, imperative that the professional standing of a radio engineer should be equal if not superior to that of an electrical engineer entitled to the A.M.I.E.E. We believe, however, that many older men or, broadly, non-students, find stumbling blocks in the A.M.I.E.E. examination, while being perfectly competent radio engineers.

There are certainly wide spheres of activity in professional wireless work which, while requiring a sound knowledge of electricity, do not require a deep knowledge of electrical engineering. If the I.E.E. had a special examination paper for wireless candidates, the radio side could be stiffened at the expense of other parts of the examination.

(Concluded on page 516.)

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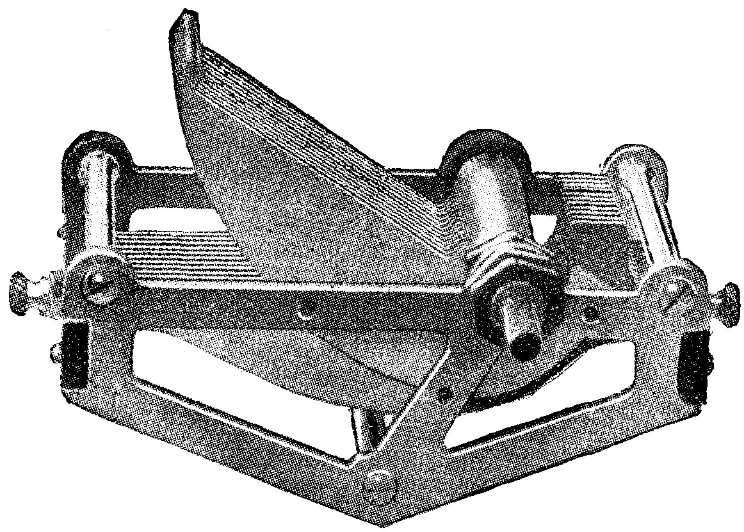
Straight-Line Frequency Condensers

By
SYLVAN HARRIS.



An example of an American straight-line frequency condenser. Note the peculiar shape of the plates.

CONDENSERS have once again come into the limelight. It seems that their lustre will never be dimmed. First it was because of the enormous losses that people thought they found in them; later it was because of the infinitesimal losses that people thought they found in them; and now it is because people have found that the shape

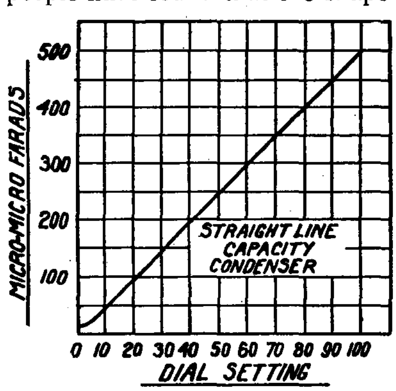


Fig. 1.—The variation of capacity with dial setting for a circular-plate condenser.

of the plates seriously affects their comfort of mind and the convenience of tuning their radio receivers.

We will say noth:ng here about the losses. These have already been treated in detail in this journal. We will confine ourselves here to a study of the effect of the shape of condenser plates. The plates in variable air condensers have heretofore generally been circular, more for simplicity of mechanical construction than for any other reason. Attempts have also been made, from time to time, to place on the market sliding plate condensers. In fact, this was probably the earliest of continuously variable air condensers. These have not proved satisfactory until of late, as the mechanical design has only recently been much improved, and the need for the straight-line type of condenser has just begun to be felt.

Shape of Condenser Plates

With regard to the variation of capacity to the setting of the condenser dial, there are three important shapes of condenser plates. These shapes are such that:—

(1) The variation of *capacity* with dial setting is linear.

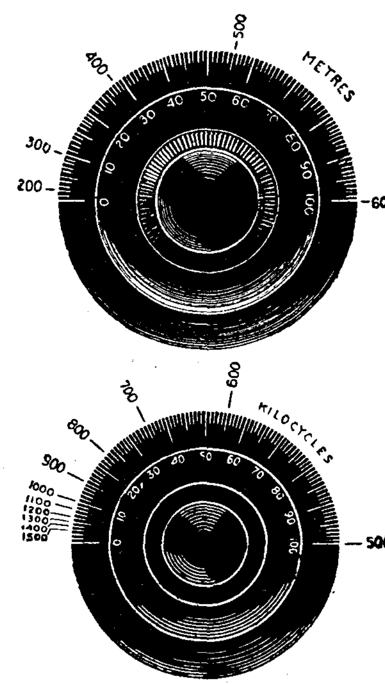
(2) The variation of *wavelength* of the tuned circuit with dial setting is linear.

(3) The variation of *frequency* of the tuned circuit with dial setting is linear.

Each of these types has its advantages and disadvantages, and we will endeavour, as far as possible, to study them in parallel order, so that the merits and drawbacks may be recognised easily.

Circular-plate Condenser

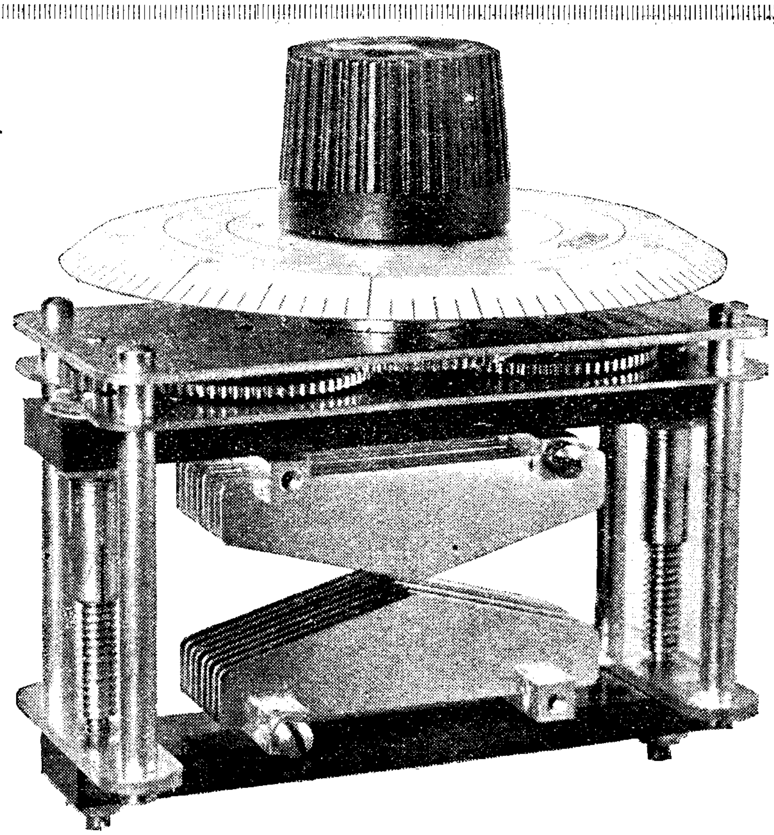
The curve of capacity of the circular-plate condenser is shown in Fig. 1. This is a straight line throughout, excepting for the small portion at the bottom. The reason why the curve rounds off at the bottom is apparent in Fig. 2. The rotor plates are not in mesh with the stator plates over their whole radius until the



Approximate dial calibrations in metres and in kilocycles for a circular-plate condenser.

rotor has been turned a little, generally about 10 divisions on the dial. Even when the plates are totally out of mesh, as shown in Fig. 3, the capacity

In America the number of Broadcasting Stations in a given band is determined on a frequency basis, and amateurs in the States are accustomed to think in terms of kilocycles, whilst in this country we think in terms of wavelengths. In this connection Mr. Sylvan Harris' observations on the relative merits of staight-line wavelength and straight-line frequency condensers are of particular interest.

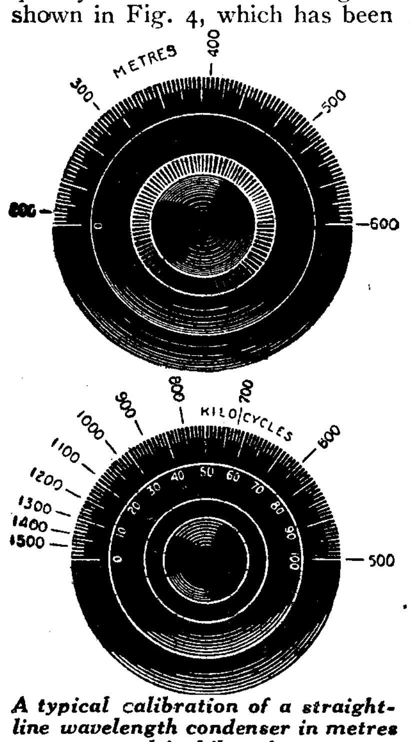


Another condenser of American manufacture. A geared movement is employed and the shape of the plates is designed to give a straight-line frequency curve.

between the terminals of the condenser is not zero, for there is a certain capacity existing between the edges of the two sets of plates and between the shaft and the stator plates.

The curve can be regarded as a straight line, however, over its major portion, and from this it follows that equal motions of the dial will produce equal changes of capacity.

When the condenser is used in a tuning circuit with a fixed inductance, however, the variation of wavelength or frequency of the circuit with the setting of the dial is not linear. The relation of the wavelength and frequency to the dial setting is shown in Fig. 4, which has been



A typical calibration of a straight-line wavelength condenser in metres and in kilocycles.

computed from the equations

$$\lambda = 1884 \sqrt{LC} \text{ and } f = \frac{159 \cdot 3}{\sqrt{LC}}$$

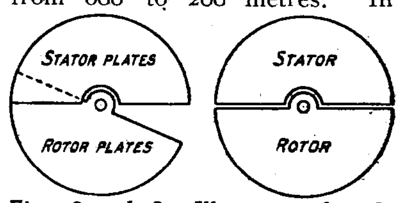
in which λ is the wavelength in metres, f is the frequency in kilocycles, L is the inductance of the coil in microhenries, and C is the capacity of the condenser at any setting in microfarads, assuming ordinary values of inductance and capacity.

Overcrowding at Low Dial Settings

There is a very significant point in connection with these curves. That is, that when we tune on the low dial settings—below about 40 on the dial—the curves become very steep, and small changes in the dial setting cause very great changes in the wavelength or frequency. When the broadcasting stations are assigned channels separated by equal frequency intervals (10 kilocycles), it is evident that there will be a great many stations crowded together at the low dial settings.

The Straight-line Wavelength Condenser

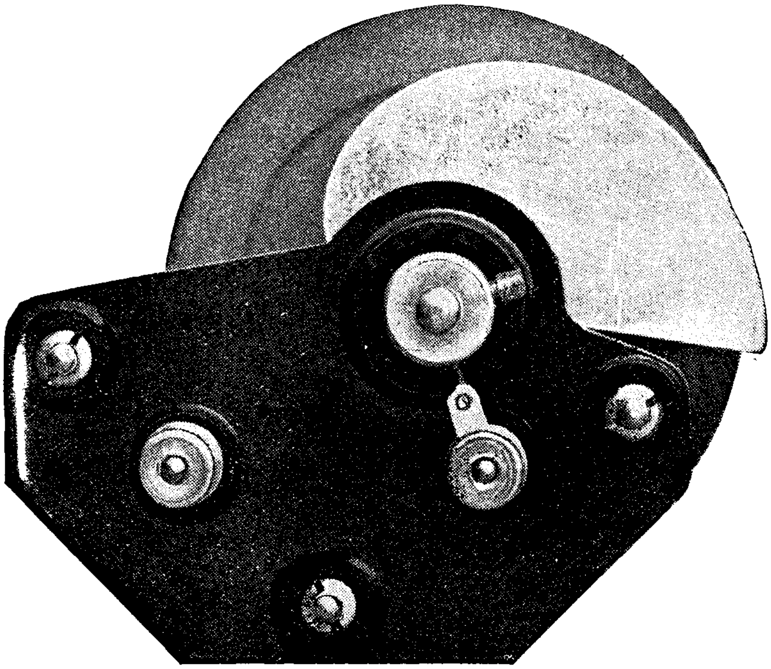
In their efforts to help relieve this crowded situation, designers of condensers have turned their attention to condenser plates of shapes other than semi-circular. The first of these that became popular was the straight-line wavelength type, which gives a straight-line calibration when dial setting is plotted against the wavelength. Such a curve is shown in Fig. 5; it has been drawn to include the wavelength from 600 to 200 metres. In



Figs. 2 and 3.—Illustrate why the Fig. 1 curve rounds off at the bottom.

other words, since we require a straight line from 600 metres at 100 on the dial to 200 metres at 10 on the dial (remember, the plates do not begin to mesh properly until about 10 on the dial is reached), we have simply drawn a straight line between these two points.

Now, if the assignment of transmission channels were made at equal wavelength intervals, say 10 or 20 metres apart, the straight-line wavelength condenser would solve the problem. But the channels are not assigned this way, since it is necessary



A typical example of a square-law or straight line wavelength condenser showing the shape of the moving plates.

for them to have a certain minimum frequency separation to take care of the side-bands which arise in modulating the carrier wave. That is, since transmission of voice or musical sounds requires a frequency band of at least 10 kilocycles to prevent interference or overlapping, if the assignment were made at equal intervals of wavelength, at the short wavelengths the frequency separation would be more than sufficient, while at the longer wavelengths it would not be sufficient. This is the reason why the assignments are made in frequencies.

An Improvement

To show the effect, the corresponding frequency curve has been plotted in Fig. 5. This has been obtained merely by taking the wavelength of points on the curve and dividing this into 300,000 to obtain the corresponding frequency. In other words,

$$f = \frac{300{,}000}{\lambda}$$

in which f is the frequency in kilocycles and λ is the wavelength in metres. It will be noted that although there is still crowding at the low dial settings with this type of condenser, the crowding is not as bad as it is with the circular-plate condenser.

In Fig. 6 the frequency calibrations of the three types of condenser have been plotted together

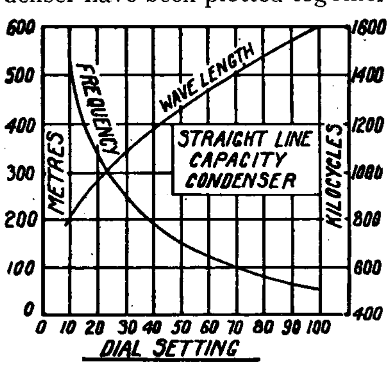


Fig. 4.—The relation between wavelength, frequency and dial setting for a circular-plate condenser.

for the sake of comparison. The straight-line frequency condenser in Fig. 6 has been assumed to have the same range as the other condensers, viz., 600 to 200 metres between readings of 100 and 10. We will not worry about whether such a condenser is possible or not at present; this will be discussed later on. At any rate, to show the desirability of a condenser that will give a straight-line calibration of frequency against dial settings, we have simply drawn the straight line between the limits of the other curves.

The figure shows very plainly that the straight-line wavelength condenser is a trifle better than the straight-line capacity condenser in a way of relieving the crowding, but that it does not completely solve the problem. There will still be some crowding at the low dial settings, while the stations at the higher dial settings will still be somewhat spread out.

A Solution to the Problem

The straight - line frequency condenser, as we have represented it, will solve the problem properly. The frequency varies in proportion to the dial setting, and the frequency difference over

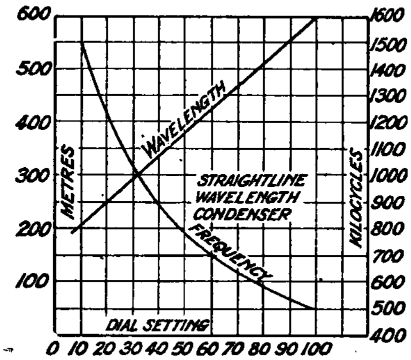


Fig. 5.—The frequency curve for a square-law condenser is not so steep as for a circular-plate condenser.

equal portions of the dial will always be the same, no matter whether it is at the lower or the higher end of the dial. The slope of the curve is less at the low dial settings and greater at the high settings, indicating that at low dial settings the crowding will be less, and at the high settings the spreading out will be less than in the other two types.

Now let us learn how the capacity must vary with the setting of the dial in these three types of condenser. Incidentally, it must be noted that the dials used with the straight-line frequency condensers must be calibrated backward; that is, in the other two types, when we are considering wavelength, an increase of capacity means an increase of wavelength, so that the dial is marked 100 when the plates are entirely *in mesh.* When considering frequency, however, this is highest when the capacity is least, so we must mark our dial 100 when the plates are entirely *out of mesh.*

Formulæ Governing the Capacity Variation

The variation of capacity with the dial setting can be studied from the formula

$$\lambda = 1884\sqrt{LC} = K\sqrt{C}$$

and

$$f = \frac{159 \cdot 3}{\sqrt{LC}} = \frac{K}{\sqrt{C}}$$

in which the quantities are in the same units as explained before.

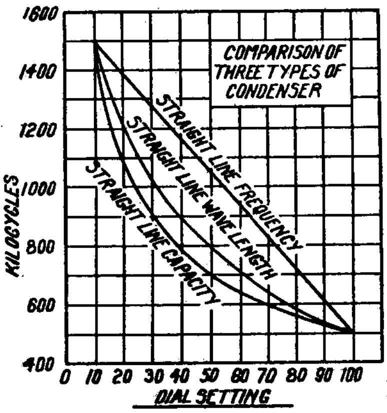


Fig. 6.—These curves enable us to compare the utility of the three types of condensers when the number of stations in a given band is allotted on a frequency basis.

We will assume the inductance to be constant, and do the tuning only by varying the capacity of the condensers. K is a constant obtained by combining the numerical parts of the equations with the constant inductance.

We then have the three laws for the three types of condenser which make these straight-line condensers :—

(*a*) For the circular type,
C is proportional to D.

(*b*) For the straight-line wavelength type,
C is proportional to D^2.

(*c*) For the straight-line frequency type,
C is proportional to $1/D^2$.

Thus, if D^2 is substituted for C in the equation for λ, we shall have $\lambda = K'D$. Likewise, if we substitute $1/D^2$ for C in the equation for *f*, we shall have $f = K'D$. Both of these resulting relations are linear equations. D represents the dial setting.

Dial Calibrations

Knowing the laws expressed by (*a*), (*b*) and (*c*) given above, it is easy for us to study how the capacity must vary with the dial setting. We shall consider the range of dial readings to extend only from 10 to 100, instead of from zero to 100, for reasons that have been explained before. There is an additional reason for doing this: if we should take zero for the dial setting and substitute this in the relation $C \propto 1/D^2$ (the sign ∝ means " proportional to "), we shall have $C \propto \frac{1}{0}$, which is an indeterminate number generally expressed as " infinity."

To show the relative variation of capacity in the three types of condensers, we have assumed the capacity at 10 on the dial of the straight-line capacity and wavelength condensers equal to unity. At 100 on the dial, the capacity of the circular plate condenser will then be 10 and that of the straight-line wavelength condenser 100. In other words, whereas the capacity ratio of the circular condenser can satisfactorily be 10 to 1, the ratio for the *straight-line wavelength* condenser must be 100 to 1. That is, if the capacity at 100 on the dial is 0.0005 microfarad, the minimum capacity will have to be 0.000005 microfarad to preserve the square law (or the straight-line calibration) over the whole dial. There are on the market at present several very satisfactory straight-line wavelength condensers.

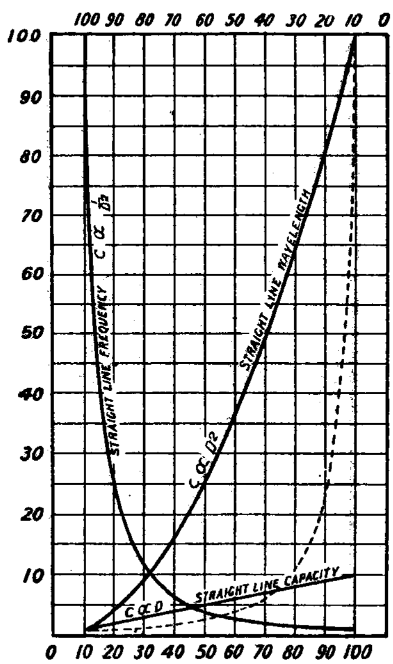
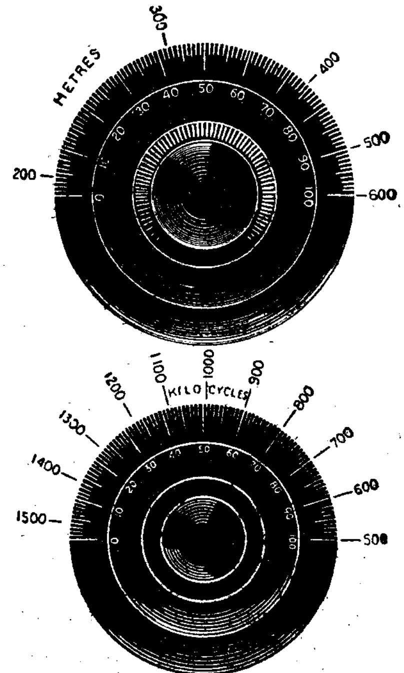


Fig. 7.—Curves showing the ratio of capacity at any dial-setting (indicated on the horizontal axis) to the capacity at 10 on the dial.



Showing how the dial calibrations would appear for a straight-line frequency condenser.

The reader must remember that the curves of Fig. 7 represent *relative* values and not actual values; thus, the capacity of the straight-line capacity condenser at a dial reading of 50 must be *five* times the capacity it has at a dial setting of 10; the straight-line wavelength condenser must have a capacity at 50 on the dial of *twenty-five* times its capacity at a dial setting of 10; this is also true of the straight-line frequency condenser.

It will be noted that the straight-line frequency curve increases as the dial setting becomes lower. This is in accordance with our statements above to the effect that when the plates of this condenser are entirely *out of mesh* and the capacity is least, the frequency is highest.

To be able to visualise more easily the difficulties which attend the design of the straight-line frequency condenser, we have reversed the reading of the latter and have made it read in the same direction as the others. The dial readings are shown at the top of Fig. 7. We have then re-plotted the curve, giving us the broken line curve of Fig. 7.

(The concluding portion of this article will be published in a subsequent issue.—ED.)

The Importance of the "Het" in the Super-Heterodyne

By J. H. REYNER, A.C.G.I., B.Sc., D.I.C., Staff Editor.

An interesting article showing that a considerable proportion of the effectiveness of a Super-Heterodyne receiver arises from the fact that the signal is heterodyned.

SUMMARY.

With spark or unheterodyned telephony transmissions a certain high-frequency amplification (or its equivalent) is essential owing to the fact that the ordinary detector is disproportionately insensitive to weak signals.

This effect is shown to be due to the "square-law" characteristic of the detectors in use to-day. High-frequency amplifiers, however, are difficult to construct and use.

It is further shown that this disadvantage is overcome in the case of reception of C.W., due to the necessity for heterodyning, and that provided the heterodyne is sufficiently strong, high-frequency amplification may be dispensed with.

The presence of the heterodyne in the "Superhet" enables full advantage to be taken of this fact, and for that reason it is suggested that more attention should be paid to the oscillator in super-heterodyne sets.

The design of a receiver depends primarily upon the purpose for which it is intended, and in particular on the type of signal which is to be received. In order to achieve long-distance reception, either of spark signals or telephony, experience shows that a certain high-frequency amplification is necessary.

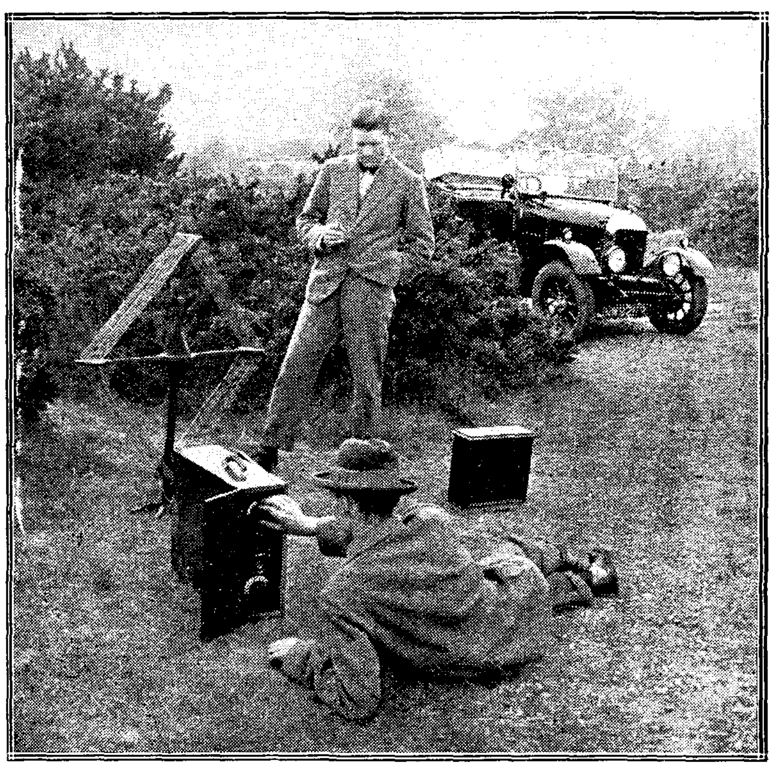
Square-Law Characteristics

Now it is well known that any of the rectifiers in common use to-day obeys a square - law characteristic, that is to say, the current which is produced through the rectifier, which is effective in producing signals in the telephones, depends upon the square of the voltage applied.

A representative characteristic is given in Fig. 1, which illustrates this point. It will readily be seen that the value of the current obtained through the rectifier when the voltage has the value OB, is four times as great as that obtained when the voltage has the value OA, which is only one-half of OB. Hence the current produced is dependent upon the square of the voltage applied.

It will be clear, therefore, that, extending the square law principle downwards to very small signals, the response of the rectifier will fall off much more rapidly than the signal itself. Local interference, on the other hand, remains the same as before, so that as the signal strength falls off, that is to say as more and more distant stations are tuned in, a point is rapidly reached where the ratio of signals to interference becomes too small for good reception.

The curve shown in Fig. 1 is for a valve employing anode rectification. In consequence, all current in the negative direction is cut off, but the same reasoning applies to a crystal characteristic, as shown in Fig. 2, in which there is a certain current in the reverse direction. The resultant uni-directional current after passing through the rectifier is still found to obey a square-law, so that the detector is more sensitive to a strong signal than to a weak signal. The curve shown in Fig. 1 applies equally well to a valve



One of the most attractive features of the Super-Heterodyne is its adaptability for use as a powerful portable receiver. The one illustrated is the eight valve receiver described by Mr. Kendall in "Modern Wireless" for July, 1925.

employing cumulative grid rectification, the square - law still holding good.

Use of High-Frequency Amplification

The only remedy for this unsatisfactory condition of affairs is to use a certain amount of high-

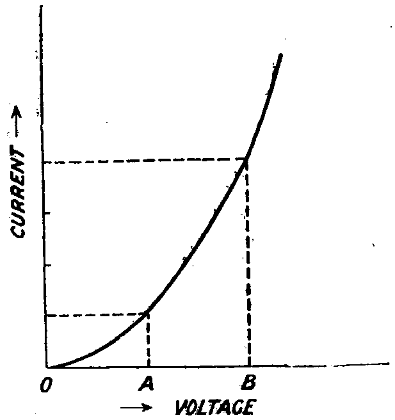


***Fig. 1.**—This curve clearly shows that the current output of the rectifier varies as the square of the applied voltage.*

frequency amplification in front of the detector. By this means the signals received on the aerial may be amplified so that they operate the detector efficiently. From this point of view an amplification of two before the detector will be equivalent to an amplification of four behind the detector, and may even result in the reception of a signal which is utterly inaudible without these high-frequency stages.

Unfortunately, the provision of efficient high-frequency amplification is a matter of some difficulty. Owing to the high-frequency involved, coil capacities, valve capacities, and stray inter-circuit capacities, become of considerable importance, with the result that it is almost impossible to obtain a high-frequency amplification of more than two per stage.

To obtain even this amount of amplification requires careful design, and the results, particularly on and below broadcast wavelengths, are liable to be very disappointing unless suitable precautions are observed. It should not be thought, however, that high-frequency amplification is an impracticable, or even an undesirable, proposition, and for straight circuits, for the reception of spark or telephony signals (unheterodyned) the results obtained justify the precautions taken.

Use of Reaction

An effect equivalent to the use of high-frequency amplification is, of course, obtained by the use of reaction, and this is in some ways a more satisfactory solution of the problem. Reaction circuits are somewhat critical, and unfortunately are only too prone to cause distortion. Probably the best solution of the problem in this case is the employment of a certain high-frequency amplification combined with judicious use of reaction.

Continuous Wave Reception

The reception of continuous waves, on the other hand, is not subject to the same disadvantages. In order to render the signals audible, it is necessary to heterodyne the incoming oscillations with a local oscillator, and this exercises a considerable effect on the process of rectification. The heterodyning process, as is well known, consists in introducing into the circuit a local oscillation, of a frequency nearly equal to that of the signals. These two oscillations will alternately swing in and out of phase and so will produce beats.

The phenomenon may be demonstrated by considering two men walking down the road together. Assuming that the two men start off in step, but that one man takes slightly quicker steps than the other, it will be obvious that the two men proceed on their way alternately coming in and out of step. In an exactly similar manner the two electrical oscillations will come in and out of step. When they are in step the combined amplitude of the two will be the sum of the two oscillations. When they are out of step the amplitude will be the difference of the two oscillations. At the intermediate point the amplitude will lie in between these two extremes.

Heterodyne Modulation

The result, therefore, of combining these two oscillations of slightly different frequencies is to produce a third oscillation, of which the amplitude is continually varied. The variations of this amplitude may be made to occur at an audible frequency, thereby rendering the signals audible in the telephones. It may be remarked, in passing, that it is still necessary to rectify these oscillations before they can be heard in the telephones, because the actual oscillations produced by the combination of the two high-frequencies are still at a high-frequency. It is only the variations which are at a low-frequency, and so are audible. Fig. 3 illustrates this effect. The incoming signal is represented by the top line, and is shown as comparatively weak. The heterodyne, which is represented by the second line, is shown as several times stronger than the incoming signal. The effect of combining these two is to produce a composite oscillation consisting of a high frequency component, modulated at a considerably lower frequency. In practice, as has been seen, this modulation is arranged to occur at an audible frequency.

Effect on Rectifier

The oscillations must now be applied to the detector in order to be rectified, and so made to produce audible signals. Consider the effect of applying a signal of the type shown in Fig. 3 to an ordinary square-law rectifier.

Reference to Fig. 1 will show that, above a certain value of applied voltage, the rectifier characteristic becomes very nearly a straight line, at any rate

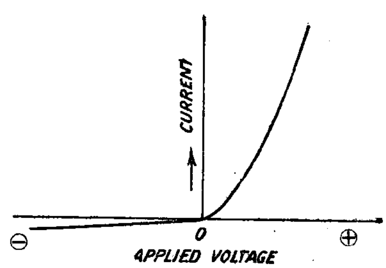


***Fig. 2.**—This characteristic of a crystal detector illustrates the reverse current, which is only of small magnitude.*

for small excursions about any given point on the curve.

Now, it will be obvious that provided the signal strength is large enough, it is possible for the oscillation to sweep right over the square-law portion of the characteristic, and for the extreme positions of the voltage swing to lie on this "straight line" portion of the characteristic. If this were the case, and the amplitude of the oscillation were varied, the variations in current which would result would be subject to a linear law. That is to say, the current would vary directly as the increase or decrease of the voltage applied.

Linear Rectification Obtained with Heterodyned Signals

This is exactly the state of affairs which exists with a heterodyned signal. The comparatively large high-frequency component of the heterodyned oscillation sweeps over the square-law portion of the characteristic, and reaches the straight line portion. This point is illustrated in Fig. 4, from which it will be seen that the low-frequency modulations, which are super-imposed on the top of the high-frequency portion, all take place over a portion of the curve which is practically a straight line.

This means, therefore, that as far as the *modulations* are concerned, the rectifier obeys a linear law. Consequently if the signals incoming on the aerial are reduced in strength, the response of the rectifier is reduced in exactly the same proportion. It does not fall off in the disproportionately rapid manner which is obtained with a spark or other unheterodyned signal.

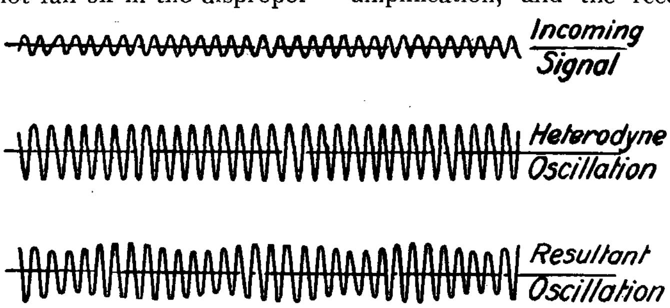


Fig. 3.—The third line indicates the variation of the resultant oscillations at an audible frequency.

Effect of Strength of Heterodyne

There is a second advantage which accrues from the use of a heterodyne. If the current through the detector is worked out, it is found that the low-frequency component (which is the only part of the current capable of affecting the telephones) is proportional to the *product of the signal and the heterodyne.*

Thus the stronger the heterodyne the greater will be the response of the rectifier, up to a certain limit, which is mentioned later.

Use of Heterodyne Doubly Effective

It follows therefore that the heterodyne is doubly effective in assisting the rectification of weak signals. In the first place, the heterodyne itself produces considerable amplification, and in the second place the rectifier obeys a linear law so far as the incoming signal is concerned.

In order that this last condition may apply, it is obviously essential that the heterodyne shall be sufficiently strong to sweep well over the square-law portion of the characteristic. This, however, is easily arranged. It will readily be seen, therefore, that for the reception of continuous wave signals, high-frequency amplification may be dispensed with. Practical experience has indicated that this is the case. Most of the long-distance amateur reception has been carried on with little or no high-frequency amplification. Moreover, the Marconi Company have carried out experiments, using eight stages of high-frequency amplification and a detector, as against a detector and eight stages of low-frequency amplification, and the reception in both cases was equally effective.

Reception of Telephony

The use of a heterodyne for the reception of telephony, however, is not practicable with ordinary circuits, owing to the whistle which is produced by the interaction of the heterodyne and the carrier wave of the transmitting station. It is certainly possible to adjust the heterodyne so that the carrier wave is on the zero point, but in this case telephony is distorted quite apart from the interference which is caused to other people by such a procedure. There is no doubt, however, that this method does bring in stations which cannot be heard if the heterodyne is not present, and this is what one would expect from the previous remarks.

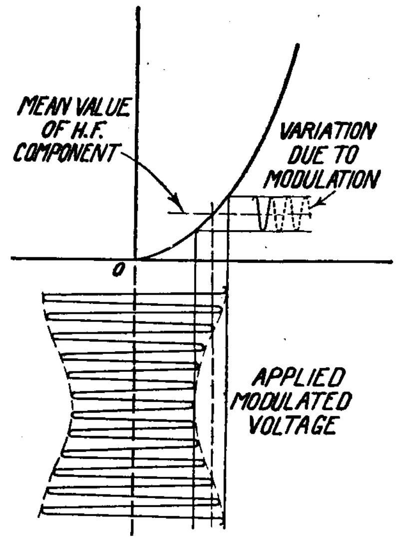


Fig. 4.—The variation due to modulation can be seen to obey fairly closely a linear law.

Consequently, if a heterodyne can be introduced at some point in the receiver before rectification occurs without causing distortion, the full advantage can be taken of the heterodyne amplification and the increased rectification efficiency.

The Super-Heterodyne

This is exactly what is done in the super-heterodyne. In this case the heterodyne is so arranged that the beat note produced is inaudible or *supersonic.* No adverse effect, therefore, results from the employment of this heterodyne oscillation, while we are still enabled to take advantage of the heterodyne amplification.

In the super-heterodyne system we select the inaudible frequency, and tune our succeeding circuits to this frequency. The system, therefore, is the same as before, the speech modulations being impressed upon a new carrier wave, which is amplified and detected in the usual manner.

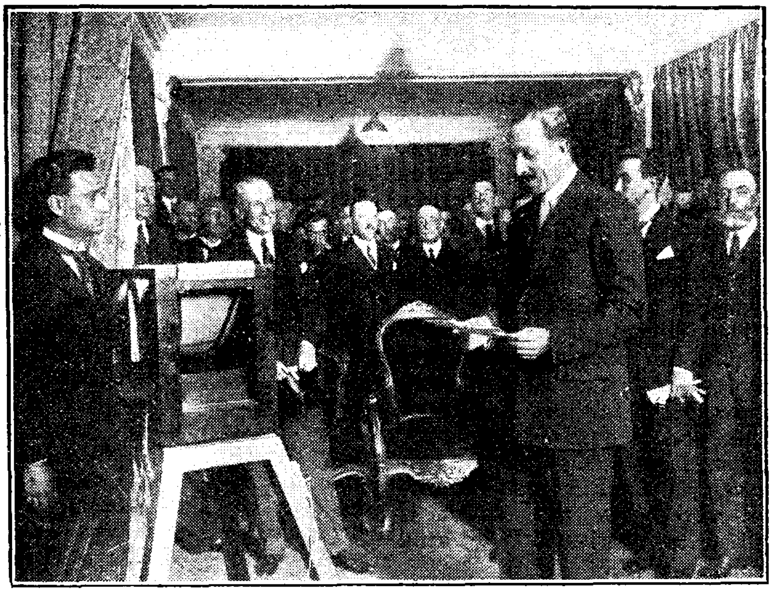
Advantages of System

There are several advantages in this procedure, such as more efficient amplification at the intermediate frequency, greater selec-

(*Concluded on page* 493)

THE NEW MADRID STATION

The Madrid station is one of the most popular of the European broadcasting stations as far as reception in this country is concerned, and readers will no doubt welcome some authentic information regarding the source of the programmes they so frequently hear.



King Alphonso before the microphone delivering the speech with which he officially inaugurated the Madrid station.

THE latest addition to the chain of Spanish broadcasting stations is that of the "Unión-Radio," Madrid, which, although some people may accuse it of plagiarising the new 2LO, was nevertheless planned some months ago, and contains many distinctive features.

It certainly takes the British stations as a model; the transmitter proper is a Marconi "Q" type; the generator produces 6 kw., and storage accumulators give up to 110 volts. Motors and generators are duplicated in case of breakdown. The station sends out "on the air" about 1.5 kw.

The Aerial

The aerial is of the single sausage "T" type, suspended between two steel lattice towers 125 ft. high, erected on the roof of one of Madrid's largest emporia, known as the "Madrid-Paris Stores," situated in one of the highest parts of the city. The roof in question is 98½ ft. above street level. The "earth" is a fan-shaped counterpoise spreading over the roof.

Two microphones are in use, of the "Marconi-Sykes" (magnetophone) type, one in each of the two studios. Between these studios is the control room, whence the studio work is observed through a window looking into whichever studio is in use. Also by means of duplicate equipment similar to that in the transmission room the modulation can be checked.

The crowd which gathered at the Madrid-Paris stores on the occasion of the opening ceremony.

The Studios

The smaller of these studios (about 10 ft. square) is used for announcements, news and lectures. The walls are hung with grey velvet serving as decoration and also as a sound-deadener. The microphone rests on its rubber-sponge bed on a sort of pedestal, and three or four easy chairs are arranged around the room. There is also a gramophone—"in case"! In the larger studio, however, there is space for a number of musicians, and a grand piano and a harmonium are provided, while the microphone is mounted on its familiar wheeled carriage, with the cut-out switch on the side. This studio is about 15 ft. by 60 ft., the walls lightly draped, but the ceiling is left bare, so that although echo is diminished the "open air" effect is not evident. All the decoration and furnishing is carried out "de luxe"—almost bizarre to English eyes.

The Artistes

The entire plan of the "Unión-Radio" is, to all appearances, in parallel with that of the B.B.C. It is formed of various electrical and radio companies in Spain, and the option is open to anyone who may care to join, to take out shares in the Unión. Artistes, composers and other collaborators will receive fees (which is not the case with other Spanish broadcasting stations), by which means they obtain all the best singers, musicians and lecturers.

The station director, Señor Urgoiti, an exceedingly earnest and enthusiastic young man, places great faith in the enterprise, and is anxiously awaiting reports from distant points, particularly from England; so anyone who hears the station is invited to "write in" or send applause cards.

Times of Transmission

As means of income, they have a percentage on sales of the various companies forming the Unión, in the form of stamps; they also allow advertisements to be broadcast, but these are sent out in a very humorous form, making a pleasant interlude to the musical items. Another item of income is provided by the weekly journal of the company, entitled *Ondas*, i.e., "Waves," in which appear the programmes of the station, together with those of other stations, when no objection to such publication is raised. It is the official organ of the "U.R.S.A." (such are the initials of the company's full title), and is the means of communication between the station and the listener.

Broadcasting times are at present arranged as follows:—

Every day, from 2.30 to 3.30 p.m.

Alternate days, from 6 to 8 p.m., and 10 to 12 p.m.

(All times approximate G.M.T. as Spain has no "summer time" this year.)

Programmes

The afternoon performance consists of a short "pot-pourri" of things appropriate to the time of the day. They call it "An hour at the table," as it occurs at the Spanish mid-day meal hour. They give a time signal, some "trio" music, a few stories and jokes, and the theatre performances for the day. In the evening each day has its own distinctive "show"—opera, musical comedy, sketches, Spanish regional folk-songs, dance music, chamber music, the classics, etc., all take their turn.

Opening of the Station

The station was officially inaugurated by King Alphonso at mid-day on Wednesday, June 17, being introduced to the public by Sr. Valentín Ruiz Senén, president (or chairman) of the Unión-Radio Company, and one of Spain's most prominent business chiefs. After eulogising the efforts of Spanish engineers, His Majesty concluded with the remark that he "was proud to count himself as one more radio listener." The speeches were broadcast to large crowds gathered in front of the Madrid-Paris Stores, in the parks, and, needless to add, to thousands of others in their own homes and offices.

Tuning Note

The call sign is EAJ7, pronounced in English "eh-ah-hota-siete," and the official wavelength is 430 metres. Transmissions start with a tuning note in the form of a sort of bugle call playing "doh-me-soh-doh." The announcer then gives the call sign, followed by "Unión-Radio, Madrid."

The Manchester Station

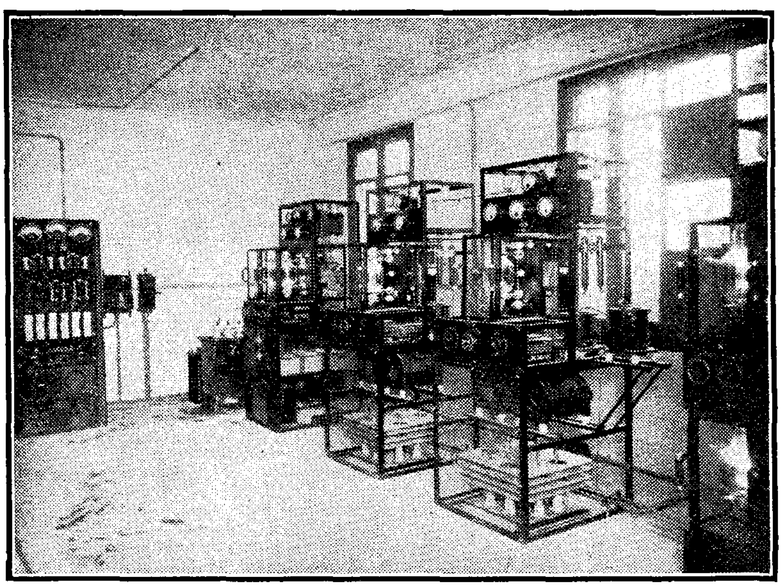
A Recital of Sea Shanties by Mr. Stanley Maher and his "Crew" of four achieved a great success at Manchester recently. Mr. Maher will appear again in a programme of songs, humour, and sea shanties on Thursday, July 30. A portion of this programme will be set apart for a performance of Beethoven's celebrated "Kreutzer Sonata," by Miss Jo. Lamb, violin, and Mr. John Wills, piano.

* * *

Operatic productions continue to be among the most popular features of the Manchester programmes. On Saturday, August 1, a performance of "Cavalleria Rusticana" will be given, the principals being Miss Stiles Allen, Miss Rachel Hunt, Mr. Edward Leer, and Mr. Lee Thistlethwaite. This opera will be relayed from 5XX.

* * *

A new production clothed in an old title, "The 7.30 Revue," will appear again in a fifth edition at Manchester on August 8. Popular numbers from musical comedy and revue, humorous sketches and interludes by the 2ZY quartet, will, as before, form the principal ingredients. For this occasion Mr. Victor Smythe, the producer, has written a series of humorous descriptive monologues.

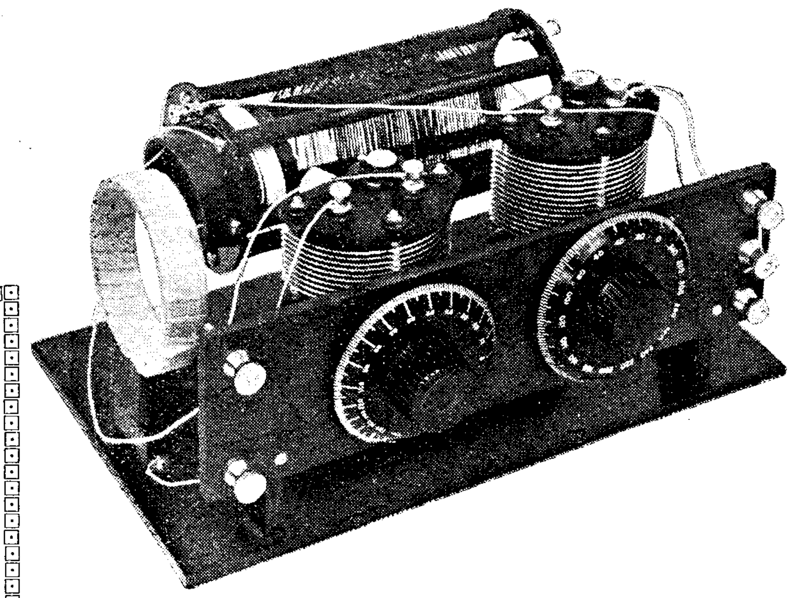


A view in the transmitting room at the Madrid station. A Marconi "Q" type transmitter is employed.

Some Notes on the Magnitude of Condenser Losses

By G. P. KENDALL, B.Sc., Staff Editor.

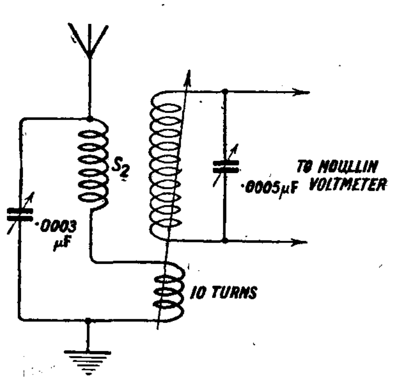
What proportion of the total losses in a tuned circuit is due to the variable condenser? In the following article Mr. Kendall makes some interesting observations on this subject which are the result of some tests made with a view to answering this question.



The complete tuning unit used by Mr. Kendall in his tests. The condensers were mounted upside down to simplify the wiring.

THOSE readers of *Wireless Weekly* who have followed the important work of Mr. Sylvan Harris upon the measurement of the high-frequency resistance of variable condensers will by now have realised that an important question is arising, which may be expressed thus: what proportion does the loss in the condenser bear to the total loss in a tuned circuit?

The results obtained by Mr. Sylvan Harris would appear to show fairly conclusively that the high-frequency resistance of any reasonably good variable condenser upon such wavelengths as those embraced in the broadcast



The circuit arrangement of the tuner illustrated on this page.

band is in the neighbourhood of one ohm, so long as the condenser is operated at the larger dial readings. This last is an important point, which must be borne in mind if any attempt is made to carry out measurements or comparisons of variable condensers, the critical setting (below which the high-frequency resistance appears to increase rapidly), being in the majority of condensers in the neighbourhood of 20 or 30 degrees upon the scale.

A Pertinent Question

Now, if the H.F. resistance of a variable condenser is to be taken as being of the order of one ohm, it becomes pertinent to ask just what effect will be produced by further lowering the resistance of that condenser to, say, half an ohm; in other words, whether the still further reduction of condenser losses is going to produce any marked effect upon signal strength or selectivity. It is probably safe to predict an answer to this question when many of the common types of high resistance tuning coils and high-frequency transformers are in use, to the effect that when the winding has a high-frequency resistance which may be ten or twenty times higher than that of the variable condenser, small alterations in the resistance of the latter will be swamped as regards their effect by the total losses in the circuit.

Effect of a Low-loss Condenser

It would seem that in such cases as this, where the high-frequency resistance of the tuning coil or high-frequency transformer swamps that of the variable condenser, the use of a low-loss condenser of one of the new types is to be encouraged, not on the ground that it will lead to a marked improvement in signal strength, but because it will probably stimulate one to make an attempt to improve the rest of the circuit to such an extent that the benefit of the low-loss condenser may be obtained to the full. Besides, of course, the latest types of low-loss condensers are unquestionably *improved* condensers in every way, from whatever point of view they may be regarded, mechanical or electrical.

Proportion of Condenser Losses

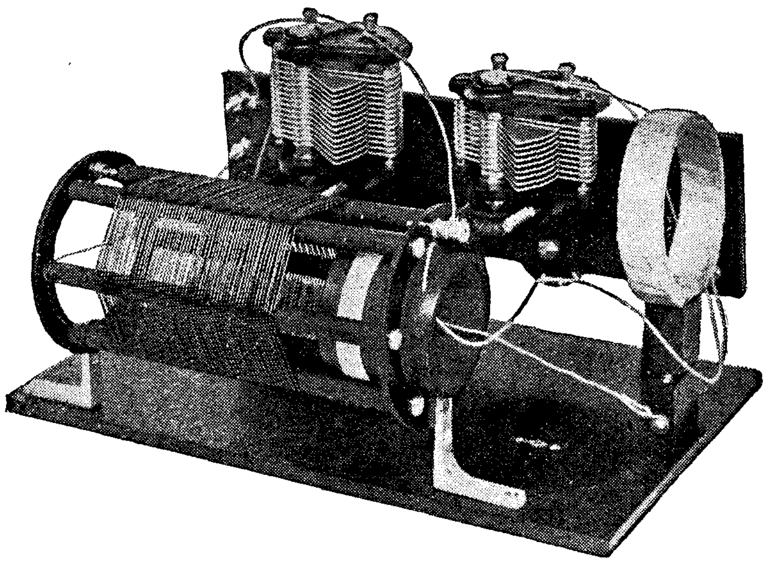
It is interesting to attempt to determine how far the reduction of losses in the tuning coil windings must be reduced before condenser losses will become a really large part of the total, and possibly an account of some simple experiments which I have carried out with this end in view may be instructive. It is to be understood that I am speaking here of results upon wavelengths of the order of 300 to 500 metres, and that any remarks which I make as to the magnitude of losses should be qualified by this proviso as to wavelengths; what may happen upon the very short waves is probably another story.

My experiments were upon the lines of an attempt to decide whether the losses in variable condensers were sufficiently large to show up as variations in signal strength when the condenser under consideration was used in what we may regard as a reasonably low-loss circuit. Such a test is probably very much less sensitive than one which uses selectivity as the criterion of performance upon the part of the variable condenser, and this must be borne in mind when considering the results.

Experimental Method

The experiment was carried out with the aid of very loosely coupled primary and secondary circuits, since it is evidently of little use to attempt to estimate the effect of small losses in the aerial circuit, where the other losses are normally already large. I accordingly constructed a simple low-loss tuner, consisting of a separately tuned aerial circuit very lightly coupled indeed to a secondary comprising a fairly low-loss coil and a standard condenser. No very special attempt was made to reduce losses in the aerial circuit, because such an attempt as a rule produces little effect of a noticeable nature in selectivity or signal strength, when using a tuner of this type, since it seems that the reduction of losses beyond a certain point is almost negligible in comparison with such factors as the earth resistance and the radiation resistance of the aerial.

The aerial circuit, then, consisted of a Burndept S2 coil and a small coil of ten turns of No. 22 double cotton covered wire wound on a piece of ebonite tube, to act as the coupling unit with the secondary. These two coils in series were tuned by a parallel variable condenser of .0003 μF capacity.



The tuner was constructed on low-loss lines in order that any losses due to the condensers should be more apparent.

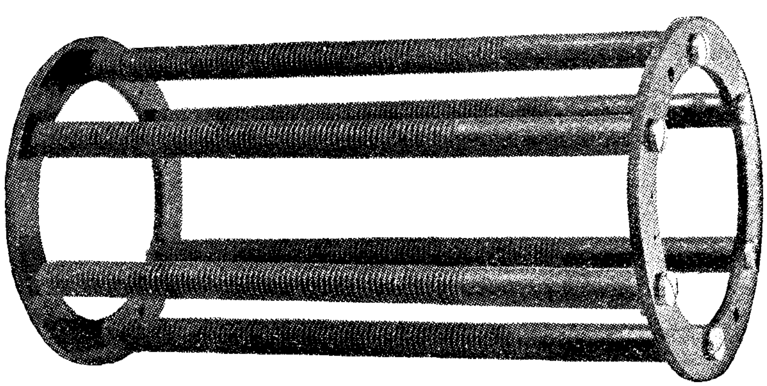
The Low-loss Secondary

The secondary consisted of a winding of No. 20 enamelled wire upon one of the squirrel-cage formers, which Messrs. Collinson Precision Screw Co. are now producing as a standard unit, the rods of the squirrel-cage being threaded, so that it is an easy matter to wind the turns of wire with a lateral spacing. The turns actually run about 16 to the inch, and quite a good air space is thereby produced between each turn and its neighbour. Across the secondary winding was connected a .0005 μF variable condenser, to act as a standard for comparison purposes, both this and the aerial condenser being of the geared type, also produced by Messrs. Collinson Precision Screw Co.

The procedure, in testing condensers was to adjust the coupling between aerial and secondary to as weak a value as would still give a fairly large figure of signal strength, and then to substitute by a simple change-over device the condenser under test for the standard condenser embodied in the unit, which is seen in the photograph accompanying this article.

Method of Measurement

The method of measurement of signal strength was the Moullin voltmeter method, the Moullin valve being connected across the secondary winding in the usual manner. A signal strength of the order of ten units from 2LO's carrier wave was obtained, and it was possible to read the scale of the milliammeter which I was using to an accuracy of .1 of a unit. This test was carried out upon a great



The low-loss type of former on which the air-spaced secondary coil is wound.

variety of variable condensers, including some with ebonite end plates, some with metal end plates and small ebonite bushes, others of the latest improved types, and so on.

The Results

In every case except one, the differences in signal strength produced by substituting one condenser for another were not large enough to express in figures upon the scale mentioned. In some cases just perceptible differences were visible in the position of the milliammeter needle, but these differences were so small that they could not be correctly expressed in figures. The one exception was a condenser of a rather freak variety, which any experimenter of experience would have condemned upon a cursory examination, and this instrument gave a reading of only 9.5, as against 10 with a condenser of normal efficiency in circuit.

Conclusions

It would seem that the conclusion to which we should come after these elementary tests is, that in a circuit wherein the losses have been reduced even so far as it is believed that they are reduced in a secondary winding like the one which I have described, the differences of condenser efficiency are still not large enough to produce a noticeable effect upon signal strength. Lest I should convey the impression of depreciating the value of a modern type of low-loss condenser, I should make it clear that previous experience of tests of a generally similar character leads me to believe that the slight differences perceptible in signal strength would become much more considerable in a test based upon selectivity.

In conclusion, it seems hard to avoid the conviction that while low-loss condensers are in every way to be encouraged, as should any improved piece of apparatus, yet they do undoubtedly throw a responsibility upon us to improve further and yet further the other constituents of our tuned circuits, in order that we may reap the full benefit of a reduction in condenser losses.

The Importance of the "Het" in the Super-heterodyne.

(Concluded from page 488)

tivity, etc., which have all been discussed in previous articles.

The most important advantage of the system, however, lies in the use of the heterodyne, which produces the double amplification effect (due to the amplification *per se,* and to the increased effectiveness of the rectifier) previously referred to. It is often desirable to provide a high-frequency valve for the purpose of avoiding radiation from the aerial, and also to produce a certain high-frequency selectivity, but from the consideration of signal strength alone this is not necessary.

It will be obvious from the foregoing discussion of heterodyne amplification that a strong heterodyne is essential. The requirements may be summarised as follows :—

(1) The heterodyne must be strong enough to sweep over the square-law portion of the characteristic on to the linear portion.

(2) When this condition has been attained, the strength of the signal obtained is directly proportional to the product of the incoming signal and the heterodyne.

The Limitations

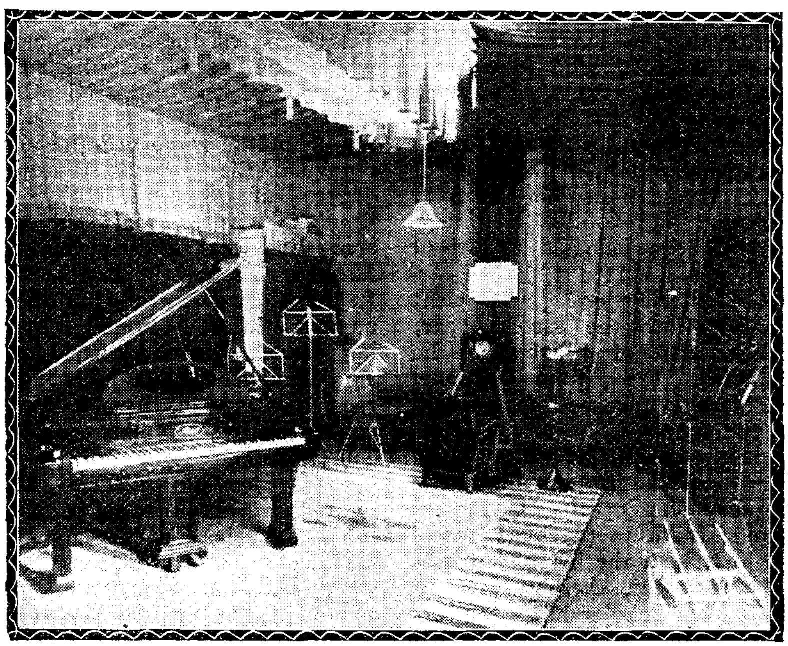
There is, of course, a limit to the increase of the heterodyne, because the characteristic of the detector does not remain linear indefinitely owing to saturation and such-like effects. In practice there is a definite optimum value of the heterodyne oscillations at which the response of the detector is a maximum, the actual value depending on the type of valve and the system of rectification adopted.

These points will be discussed in a future article, and values for some of the more common types of valve will be given.

It may be observed, however, that the optimum heterodyne value is of the order of 2 to 3 volts, which is quite a strong oscillation.

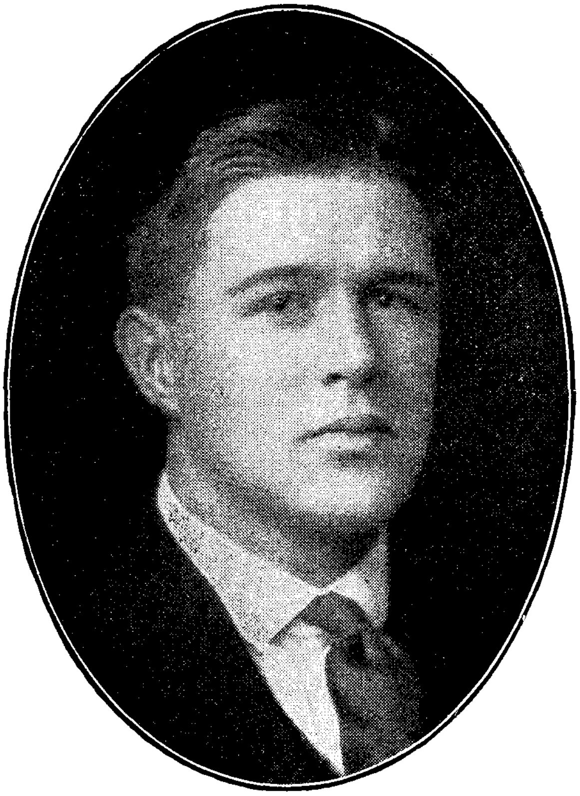
An increase of strength of the heterodyne will have little effect on signals which are already good, but will be distinctly beneficial in the reception of distant stations.

The tendency is thus for all stations to be of about equal strength, and this is, of course, one of the first points observed in practice with a good super-heterodyne receiver.



The studio at the Hilversum Broadcasting Station in Holland. The microphone is similar to that used in the B.B.C. studios.

APPOINTMENT OF Mr. J. H. REYNER, A.C.G.I., B.Sc., D.I.C., TO THE STAFF OF RADIO PRESS LTD.



A recent portrait of Mr. Reyner.

IN connection with the development of our Research Laboratories at Elstree, we have considerable pleasure in introducing to our readers Mr. J. H. Reyner, who joined the staff of Radio Press, Ltd., on July 1.

Mr. Reyner, although comparatively young, is possessed of high qualifications, his career at the City and Guilds (Engineering) College being a record of successes.

On entering college he went straight into the second year, at the end of which time he obtained the John Samuel Scholarship for the best student of the year.

At the conclusion of the third year course he obtained the Associateship of the City and Guilds Institute (A.C.G.I.), and again headed the list of successful candidates, thereby gaining the Unwin Scholarship. He further achieved the distinction of gaining the Henrici Medal for the best student in Mathematics.

He followed this up with a fourth year course in research work, under Professor G. W. O. Howe, on Radio Telegraphy and Telephony, at the conclusion of which he was awarded the Diploma of the Imperial College (D.I.C.).

During the same year he also obtained the B.Sc. Honours degree of the University of London, the special subjects being Electrical Engineering and Mathematics. Perhaps Mr. Reyner's qualifications can best be appreciated from the following extract from an official college document: "This brilliant record is nearly, if not quite, unique in the annals of the college."

Since leaving college Mr. Reyner has been engaged with the Post Office Engineering Department. He has been responsible for the design of receiving equipment at the various coast and other stations controlled by the Post Office.

He has further been responsible for the design of complete receiving stations which have been erected under his supervision, including, in some measure, the Direction Finding Service, which is now being rapidly developed, so that he has been able to keep well in the forefront of developments in wireless reception.

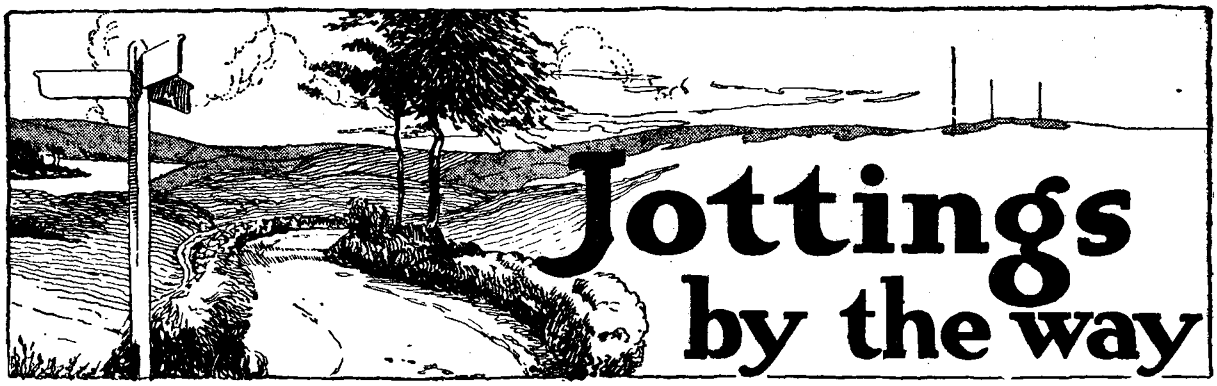
Mr. Reyner has already obtained considerable experience in the preparation of articles of interest to the radio public, and has, in fact, written two books on the subject. One of these, *Modern Radio Communication*, is fast becoming accepted as the standard low-priced text book on wireless.

The second book is a very valuable collection of data, which embraces every phase of the science, and will be published by Radio Press, Ltd., on September 1.

Mathematics, as such, are of little interest to the average reader. Mr. Reyner, however, while intimately conversant with the more technical and mathematical aspects of radio, is an expert in the art of investigating problems from a theoretical and practical standpoint, and subsequently placing the results obtained in a very simple form, easily understood by the non-technical public.

Our readers may, therefore, look forward to a series of most helpful articles from Mr. Reyner's pen, many of which will be the result of research work carried out at our new laboratories, and of which a large proportion will indicate, from theoretical considerations, the most fruitful lines of experiment on any given subject.

Jottings by the way



Uneasiness

FOR some time past we of the Little Puddleton Wireless Club had not been feeling quite happy. Whenever one member met another you might hear him ask: "Has anything been heard of him?" and see him answered with a mournful shake of the head. Heard of whom? you inquire, reader. Why, Mr. Hercy Parris, of course. Since he left our shores there have been odd messages from him, it is true, or, rather, messages purporting to be from him. But somehow we missed in them the true Parris ring, and all of us came to the conclusion that they were fakes sent across by those responsible for his disappearance. It was the General who suggested that a cable should be sent to him at his last known address in the States. I was entrusted with the necessary money and despatched to the post office to send it on its way. For several days we waited, but no reply came. Members asked me urgently to tell them what I had said in my despatch. I refused, merely telling them that I had asked a question, and that the fact that there was no reply was conclusive proof that Mr. Parris was missing. The question that I had asked was quite simply, "Can you lend me fifty pounds?" Could anything be more suitable for the purpose?

A tear splashed sploshily on to the top of Poddleby's bald pate.

Theories

On the fourth day a special meeting of the club was convened to consider the grave situation arising from the loss of Mr. Parris. The matter was discussed from every point of view. All kinds of theories were put forward by various members. Gubbsworthy held that he had been captured by gunmen and was being held up to ransom. But Poddleby believed that he had been bitten by a rattlesnake, whilst Admiral Whiskerton Cuttle's view was that he was languishing in Sing Sing owing to mistaken identity. Many other suggestions were based upon the perils of mad Ford cars, of six-shooter sheriffs, of broncho-busting contests, of vamps, of earthquakes, and of runaway trains. None of these found universal acceptance at the meeting, though it was generally agreed that Mr. Parris must be in a tight corner, and that something must be done, right soon, to help him out.

I Volunteer

When they had all done their bit of talking I rose gracefully to my feet. "As one," I said, "who has considerable experience of American life gained from bi-weekly attendance at the movies, may I be allowed to offer my suggestion? It is obvious that poor Hercy (here a tear splashed sploshily on to the top of Poddleby's bald pate) is what over there they call up against it. The only thing that can avail is for a real square-jawed hundred-per-cent. cast-iron he-man to go forthwith to his aid. As one of these I am prepared to journey instanter to America and to rescue poor Hercy even if I shed the last drop of my blood in the attempt. Lest, however, you should be nervous about sending me I would remind you that it is never necessary in the States for a hero to empty his veins entirely. Though he may lose pints and pints in the first three reels he always comes up smiling in the last one."

Poddleby to Accompany Me

When the cheering had died down it was proposed by General Blood Thunderby that I should be sent on behalf of the Little Puddleton Wireless Club to the rescue of Mr. Parris. I required, of course, a companion, just as Holmes would be lost without his Watson, Swan without his Edgar, or Mason, if compelled to face a cold hard world minus his Fortnum. The General said that he was sure that anyone in the room would be willing to volunteer, and it rested with me, gallant fellow that I was, to pick my man. Without a moment's hesitation I selected Poddleby, who, I knew, would never fail me in the worst crisis. Poddleby rose and accepted the job, and we stood with clasped hands whilst the club sang "For they are jolly good fellows" in several different keys.

He had played snap with two parsons.

Our Voyage

Thus it comes about that I am writing these notes not in the seclusion of my own study in Little Puddleton, but in one of New York's crowded caravanserais. If you do not know what these look like, visit the pictures and you will soon see. Poddleby and I crossed on that splendid liner, the *Maldemeria*, which had one of the worst passages on record, a hurricane, with frequent typhoons interspersed, raging from port to port. When I talked about the weather to the captain on the last day he said that the Atlantic had been like a millpond all the way; but you know how sailors talk. If it were not a full-blown storm it felt like one to Poddleby and me, in spite of Professor Goop's Rich Red Syrup for Pale Green Sailors, of which we took a large supply with us.

Poddleby in Trouble

Arriving on the other side, Poddleby has a nasty adventure, narrowly escaping a sojourn in Ellis Island owing to his failure to produce the necessary wad of money. Though he had left port well padded with notes, he had played snap with two parsons during his less pale green moments, and these gentlemen, who promised to devote all their winnings to missionary enterprise, had left him completely skinned.

The Search Begins

As soon as we had arrived at New York and taken our belongings to the hotel, we set out with no delay at all upon our quest. Hailing a taxi we jumped in and directed the driver to take us to the underworld. The man looked puzzled, but eventually appeared to understand, and when the clock had ticked up umpteen dollars, pulled up at the portals of an even larger hotel than that in which we were staying. He explained that we should find the underworld here. We did not believe this, and told him to drive us to the Bowery. Several times during our drive we stopped the taxi by beating upon the window, because we had seen a man very like Mr. Hercy Parris upon the pavement. Mr. Parris, I should mention, wears horn-rimmed spectacles, so that he is easily recognised. On closer inspection none of them turned out to be the object of our quest, and we drove on after apologies. When we had spent two or three days in this way without result, I said to Poddleby, "This is no use. We must get among the toughs." "The toughs?" said Poddleby. "Yes," I said, "the bad lads.

A Journey to the Underworld

"The fellows who really are of the underworld. It is into their hands, without a doubt, that Mr. Parris has fallen, and they alone can help us."

Toughs

Our hotel porter was a most obliging person. When we asked him if he could put us among the toughs, he said, "Can a duck swim?" Apparently that duck could, for we soon found, thanks to his kind introductions, that we got all that we wanted and then some. You must excuse me if I lapse occasionally from the mother tongue. This American language is so catching. Having been taken home three nights running in an ambulance, and still

His reply was to pull a gun from his belt.

having no news of Mr. Parris, we decided to go forth into the great open spaces.

The Great Open Spaces

My idea was that we should find him in some little place with a name like Cocoatin or Bootsole in the heart of the wilds. I felt that the odds were that he had been abducted by bandits during one of the train "hold-ups," which are, of course, so common in America that it is proposed shortly to include them in the

"Yep," he said, just like that!

time-tables. Having been removed from the train by the outlaws he would be taken to some small place in the hills where men were men and might was right, and other things of that kind obtained. The difficulty was to select a likely spot. A reference to the American equivalent of Bradshaw showed that there were quite a few railway stations which might be regarded as doors to the great open spaces.

Lone Camp

However, by opening the volume at random and dabbing with a pencil with our eyes shut, we selected Lone Camp, and duly journeyed thither. Our first impressions of Lone Camp were distinctly favourable. It was just the kind of place in which anything might happen. When we disembarked from the train there were a lot of fellows lounging about on the platform. Approaching the nearest one I asked him to take our luggage to the hotel. His reply was to pull a gun from his belt and to begin writing his name with bullets through Poddleby's new suit case. This was most promising. I at once shook him heartily by the hand and said that we had been trying to meet him for days and days. This soothed the man, and soon we were like brothers. Taking him gently by the ear I pulled its hairy orifice towards my lips.

Found

"Have you got Hercy Parris?" I whispered. Drawing his gun pensively he removed Poddleby's hat with the first shot and my cigarette with the second. "Yep," he said, just like that!

[The next episode of this thrilling drama of life and death will be screened next week. Do not fail to see Hercy Parris, Wayfarer, and Poddleby leaping the gulch on unbroken bronchos.]

WIRELESS WAYFARER.

The Radio Society of Great Britain

AN ANNOUNCEMENT.

Owing to the desire of the British Broadcasting Company to reduce the number of talks to be broadcast during the summer holiday period, and to increase proportionately the number of musical items, the Society has decided to forego its next three talks. It realises that during holiday time listeners will prefer orchestral or vocal items to lectures on wireless subjects, so, in order to keep up with this holiday spirit, the Society willingly foregoes the valued privilege of broadcasting these talks during the next five weeks. The talks will be resumed on the 19th September. Suggestions for suitable talks on wireless matters are always welcomed, and should be addressed to the Secretary, The Radio Society of Great Britain, 53, Victoria Street, London, S.W.1, when every endeavour will be made to comply with the requests so made.

Some Useful Tuning Charts

The tuning charts given below should prove of particular value in view of the fact that the approximate inductance values of some typical commercial plug-in coils are indicated along the inductance scale.

THESE charts are designed to facilitate the rapid design of tuning circuits or to enable the wavelength of any circuit to be determined with a minimum of trouble.

If the inductance and capacity are known, the wavelength of the circuit can be obtained and *vice-versa.*

The inductance is expressed in microhenries (μH). In many cases, however, plug-in coils, of which the inductance may not be known, are used.

Some typical standard coils on the market have therefore been inserted in their appropriate positions.

The capacities are expressed in micro-microfarads (μμF), this being a convenient unit for very small capacities.

One μμF is 1/1,000,000 μF, so that to convert a capacity in μF to μμF it is simply necessary to multiply by 1,000,000.

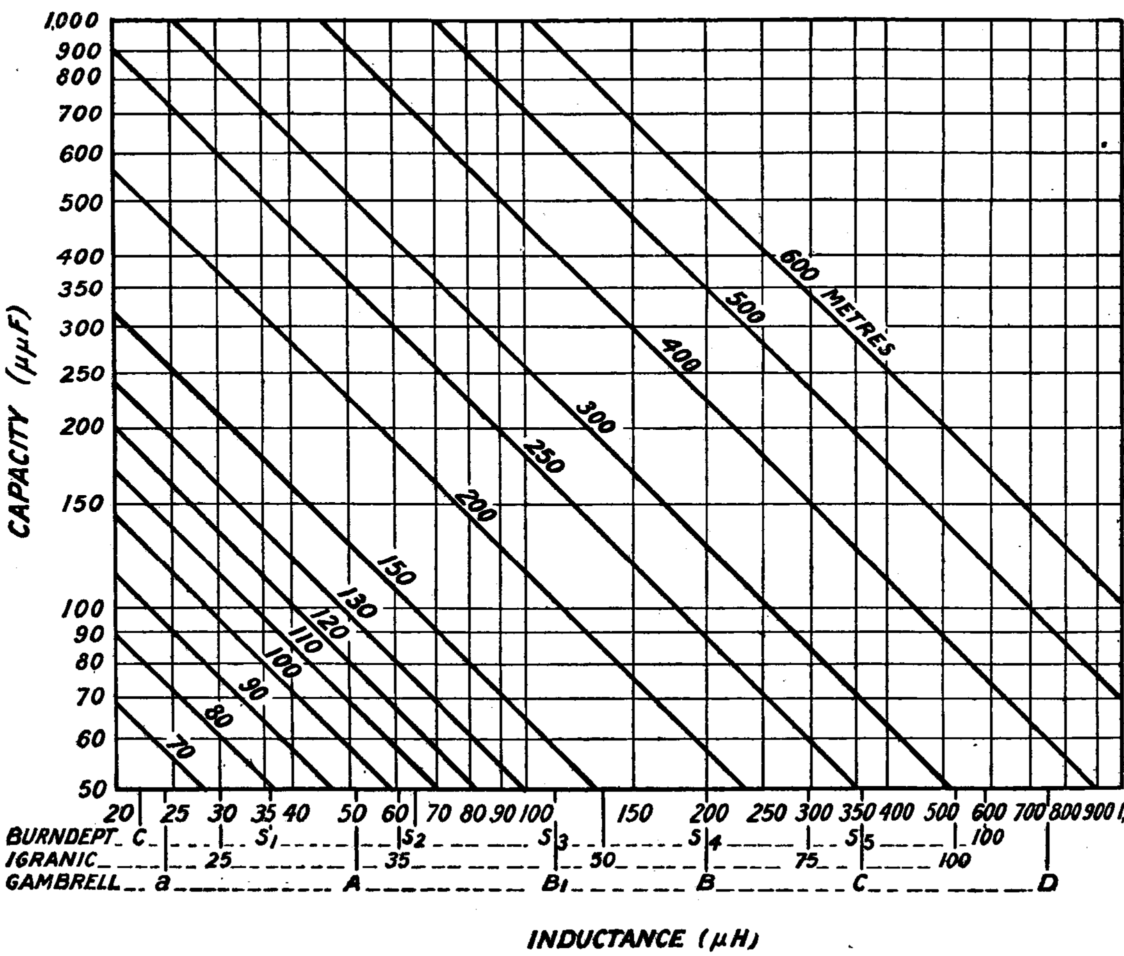
E.g., .0005 μF = .0005 × 1,000,000 μμF = 500 μμF.

A table of some of the more common values of capacity is appended.

μF	μμF
.00005	50
.0001	100
.0003	300
.0005	500
.001	1,000

Method of Operation

The method of operation is as follows :—The value of the inductance is noted on the horizontal scale and the value of the capacity on the vertical scale. The point where these two lines intersect will give the wavelength, which may be read off by reference to the diagonal lines.



Examples

This point will be made clear by means of a few examples.

Example 1.

A coil having an inductance of 150 microhenries (μH) is tuned with a condenser of .0003 μF. What will be the wavelength of the circuit?

.0003 μF = 300 μμF

Referring now to the chart, it will be seen that the 150-μH line and the 300 μμF line intersect on the diagonal line marked 400.

Hence the wavelength of this circuit will be 400 *metres*.

Example 2.

A circuit is required to tune to 365 metres. A variable condenser of .0005 μF (max.) is available. What is the nearest standard plug-in coil which can be used to tune with this condenser in the middle of the scale?

The capacity in the middle of the scale with an ordinary semi-circular plate condenser will be .00025 μF=250μμF.

Look along the capacity line at 250 μμF until 365 metres is obtained. Here a certain interpolation is necessary.

The 250 μμF line cuts the 300-metre line at 100 μH, and the 400-metre line at about 170 μH.

The inductance required will be approximately midway between the two, and a reference to the inductance scale will show that the nearest standard coils are: Burndept S3, Igranic 50, Gambrell B1.

Example 3.

A Gambrell B coil is to be tuned with a 500 μμF condenser. What will be the wavelength range?

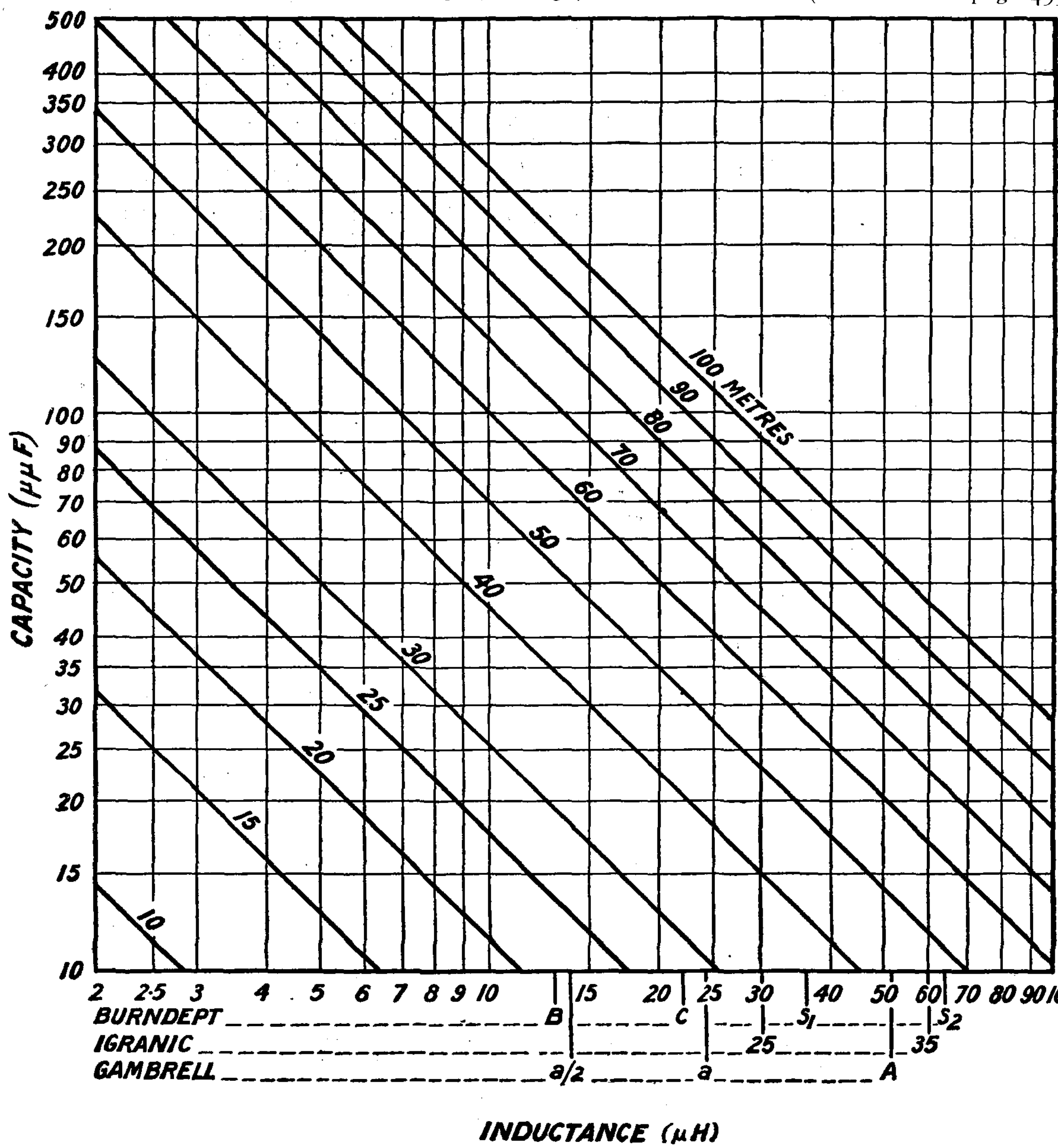
Looking along the inductance line for the B coil (200 μH) it will be seen that this intersects the 500 μμF line at 600 *metres*.

The minimum value of the capacity depends upon the condenser employed, the stray circuit capacities and the coil capacity.

This is not likely to be less than about 60 or 70 μμF, which gives 200 *metres* approximately for the minimum.

The wavelength range is thus 200 to 600 metres.

(*Concluded on page* 499)



WIRELESS NEWS IN BRIEF.

THE retirement from business of Mr. Guy Burney, founder and managing director of the Sterling Telephone and Electric Co., Ltd., has recently been announced. Mr. Burney, who is a member of the Postmaster-General's Advisory Committee on Broadcasting, is a well-known figure in the wireless world, as the founder and first chairman of both the Telephone Manufacturers' Association and of the National Association of Radio Manufacturers.

As early as 1900, in collaboration with the Company's engineers, he introduced, amongst other instruments, the "Era" Automatic Telephone, which was the first commercial multiple automatic interphone to be placed on the world's market. It was this instrument which brought the Company into prominence.

Mr. Burney was one of the first to exploit the commercial possibilities of wireless on a large scale, and he holds the opinion that the time is not far distant when wireless will be as necessary in every modern home as water and electric light.

We understand that a well-known French amateur who uses 55-watts on a 33-metre wavelength received messages on Sunday, June 7, at 4.50 p.m., from an amateur 2AE in New Zealand. Experiments in short wave transmission continue, and it is reported that Nauen, transmitting on a 72-metre wavelength to New Guinea, chronicled good results over the 6,250 miles between Germany and New Guinea.

* * *

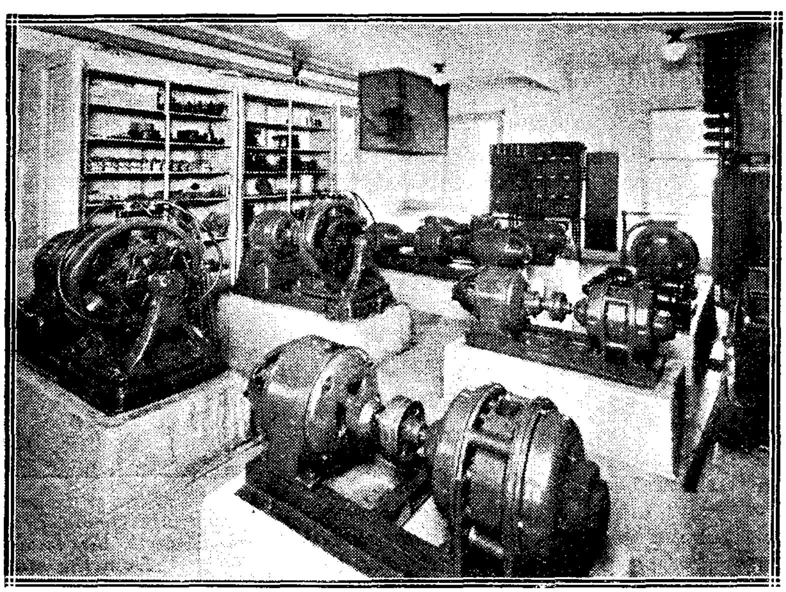
That the Postmaster-General does not propose to reduce the wireless licence fee pending the report of the committee which the Government are about to appoint to examine the arrangements, financial and otherwise, for the maintenance of broadcasting services, was stated by Viscount Wolmer, Parliamentary Secretary to the Post Office, in reply to a question raised in Parliament.

* * *

British listeners will be interested to hear that the B.B.C. will carry out some important experiments in September with a view to arriving at a practical scheme for relaying, on an exchange basis, not only Continental, but also American, programmes. Subsequent developments of the service will probably depend on the success of these tests.

* * *

In connection with the Macmillan Arctic Expedition, the U.S.A. Naval Secretary, Mr. Wilbur, recently threatened to withdraw from the venture the naval hydroplanes which are taking part in it unless the standard naval high-wavelength apparatus was carried, in addition to the low-wavelength transmitters and receivers used by the expedition. We gather that the misunderstanding has now been adjusted, and that the expedition will employ both types of apparatus.



The main generator room at KGO, the General Electric Company's Broadcasting Station at Oaklands, California.

Some Useful Tuning Charts.

(Concluded from page 498).

Short-Wave Chart

The second chart is a special short wave chart, which is operated on exactly the same principle but extends to smaller values of inductance and capacity.

In all calculations the capacity must be the total capacity in the circuit, due allowance being made for stray and coil capacities, which are best estimated as being about 50 to 70 $\mu\mu$F for normal circuits.

Use with Aerial Circuits

When using the chart with aerial circuits the equivalent aerial capacity should be employed.

Assuming the capacity of the aerial itself to be 250 $\mu\mu$F (an average figure), the equivalent capacity may be obtained as below.

With the tuning condenser in parallel with the coil,

C equivalent $= 250 + C$ condenser $\mu\mu$F.

With the tuning condenser in series with the coil,

$$C \text{ equivalent} = \frac{250 \times C \text{ condenser}}{250 + C \text{ condenser}} \ \mu\mu F.$$

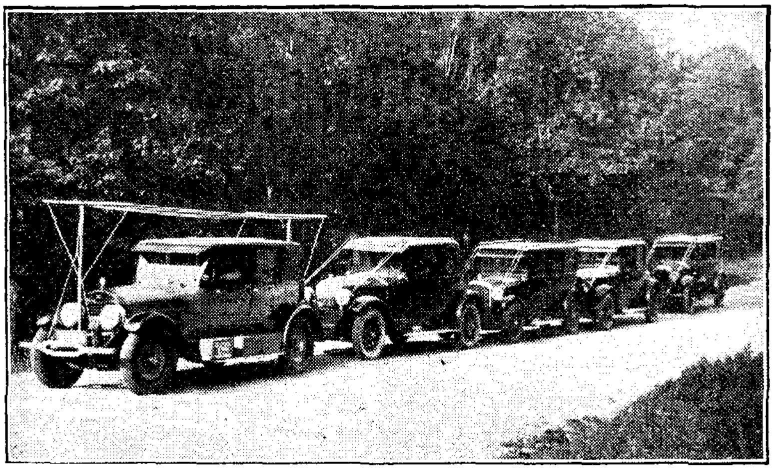
With C.A.T. (with a .0001 μF series condenser)

$$C \text{ equivalent} = \frac{70 \times C \text{ condenser}}{70 + C \text{ condenser}}$$

Some Personal Experiences at Well-

By PERCY W. HARRIS

In this highly informa- readers of " Wireless information gathered to NKF (Radio Res- United States Navy, (Westinghouse Manufa- burgh, Pa.), and WGY, Schenectady



A fleet of cars equipped for short-wave work. The first car carries a 23-metre telephony transmitter. (Courtesy A. H. Grebe Co.)

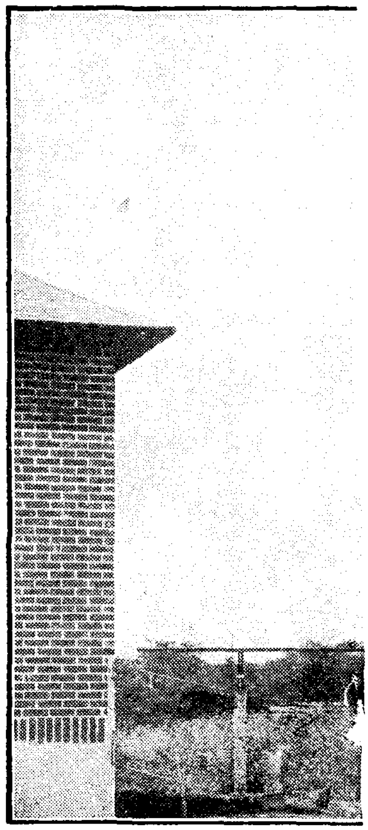
WHATEVER else it may have done—and its list of achievements is already surprisingly high—the amateur radio movement has at least demonstrated to the world at large the practicability and, indeed, the remarkable efficiency of short-wave transmission and reception. These short wavelengths—and as " short " is but a relative term, it is well to define them as wavelengths below 100 metres—can be looked upon without any great stretch of imagination as the waves of the future, for the possibility of an almost infinite number of simultaneous transmissions is to the commercial radio engineer one of the most alluring of short-wave charms.

Big Firms at Work

It is not surprising, therefore, to find that the big commercial radio companies and Government Departments engaged in the art have already done much to exploit short-wave working. Within a few days of arriving in New York I made a point of calling upon Mr. Taylor, chief engineer of the Radio Corporation of America, for the purpose of discussing the use of short waves with him. The Radio Corporation of America is, as most readers of *Wireless Weekly* know, a great radio organisation merging the wireless interests of the old Marconi Wireless Company of America, the Westinghouse Electric Company, Western Electric Company, and several others. On Long Island the Radio Corporation operates the high-power station, " Radio Central," which until recently has been working on some of the longest wavelengths used in radio communication. Now, although they are still using wavelengths of the order of 19,000 metres or more, the Corporation has also installed apparatus to work below 100 metres, and regular experimental work is being conducted on wavelengths around 20 to 30 and 90 metres.

Short Waves in Daytime

One of the big problems in short-wave work is to effect reliable communication both day and night. Some short waves have the most remarkable penetrating power after dark, reaching to the most distant points of the earth; yet a few hours later, when daylight conditions prevail, it would appear to be difficult to hear them one hundred miles



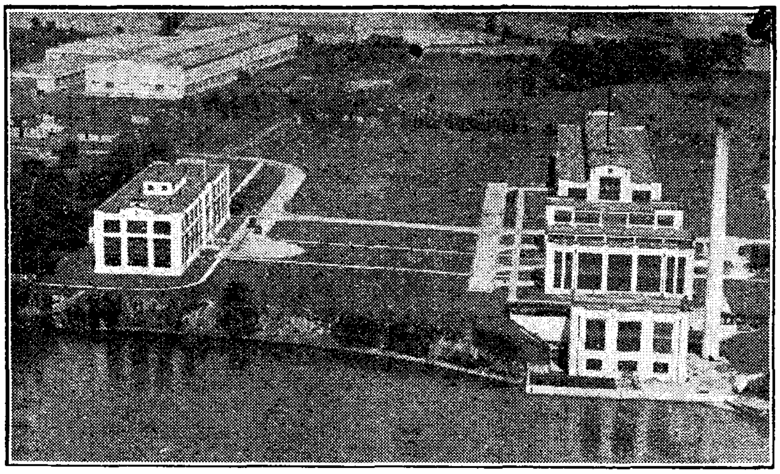
The base of the aerial from whi- transmissions are sent out. beneath the loading coil. Th- from the station building

-known American Short-wave Stations

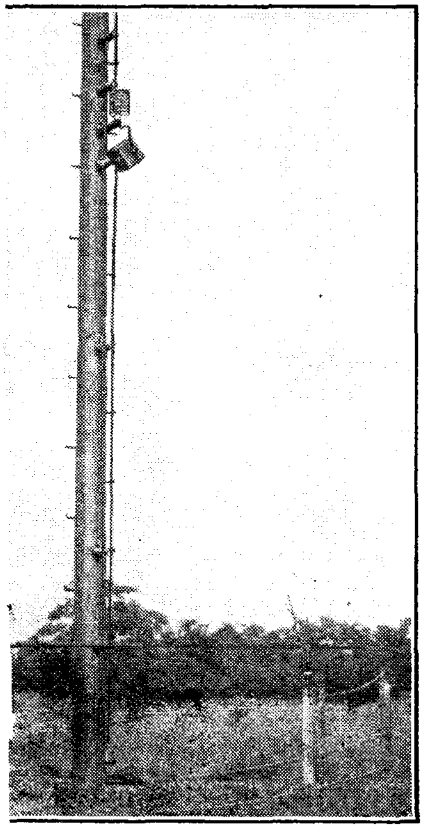
, M.I.R.E., Assistant Editor.

ive article Mr. Harris gives Weekly" much exclusive personally during his visit arch Laboratories of the near Washington), KDKA turing Company at Pitts- (General Electric Company, New York State).

away, even with the finest receiving apparatus now available. Much recent work has been carried out for the purpose of finding which short wavelengths



The research buildings at NKF (near Washington). The NKF short-wave transmissions radiate from the vertical pipe aerial on the roof of the building on the right. A counterpoise of horizontal pipes is used here.



ch the well-known KDKA short-wave Notice the tilted aerial ammeter just is meter is read with field glasses . (Courtesy Westinghouse Co.)

will "carry" the best in daylight. All the authorities with whom I have discussed the matter agree that so far wavelengths of about 20 to 25 metres appear to be the most successful.

Dr. Taylor and the Iron Pipe

Some of the finest experimental work on short wavelengths has been carried out by the United States Navy at their Research Laboratory at Bellevue, a suburb of Washington, the national capital. This laboratory is excellently equipped, and the buildings are shown in one of our illustrations. The laboratory is under the direction of Dr. A. Hoyt Taylor, a scientist of international reputation, who has devoted practically his entire attention for many months past to short-wave transmission and reception. British experimenters who are well acquainted with the loud and steady signals from station NKF on various wavelengths below 100 metres will be astonished to hear that these signals are sent out from an antenna consisting of nothing more than a rusty iron pipe perched on the roof of one of the buildings (I have indicated it in the photograph), other rusty pipes being spread around as a counterpoise.

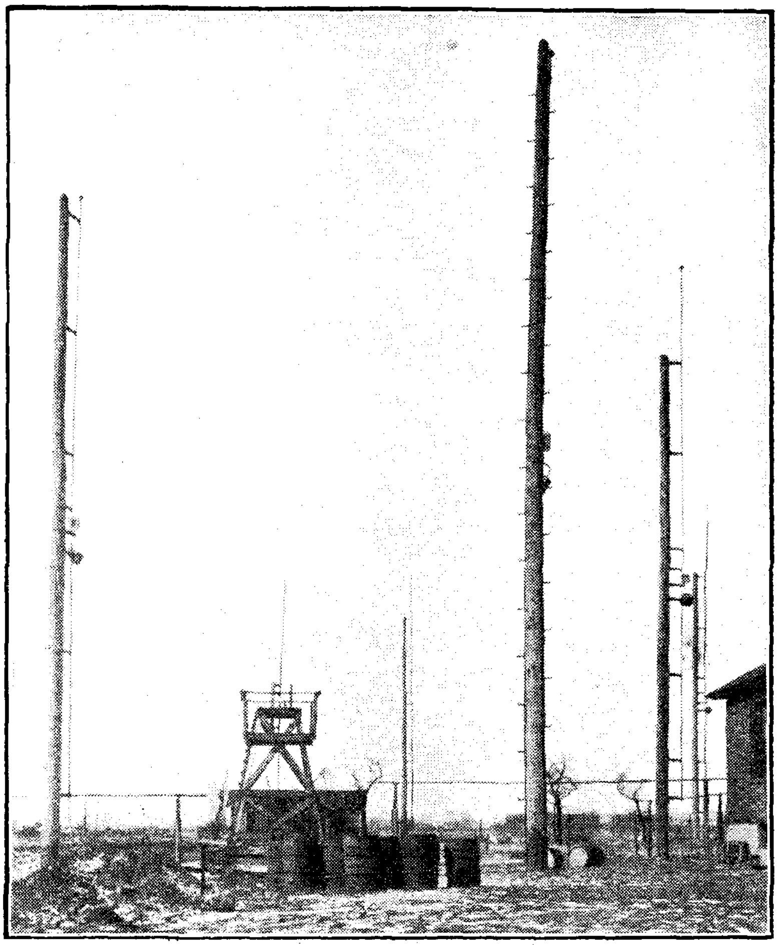
I naturally expressed surprise to Dr. Taylor that in such wonderfully equipped laboratories an aerial of this kind should be used, as a rusty iron pipe did not appear to me to be the highest expression of electrical efficiency on short waves!

From Start to Finish

Dr. Taylor smiled. "There is no need to worry about the conductivity of the antenna," he said, "when you consider that on these short waves practically all the resistance is radiation resistance. If we were to make the antenna of high conductivity copper, there would be such a slight increase of efficiency that it would not be worth while to do so!"

The NKF laboratories differ from others I visited in that not only is experimental work conducted there, but the first models of all naval receivers are built and finished complete, in exactly the form in which they will be used in the various naval stations. This means that workshop equipment has to be provided to finish everything down to the finest detail, so that when, for example, a new short-wave receiver is finally approved and the first model has been made, it is only necessary to hand the actual model to a manufacturing firm, such as the Westinghouse or Western Electric Co.'s, for copying, without any further designing work being needed. Those readers who appreciate the difference in efficiency between preliminary bench " hook-ups " and finished factory-built designs will realise the wisdom of the policy adopted.

Experimenters who think themselves lucky if their wave-meters are accurate to within a metre or two would certainly be interested to see some of the wave-meters that Dr. Taylor showed me at the Bellevue Laboratories. One was guaranteed accurate to within one-hundredth of one per cent.! Great accuracy in the calibration of all the American naval apparatus is now being attained by what are known as " crystal-controlled " circuits. By utilising certain properties of quartz crystals it is possible to obtain wonderful constancy, and it is the intention of the Naval Department ultimately to have every transmitter under its control fitted with this special quartz crystal arrangement to maintain a constant frequency.



A group of short-wave aerials at KDKA (East Pittsburgh). The small aerial and platform is used for experiments on waves of fifteen metres or so.

Crystal Oscillators

I cannot in this article give you any particulars of these " crystal - controlled " wave-meters, receivers, or transmitters, as space is limited. The leading radio laboratories in the United States are nearly all investigating and making use of the phenomena.

Nor have I space here to describe in detail the highly interesting short-wave receiver designed by Dr. Taylor for the naval short-wave working. This goes down to about 10 metres, and is somewhat smaller than the Grebe short-wave receiver which I recently described in these pages. It differs from the Grebe receiver in its reaction control method, the Grebe receiver having condenser control of the reaction, while the naval receiver is resistance-controlled. All the Navy receivers are fitted in special aluminium cases with a rough black surface similar to that used on many German optical instruments, such as microscopes. All have spring clip connections for batteries, so that when the panel is withdrawn there are no wires to disconnect.

East Pittsburgh

KDKA is naturally the Mecca of every short-wave enthusiast visiting the United States, and by the kindness of the Westinghouse Company I was given full facilities to inspect all the short-wave plant at this famous station. Thousands of British experimenters who have listened to the short-wave signals broadcast from KDKA will be interested in the photographs, which show the station and a close-up view of the actual aerial used, which consists of a rigid copper pipe, in the middle of which is the loading coil. Immediately beneath this is placed the aerial ammeter, which is purposely tilted so that its dial may be observed from the operating room by means of a pair of field-glasses! The aerial ammeter has to be placed at the point of maximum current, and in this aerial the point of maximum current is near the centre.

The Feed-In Method

The " feed-in " method is particularly interesting. The short-wave transmitter is situated close to the window immediately adjacent to the pole, and a lead is taken from a single tapping on the inductance of the main oscillating circuit. This goes to a fixed capacity air condenser and thence by a copper rod to the base of the copper tube.

Wavelength Changes

The air condenser is situated just outside the window and consists of two circular plates separated about an inch. By using such arrangements the aerial oscillatory current does not enter the station, and as the feed is to a high potential point, very little current flows in the feeder line. The short-wave transmitter circuit is constantly changed, and not only the wavelength but even the degree of distortion is frequently altered in the course of experiments. When I was in the station the wavelength used was 63 metres, although previously it had been in the neighbourhood of 68 and 70 metres.

Distortion

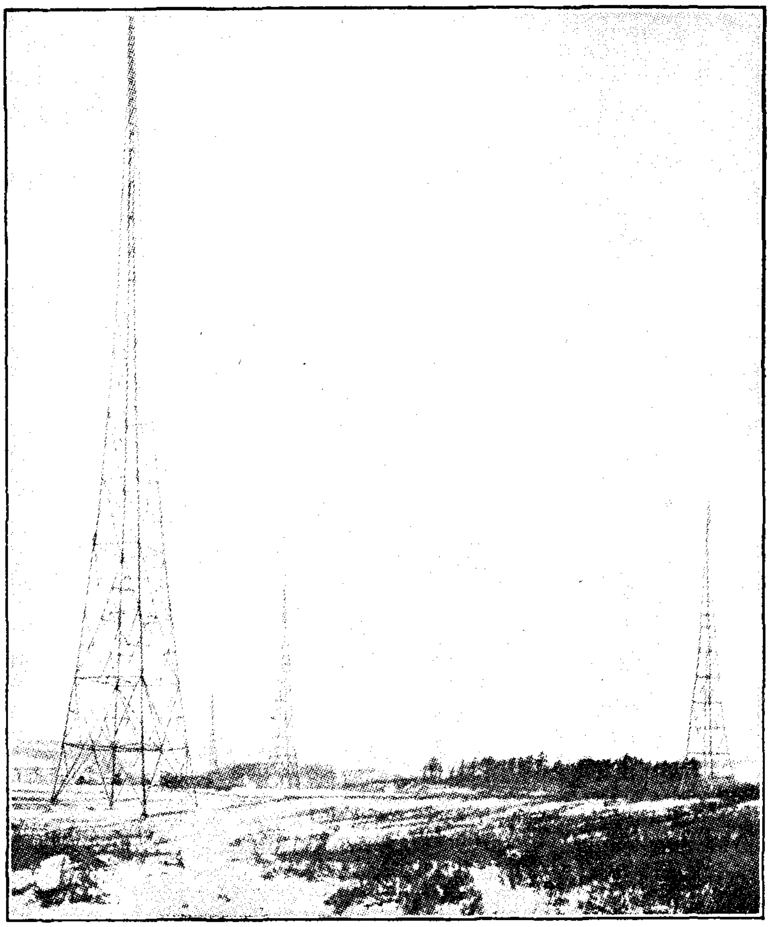
The distortion of KDKA's short-wave signals, due to high-speed fading, was one of the many technical points I discussed with experts in the United States. Dr. Taylor told me that it was prominently noticeable even in Washington, but that the effect could be minimised considerably by arranging several antennæ at a distance of half a wavelength apart and combining the resultant signals, as the fading on two nearby aerials is by no means synchronous.

This point was confirmed by the engineers at KDKA, who also told me of another most interesting point. The short-wave signals are so frequently received in Australia at good strength that special programmes have been sent for the benefit of that continent. A large number of letters from Australian listeners prove that in Australia there is very little high-speed fading, and KDKA has been rebroadcast in Australia so satisfactorily that every word could be understood. For some reason or other the distortion due to high-speed fading, so noticeable in England, is almost absent in Australia.

Although the Westinghouse Company's experiments at KDKA are so well known, very little seems to have been heard in this country of the excellent work being done by the General Electric Company at their new experimental station at South Schenectady. By the way, it is not easy for English readers to realise the distances between the various stations, and I suggest that readers of this article look at a map of the United States (the bigger the scale the better), when they will see that Pittsburgh is a very considerable distance from the Atlantic coast.

South Schenectady

As a matter of fact, the Westinghouse station KDKA is not actually at Pittsburgh itself, but some thirty miles to the east of it at a place called East Pittsburgh. Schenectady, one of the prettiest little towns I visited in the United States, is in New York State, but several hours' journey from the city. WGY itself is at the General Electric Company's works, although the short wave experiments are carried out at South Schenectady, fifteen or twenty miles away. The short-wave equipment at South Schenectady is particularly fine, and transmissions are taking place with fair regularity on wavelengths of 38 metres, 109 metres, and 1,660 metres. The 38-metres set utilises a "push-pull" master oscillator, and push-pull amplifier with an aerial energy of about 2½ kilowatts. This, by the way, is considerably less than is often used at KDKA, where power up to 12 or 15 kilowatts is sometimes put into the short-wave transmitter aerial.



Four steel towers at South Schenectady. These are used for long-wave experiments. The short-wave work is done in the same field, modulated current being provided from the WGY studio by land-line. For short-wave work the call 2XK is used.

Transmitting Wavelengths

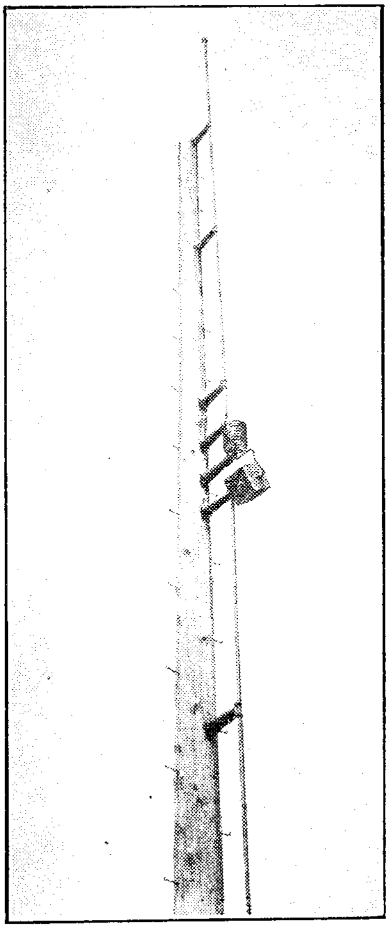
At South Schenectady there are a number of separate buildings housing the different transmitters, and in a main building there are three valve-rectifiers, each of which can deliver 100 kilowatts of rectified energy. By means of a roof bus-bar wiring system power can be delivered to any or all of the sets in this building, while modulated high-tension current carrying the WGY programme can be delivered to any or all of the separate buildings.

On the 38-metres set an aerial of

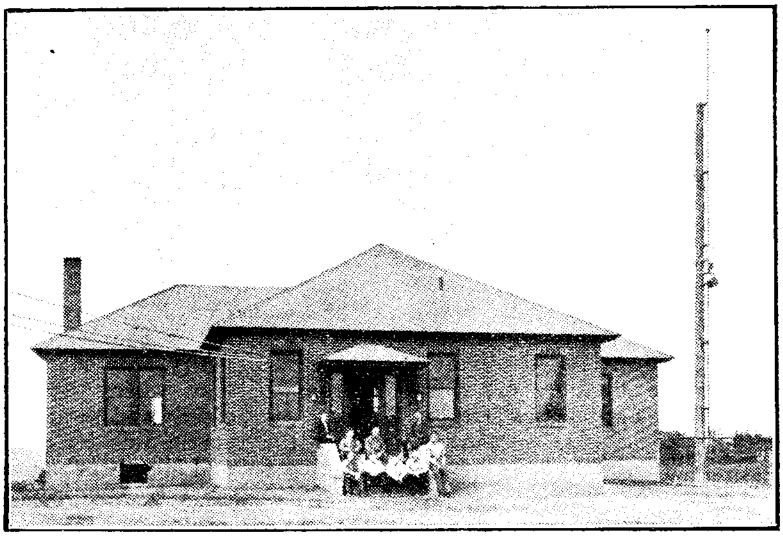
similar dimensions to that used by KDKA is in operation, although I noticed that the loading coil was split and the aerial ammeter placed centrally, which would appear to be preferable to the method at KDKA, where the ammeter is placed below the loading coil. As is the case with KDKA, there is no counterpoise, the antenna resembling the original Hertz arrangement. The feed-in method is slightly different from that used at KDKA. At the base of the aerial is placed an oscillating circuit, from one point of which a connection is made to the bottom of the copper tube. This oscillatory circuit is fed by a power line from the transmitter within the building, so that, again, the aerial current does not enter the building.

The 109-metres set is situated in its own building. This has three "T" aerials, one end of the top of each "T" being joined to a central insulator. The tops thus radiate from a central point, and the three down-leads are brought together to a lead-in insulator on the top of the roof. Experimenters should listen for these signals, which I fancy will be heard at excellent strength here. I was informed that they are usually sent out on the three wavelengths of 38, 109, and 1,660 metres, between 6.45 and 11 p.m. American Eastern Standard Time (this is five hours earlier than Greenwich mean time or six hours earlier than Summer Time).

I was rather surprised to find that transmissions were also being carried out on 1,660 metres. I discovered that the General Electric Company were anxious to find the degree of fading and the proportion of atmospheric interference on the various wavelengths. The 1,660-metre wave is being tried for long-distance transmission.



A "close-up" of the KDKA short-wave aerial.



KDKA station and the aerial (on right) from which the short-wave transmissions are sent out

At NKF, KDKA and WGY (or, rather, 2XK, the short-wave call of WGY), the short-wave transmitting inductances were invariably made of copper strip wound on cylindrical skeleton formers of dry wood. Such materials as ebonite, bakelite, etc., prove useless on these short wavelengths, particularly when powers of the order of one kilowatt or more are being used. Pyrex glass is utilised to a considerable degree for insulating various parts of the apparatus. So far as receivers are concerned, I notice that neither the Grebe nor the Navy receiver for short waves use valves from which the bases have been removed, and I am inclined to think that the recommendation so often made to remove the tube base is not quite so important as some people think. I discussed this question with Dr. Taylor at NKF, and he told me that very little difference will be noticed above about 40 or 50 metres, although below this there is some advantage in removing the base. It should be remembered that American as well as some of the British valve manufacturing firms have now abandoned the metal base-cap, which no doubt caused much trouble in the earlier short-wave experiments. On commercial and Government receivers the rapid interchangeability of valves made possible by adhering to the conventional base possibly outweighs the advantages of a slight increase in efficiency by removing it. Below ten metres, of course, the whole problem of set design must be reconsidered, and my remarks do not apply to these ultra-short wavelengths.

A number of anti-vibratory valve sockets are now available in America, and the Navy departments have now evolved a special type of base which, I understand, will be standard for all wireless apparatus in the American services. This will take a size of valve different from that sold to amateurs. The Navy department, by the way, seems to favour a valve which corresponds in its electrical characteristics to the Western Electric Peanut available here.

Amateur Wireless Operating Procedure

By An Amateur Transmitter.

A short article giving some hints on how amateur two-way working may be facilitated and confusion in the exchange of signals avoided.

CQ, CQ, CQ, CQ, and so on for twenty, thirty or more times! Listening on the amateur bands almost any night will result in the above string of letters being heard, and it is truly remarkable the number of stations there are who follow this extraordinary procedure. Their one idea seems to be: make as much noise for as long a time as possible, and someone is sure to answer out of the many who will inevitably hear. Such crass stupidity results in exactly opposite effects, and many a good long-distance communication has been missed by reason of "sitting on the key." The author, on several occasions, has been hunting around for some station to connect with, only to hear this interminable CQ call, with the station's call-sign, if not omitted altogether, left out for such a time that the listening station operator tunes away, disgusted, to find a more sensible operator.

The same remarks apply to the use of the "Test" signal, many stations continuing to send it for a seemingly endless period of time, and not dreaming of signing or "changing over."

Transatlantic Working

Again, it is the rule, rather than the exception, to find stations calling ARRL, for, figuratively, hours on end, and then, strange to relate, never dreaming of listening for a reply from one of our American brothers. The writer has personally heard this kind of thing so many times that it has become a matter for wonder that the Americans trouble to reply at all!

Imagine the feelings of a U station operator, say, when, after having replied to a ten-minute ARRL call (by no means unusual), he in return receives no reply, neither does he do so to a subsequent call.

Another annoying fellow is the one who will repeat everything, even when you have, in reply to his QRK?, said QSA! Surely, if his signals are strong, there is no need for each word to be repeated.

A Suggestion by the A.R.R.L.

The traffic department of the American Radio Relay League is endeavouring to improve the whole position, and has suggested that every operator knows that he is QSA everywhere when working on the very short waves, and this obviates the necessity for QRK? and so on. This would appear to be an excellent thing, if operators would adopt it, and will, in the case of ARRL members in America and Canada, simplify the handling of traffic.

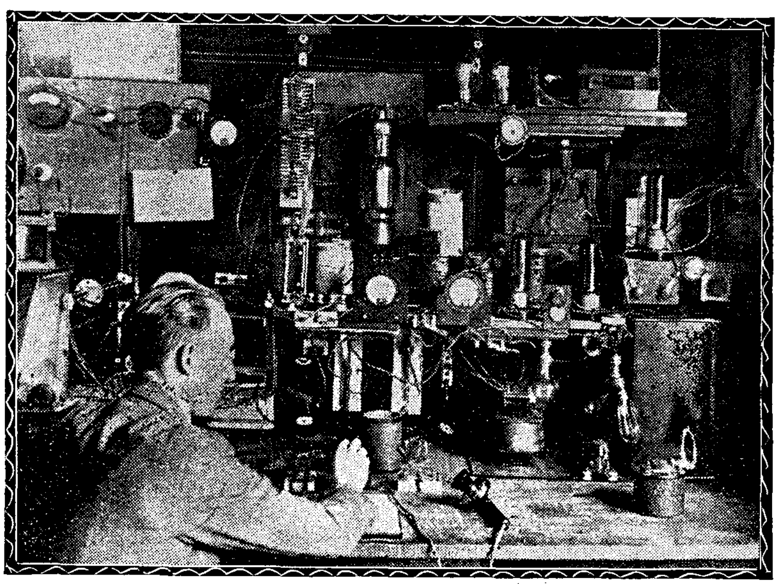
British operators of experimental stations should read their licences, as issued by the General Post Office, for an indication of how many times to call TEST or another station. For example, 2ZYX wishes to connect with a station for purposes of experiments, and he proceeds as follows:—

TEST, TEST, TEST de 2ZYX, 2ZYX, 2ZYX. This is as laid down in his licence, and is to be followed by a period of listening.

Useless Repetition

The point I wish to emphasise here is, *don't* send TEST twenty times and your own call once, or, alternatively, don't send TEST twenty times and your own call as many; stations get tired of listening to this kind of stuff, and are far less likely to reply if such procedure is followed.

Another interesting clause in the transmitting licence states that listening shall in all cases be performed on the wave it is intended to use, before transmission starts, in order to prevent



Mr. Maclurgan, a leading Sydney experimenter, at his station 2CM. He has been successful in establishing two-way daylight communication, on a wavelength of 20 metres, with Mr. E. J. Simmonds (2OD) of Gerrards Cross.

interference being caused with any other station. This trouble is not so prevalent on the short waves as on the 150-200 metre band, where stations work telephony. It is a hard thing to say, but the writer is convinced that this regulation is, in the main, disregarded, as stations often start up, usually with large power, right on top of a weak transmission which one is trying to read. The wavelength of the interfering station may not be exactly the same as that of the weak station, but the side-bands make up for that!

Importance of Correct Spacing

Returning to the question of operating, it is essential for successful long-distance communication that the calling station shall send his station call-sign slowly, deliberately, and with good spacing between the end of one sign and the beginning of the next, in order that he may be correctly copied by the receiving operator.

Cases have come to the writer's notice in which a call-sign ABC sent several times could easily have been read as CAB or BCA, thus upsetting things as far as that station's distance record was concerned. Always give a call-sign in such a way that there is no possibility of its being misread, and you will find the stations coming back as soon as you have said K. From the point of view of the receiving station, it is always advisable for the operator to be on the watch for errors due to bad spacing, it being frequently the case that a received KE was intended for C, while the same letter may be badly sent so as to read TR. MA altered to Q may make an otherwise senseless jumble into an intelligible word, whilst it is not by any means unusual for one to receive 5 where H was intended; in the same manner V may be wrongly sent and read as 4. Many other possible sources of error will be apparent to the reader, and should be borne in mind when the received message appears incorrect.

The Use of Abbreviations

For the benefit of those new to the game, it may be observed that there are several abbreviations in constant use which may not be fully appreciated by those who have not learned them. At the end of a communication, for instance, one hears one station say to another, "CUL 73's OM," and that certainly appears meaningless if you don't know what it's all about. CUL is an abbreviation for "see you later," and is often varied to "CU agn," the meaning of which is obvious. 73's is a term meaning "kind regards," or words to that effect, and originated, we are told, in old-time land-line procedure. OM is a contraction of "old man," and, naturally, is used in a friendly sense.

Minimising Interference

Sea-going operators have, possibly, the greatest difficulty of any in establishing communication with another station, on account of interference, and it is common to precede a call to, say, Cape Race (VCE) with several V's in this way:—vvvv, VCE, VCE, VCE de XYZ, XYZ, XYZ, K.

If no reply is forthcoming from the station called, the calling station does not repeat for 15 minutes, in which time other traffic is handled. This would appear to be worthy of adoption by the amateur, and would certainly save a lot of wasted power and QRM, thus also not raising so much indignation from those suffering from your flat tuning or wavering note.

A Worthy Example

With regard to the use of abbreviations and other signals, how much time is wasted in unnecessary repetition! One often hears a station, upon receipt of a message, say R, or OK, for ten or a dozen times without stopping. Quite unnecessary, as far as we can see. Listen to GNF working ships for a lesson on operating procedure; see how upon receipt of, say, ten messages GNF comes back with "R" without even a call-sign at times. What a change from the "ham" who says OK for twenty minutes!

Did that man send a word incorrectly or is that an automatic station working? The erase sign consists of eight dots, but most amateurs send nearer eighteen before they repeat the word sent incorrectly.

In cases where messages have been incorrectly received, or received with the exception of a word here and there, the receiving station comes back with :—

"ABC, ABC, ABC DE XYZ IMI (repeat), WA (word after) ......(last word correctly received) WA......WA...... K."

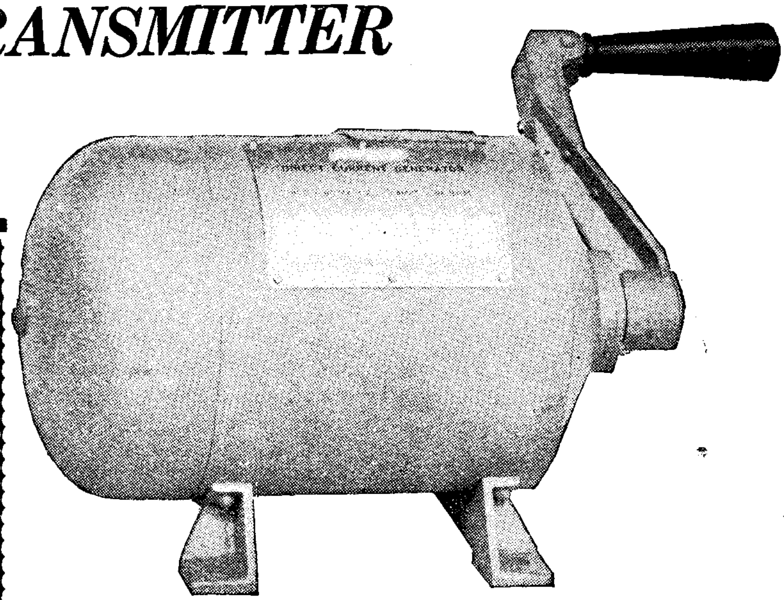
This may need some explaining for the benefit of the uninitiated. ABC is the call of the station transmitting the message, and XYZ is that of the receiving station. The abbreviation IMI means repeat, and the whole thing then reads, after the calls, "repeat word after ...... word after ...... and word after ......Carry on." Such abbreviations save considerable time, but do not carry their use too far, or confusion is sure to result.

The members of the Crewe and District Radio Society assembled in the grounds at Crewe Hall on the occasion of their field day.

SOME NOTES FOR THE AMATEUR TRANSMITTER

By C. P. ALLINSON (6 YF).

A short article dealing with some points of interest to beginners in transmission.



A 20-watt hand generator suitable for use with a low-powered transmitter. The windings are so arranged that power is delivered for both the anode and the filament supply.

THE question of H.T. supply is usually a rather important one to the amateur who is starting to take up transmitting, and in many cases requires very careful consideration.

When a D.C. supply of 240 volts or thereabouts is available the problem is greatly simplified, for, by using a transmitting valve with a low impedance, the usual power of ten watts can easily be drawn by the valve. Further, the use of this source of H.T. generally does away with the need for smoothing or filter circuits, even when telephony is being used, as the supply is already very steady and smooth. Should any ripple or hum be present, a very simple smoothing circuit such as that shown in Fig. 1 will do. The values of the components are: L1 (the iron-core choke) 20 henries, while the two fixed condensers C1 and C2 should be 2 or 4 microfarads each.

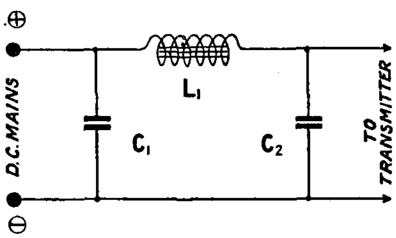


***Fig. 1.**—This simple filter circuit is usually adequate when power is taken from D.C. mains.*

H.F. Chokes

When H.T. is being taken from D.C. mains, it is usually advisable to employ shunt feed, as in most cases the negative main is earthed. There is then no need to risk getting a shock from touching the transmitting helix or tuning condenser, which would otherwise be at high potential if series feed were employed. It is important also that the H.F. choke in the positive H.T. lead be really efficient, or else H.F. power may be lost; 200 or 300 turns of d.c.c. copper wire on a $2\frac{1}{2}$-in. or 3-in. former will generally be sufficient when working on 150 to 200 metres. Similarly if a small choke of 50 or 60 turns is placed in the H.T. negative lead an improvement may result. If a direct-coupled circuit is used with a water pipe or buried earth, and not a counterpoise, a blocking condenser may need to be placed in the earth lead, so as to prevent the H.T. circuit being completed *via* the earth. This should have a value of not less than .001 μF capacity. The complete circuit may then be similar to that shown in Fig. 2, in which the need for a blocking condenser is done away with by the method of keying shown. If, however, the positive main is earthed it will be necessary to include it.

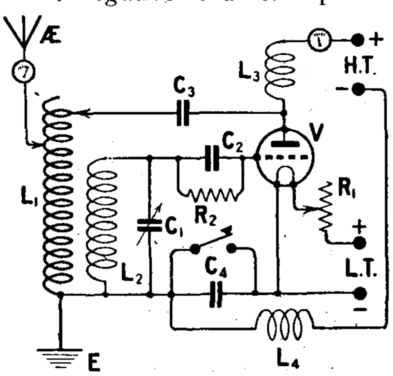


***Fig. 2.** — A typical transmitting circuit. The method of keying helps to prevent key clicks.*

Filters for Generator Supply

Another means of obtaining a supply of H.T. for a valve transmitter is the use of a small generator, which may be either hand or motor driven. In this case the use of a smoothing circuit is nearly always necessary, and this may be similar to that shown in Fig. 1, but using two chokes and three condensers as shown in Fig. 3 at A, or may be arranged as at B, the values being as follows:—In A, L1 and L2 are 20 henries each; C1, C2 and C3 are 4 microfarads each; in B, L1 and L2 may be 10 henries each, C1 and C2 having the values previously given. It should be borne in mind that if ripple or hum is still present it is not nearly so effective merely to add more capacity as it is to add both capacity and inductance by making a chain of filters. Whenever filter circuits are used it is advisable to place a fuse in one of the H.T. leads, in case one of the condensers breaks down and shorts the H.T. supply. A typical H.T. generator of the hand-driven type is shown in the accompanying photograph. With many generators, of which the

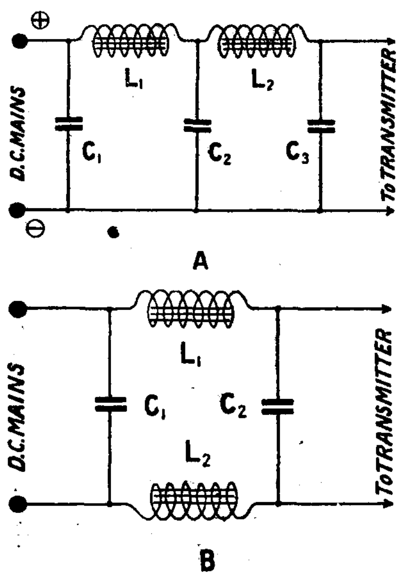


Fig. 3.—Alternative methods of improving the Fig. 1 filter circuit.

speed varies with the load, it will be necessary to use a "back load" in order to keep the speed of the generator constant. If this is not done the motor will swing or "hunt" as the key is pressed and released, and the output voltage will thus vary, causing the emitted wave to swing. This back load consists of a resistance which draws the same current as the valve, and it is connected across the H.T. terminals when the key is up. This keeps the load on the motor, and therefore its speed, constant. The scheme of connections is shown in Fig. 4. It is necessary, of course, that this resistance be able to carry the requisite current without heating up.

H.T. from Batteries

High-tension current may also be supplied by primary or secondary batteries. If primary batteries are used they are generally of the dry-cell type, and need to be constructed of very large cells, otherwise they will not be able to give the heavy discharge necessary to run a transmitter for any length of time. As the average current taken may be in the region of 20 or 30 milliamperes, it will be seen that this form of H.T. battery needs to be exceedingly robust if long service is to be obtained. Secondary batteries or accumulators are a much more practical method to employ than the preceding, except, of course, in cases where it is not possible to get them recharged; they will supply the required current without strain, and will probably give about 50 hours' working, reckoning their capacity as being 1,000 milliampere hours. When such accumulators are used it is necessary to see that all the usual attention is given them, such as keeping up the level of the electrolyte, etc.

Methods of Keying

There are various methods of keying a low-power transmitter, and some are shown in Fig. 5. The various positions at which the key may be inserted are indicated with a cross, the circuit shown being the Meissner. The least desirable is placing the key in the H.T. positive lead, as a shock may be received if the key is touched, but this disadvantage does not apply when the key is in the H.T. negative lead. Placing the key in the position marked A is a very useful method, as it helps greatly to eliminate key click, while a very popular method of keying is that shown at B, where the key is placed in

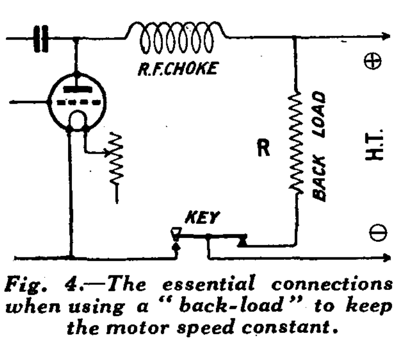


Fig. 4.—The essential connections when using a "back-load" to keep the motor speed constant.

series with the grid-leak. When the key is up, a large negative charge rapidly builds up on the grid owing to the charging-up of the grid condenser due to the high emission of the valve; this is large enough practically to stop any plate current flowing, and is a very efficient method of keying. In both these positions it may be found an advantage to shunt the key contacts with a .002 μF fixed condenser.

In practice, when using the "B" method, the grid-leak with the key in series is connected straight from grid to filament, and not as shown in Fig. 5, which is drawn to make the theory of the method clearer.

Keeping the Grid Negative

Actually the use of a grid condenser and leak is not always necessary, and as the function of these components is to keep the grid at a certain negative potential a grid battery may be used instead, while if the power used is very small possibly no advantage will be derived from using either method. Frequently, how-

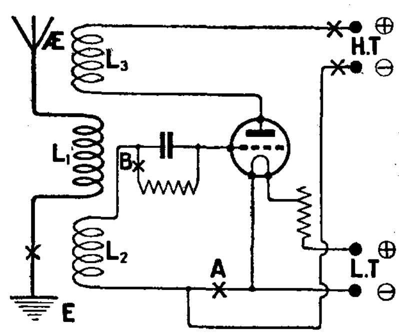


Fig. 5.—A form of the Meissner circuit. The key may be inserted at any of the places marked X.

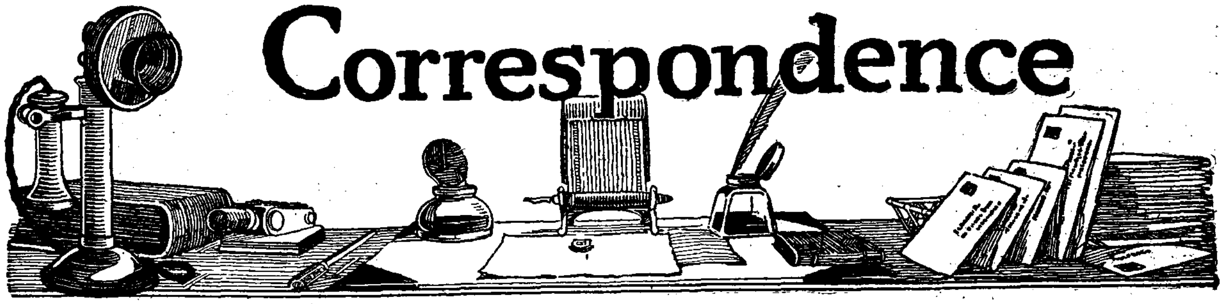
ever, the use of one of these methods will result in a reduced plate current without any reduction, and sometimes a decided rise, in aerial current.

When working with an amateur who is only a short distance away it is good practice to reduce power, thus reducing any chances of interference with amateurs near by who are attempting long-distance work.

When batteries are being used as an H.T. supply this is a simple matter, as it is only necessary to tap off a lower voltage. With D.C. mains a high resistance may be placed in the positive lead to reduce the plate current.

If a generator is used its speed may be reduced, so lowering the output voltage. If driven by an accumulator a resistance in series with this will generally be found satisfactory.

Correspondence

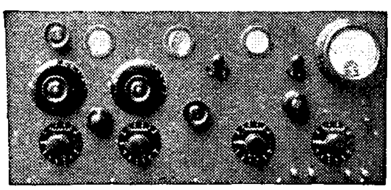


ENVELOPE No. 2

SIR,—Since wireless telephony has become so interesting, in my few spare moments I have tried to study the most elementary details of this most marvellous science, but the more my slow working brain understands some of the minor details, the more I am astounded at my ignorance.

But thanks to *Wireless Weekly, Modern Wireless* and, lastly, *The Wireless Constructor,* I have been able to gather a few crumbs from the Editor's table, and herewith give a few items, showing the progress, a growing (older) boy—born October 3, 1855—has made in this sublime science, also photographs of the instrument.

You will note in the first place that the circuit is yours, namely, that of the "Family Four-Valve Receiver" (Envelope No. 2, by Percy W. Harris, M.I.R.E.), but the panel was kept upright instead



The "Family Four-valve" Receiver made by Mr. Friend.

of horizontal, as in the "Family Four" as originally made.

Note also that the first switching arrangement has been omitted in order to simplify matters, but I have introduced separate H.T. leads for the third and fourth valves, also separate grid-bias tappings for the above valves and .25 megohm leaks across the secondary windings of the two "Eureka" transformers, which amply repays for extra pains and expense taken.

The set is a first-class instrument, and I can thoroughly recommend it for ease of management and quality of tone.

I am looking forward to getting something good on Mr. Harris' return from America, but one of our customers—who has lived in America—tells me that he likes the English receivers the best.

Wishing you every success.—Yours faithfully,

ALFRED FRIEND.

Ilfracombe.

ALL-CONCERT DE LUXE

SIR,—May I take the liberty of testifying as to the excellence of this receiver? (Envelope No. 4, by Percy W. Harris.) I have tried a considerable number of the sets so aptly described by Mr. Percy Harris and Mr. J. Scott-Taggart, but always return to the tuned anode method employed in the All Concert. The list of stations received at loud-speaker strength is rather formidable, and an excellent testimony to the sensitivity of the circuit. My receiving aerial —70 ft. long, 30 ft. high—is none too good owing to unfavourable and limited surroundings, yet the following stations have been received at full strength on an Amplion A.R.19-type loud-speaker with an additional stage of L.F. amplification:—*All* the B.B.C. main stations. Relays: Swansea, Liverpool, Sheffield, Hull, Nottingham, Edinburgh, Leeds, Bradford; Chelmsford, Radiola, S.F., Konigswusterhausen, Madrid, Rome, Hilversum, The Hague, Brussels, Frankfort-am-Main, Hamburg, Oslo, Leipzic, Petit Parisien, Posts and Telegraphs, Berlin, Munster. On the phones: WBZ four times, WGT twice, KDKA once, out of only eight attempts to cross "the pond." These stations at times would have worked a loud-speaker, but failed badly. Also between 60 and 70 amateurs on 90 metres to 400 metres.

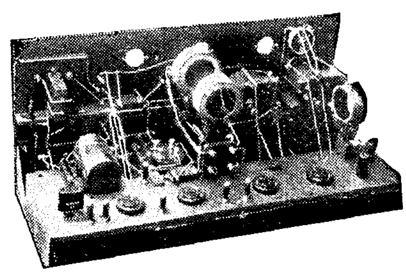
I find the circuit exceptionally stable and the tone materially increased by the inclusion of a .006 μF condenser across the loud-speaker terminals, and, of course, 1 Mfd. across the H.T. battery. A .001 μF condenser across the primaries of the L.F. transformers does not appear to make any material difference. I might add that I at present write a weekly wireless article for the *Yorkshire Observer,* and have repeatedly recommended this set for general use, as I am confident of its excellence.

May I add my appreciation of your excellent publication *Wireless Constructor,* which is the best sixpennyworth in wireless literature and the most useful compendium of wireless data for the amateur, published at such a reasonable price; in fact, it is a worthy "competitor" of *Modern Wireless,* where the pocket will not allow the purchase of both.

Perhaps you would register my call sign, 2AVX, in your next list of amateur stations, and if at any time I may send you a photograph of my station and descriptive data I should be glad to do so.—Yours faithfully,

M. H. WILKINSON.

Shipley, Yorks.



A back-of-panel view of Mr. Friend's "Family Four-valve" Receiver.

INFORMATION REQUIRED

SIR,—I shall be very much obliged if any of your readers can help me in regard to getting information concerning the best kind of wireless set to take out to India. I am thinking of taking out a three or four-valve set, as I shall have to be able to get both Calcutta and Bombay, which are 1,200 and 800 miles respectively from where I shall be stationed. I should also like to be able to pick up London if that is at all possible without too much expense.

As I have had no experience with wireless, I am anxious to get information from anyone who has had experience, and particularly from any who may be in this country and who know something about wireless in India. I may say that I shall be stationed south-west of Madras in the South of India.

I am also informed that it is necessary to get a special licence from Simla in order to import the set. I should like to have some information upon that from anyone who can give it to me.

I shall be very grateful if you can publish this letter in the next issue of your valuable journal so that your readers may help me.—Yours faithfully,

H. A. Popley.

Addiscombe, Croydon.

A "MIDGET" SINGLE-VALVE RECEIVER

Sir,—I have recently built the "Midget" single-valve receiver described in an article by A. S. Clark in the May edition of *The Wireless Constructor*.

In the enclosed photograph you will see that I have used a sloping panel.

The "Midget" is all that the author claims, Chelmsford, Radio-Paris and one other long-wave station not yet identified (German or French testing) coming in very strongly without interfering with each other.

London, Bournemouth, Petit-Parisien and several other stations, whose call signs I have not yet heard, have also been received.

Other constructors of the "Midget" may not have had such good results as myself, but I have the advantage of an extremely good aerial. On this aerial I have received 2LO on a condenser-tuned crystal set loud enough to hear speech.—Yours faithfully,

G. E. Ridley.

Eastbourne.

AN IMPROVED TWO-VALVE RECEIVER

Sir,—We are writing to tell you of our great success with the "Improved Two-Valve Receiver" as described by Mr. Stanley G. Rattee, M.I.R.E., in the January number of *Modern Wirelsss*.

Four of us who have used the circuit have had very good results. On a very small indoor aerial 8ft. high and 12ft. long five B.B.C. stations have been received. As we are only 30 miles from London on the north side we get 2LO and 5XX at loud-speaker strength. The other stations were Birmingham, Bournemouth and Nottingham, not to mention various others of which we did not get the call-signs. Without an earth we find we can get very good results; this has simplified matters for us, as we have portable sets. On an outdoor aerial we have had many German stations, Radio-Paris and all the B.B.C. stations very well.

We enclose a photograph of the sets and hope you will find a use for it.

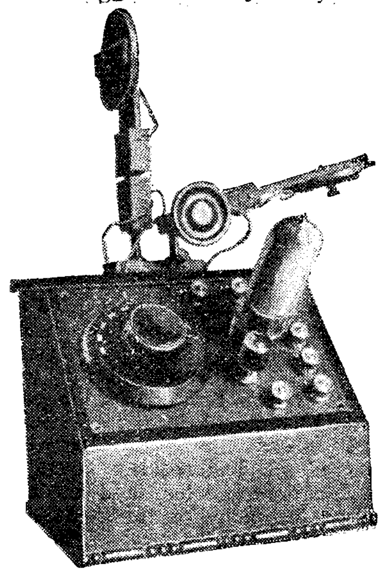
Wishing *Wireless Weekly*, *Modern Wireless* and *The Wireless Constructor* the very best success in the future.—Yours faithfully,

W. S. Palmer.
B. N. Reavell.

Bishop's Stortford.

THE "TWIN-VALVE" RECEIVER

Sir,—Having made up the Twin-Valve Set as described by Mr. John Scott-Taggart in the January issue of *The Wireless Constructor*, I wish to congratulate you on evolving such a fine circuit, as the results obtainable are remarkable. I have followed your design to the letter, the only alteration being an R.I. transformer in place of the Success, the primary and secondary connections for which I find the same. Results obtained may interest you. The set was completed just a few minutes before 2LO closed down, and the volume obtainable from this station was tremendous. Using an Ultra loud-speaker, music could be heard all over the house. Madrid was the next station received, and was comfortably audible in a large room on the loud-speaker.



The neat "Midget" Single-valve Receiver made by Mr. Ridley.

Four portable receivers constructed by readers at Bishop's Stortford.

The next day I received Belfast, this being the only B.B.C. station working in the afternoon, also 5NO.

The same night at 1.30 a.m. I tuned in WGY, which station was received at about R.6 on 'phones and audible 6ft. from the loud-speaker. Subsequently I received KDKA on 326 metres. One other station, 5AF, on 425 metres, has been heard, but so far I have not been able to identify where this transmission came from, although the announcer spoke English.

My aerial is 75ft. high at one end and 50ft. at the lead-in point, and consists of electron wire.

Thanking you once again for this valuable circuit, by far the best of many I have tried.—Yours faithfully,

J. H. Ross

Isleworth, Middlesex.

THE ANGLO-AMERICAN SIX

Sir,—I am now in a position to send a full report on the working of this excellent receiver (described in *The Wireless Constructor*, January, 1925, by Percy W. Harris).

The set was completed at the end of March, and six weeks' serious testing has been given subsequently.

With a position only seven miles S.E. of 5IT and using a P.M.G. aerial 30 ft. high, unscreened, and counterpoise earth 10ft. from the ground, the results obtained are as follows:—

2LO, full 'phone strength with crystal clarity and no interference; 6BM, ditto; 2ZY, ditto; 5NO, ditto. In loud-speaker reception of above using first and second note magnifiers with a home-made pleated diaphragm loud-speaker, good volume with remarkable purity is obtained.

Glasgow, Aberdeen and Belfast equally pure on 'phones, but interference from local station.

Continental stations, including Hamburg, Petit-Parisien, Ecole Superieure, Zurich (and others unidentified) come in with remarkable purity and volume; indeed, the strength of most Continental main stations equals that of 2LO, which, in the writer's opinion, approaches perfection in reception, the only difference being in the *slight* interference from ship signals and other traffic sometimes noticeable.

Rome was received recently at 11 p.m. with clarity at moderate 'phone strength. Madrid, of course, is quite good strength, although since the set was finished this station seems to be falling off, perhaps owing to summer conditions.

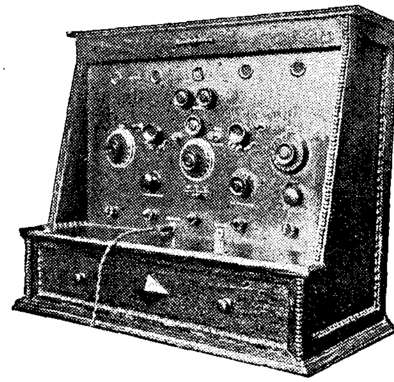
The Western Electric Co.'s station at New England was picked up at 1.30 a.m. early in April and held for three hours without fading. Reception of speech and music compared with that of the *local station on crystal* for *purity* and *strength.* Atmospherics were negligible on this occasion. Other American stations were picked up. The writer has not since tried for transatlantic reception, but was much impressed with the purity obtained.

With suitable aerial coil and neutrodyne units 5XX and Radio-Paris come through on the loud-speaker with great volume and purity using first and third high-frequency valves only, the second valve and second neutrodyne condenser being cut out. Reception from Radio-Paris at 12.45 on Sunday mornings is the finest loud-speaker reproduction of distant stations programmes the writer has heard.

The crystal clarity of distant station reception claimed by Mr. Harris is fully justified, and although summer conditions are with us, the quality of reception to-day is excellent.

Valves used are Marconi V.24's in the H.F. stages with valve-pin adapters, D.E.3 as detector, Marconi D.E. 5B first stage and L.S.5 second stage for power amplification. I have also used A.R. dull emitters with success in the H.F. stages.

I trust these notes will be of interest to others, especially those who, with the writer, are concerned with faithful and pure undistorted reproduction of the items as transmitted. The Anglo-American Six



The handsome receiver built by Mr. Reynolds, with the help of "Modern Wireless."

will give one this, even on the more distant stations, with a certainty which is delightful once the set has become familiar.

However, it is not a set for the beginner, as results depend to a large degree on critical adjustment of filament, anode voltages and neutrodyne settings and the correct balance between all three, but once found, these adjustments are easy enough to tabulate for future reference.

The set is highly selective, and in the present case works better with series tuning for distant stations, although parallel tuning seems preferable for local station and Chelmsford high power. — Yours faithfully,

L. A. Bayliss.

Birmingham.

A READER'S APPRECIATION

Sir,—I am sending you herewith a photograph of my latest set, which I have designed and made myself. I have been a *Modern Wireless* enthusiast since its first number, and I have every month's issue carefully kept, for the re-reading of the old ones is quite interesting and instructive.

The enclosed represents my advancement by degrees from the Coherer stage, thanks to *Modern Wireless.* The set consists of 2H.F., D. and 1L.F. transformer, 1L.F. choke. I have received WBZ on the loud-speaker at the volume and clearness with which I receive the local station. I get other American stations, but I have got past the stage when, because it was a distant station, one used to sit and listen to any old noise just to catch the announcing of the station.

I can enjoy the broadcasting from any of our B.B.C. stations with one or two exceptions. My chief trouble is local oscillators; one continuous howl!

I might add that the local club of which I am a member voted it the best set for reproduction that any member possessed or had heard.—Yours faithfully,

A. Reynolds.

Birmingham.

INTERFERENCE FROM A.C. MAINS

Sir,—With reference to the query on the above subject from D. G. H. (Wandsworth) which appears in the Information Department columns of your issue of the 8th inst., the following may be of interest.

I recently encountered trouble from this cause to such an extent that the loud-speaker emitted a roar which could be heard all over the house and completely drowned out any but the very loudest signals. While trying to devise some expedient for getting rid of the nuisance I noticed that the interference increased slightly as I moved away from the set and also that, when working the set, it was considerably lessened if I stood up instead of sitting down. This caused me to investigate a lamp which is fixed to the wall just above the table on which the set stands, and I found that on bringing my hand near the lamp the noise was considerably diminished, and on touching the lampholder or any part of the metal bracket with my finger it disappeared entirely. I ran a wire from the bracket to the earth terminal of the set, and have had no more trouble since. As far as I can see the explanation is that such fittings as wall brackets are, as far as the low-frequency lighting current is concerned, very well insulated from earth, and therefore capable of receiving by induction a considerable charge from the A.C. wires passing through or near them, and it is the varying field set up by this charge in the neighbourhood of the set which causes the trouble. D. G. H. may be able to overcome his difficulty in the same way.—Yours faithfully,

G. M. Rooker.

Barcelona.

ENVELOPE No. 5

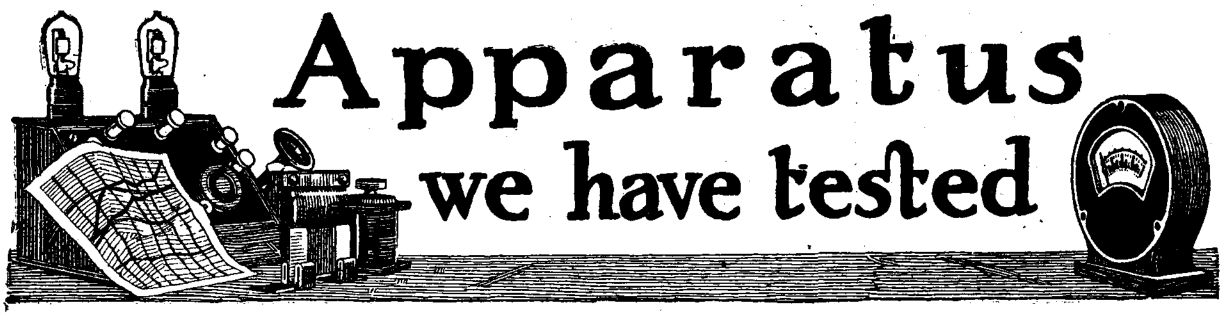
Sir,—A few notes on the "Omni" receiver. This has been a most pleasant companion during convalescence from an illness, and this is perhaps the chief reason for my writing. As aerial, of course, I used only a frame (normally used for my super het.), and had, therefore, to confine myself to peculiar circuits. I have a paste-up book in which I have collected most of the circuits so far published. But I could not find anything very suitable. Charging difficulties prohibit more than a couple of valves. Could we have more Omni circuits, please, and could they be published with notes as in *Wireless Weekly* in a collected form and in a comprehensive range? It is the experimental side—the variations and so on—that are so interesting. For instance, I got hold of a diagram of a Flewelling circuit and have just tried it; well, it worked with razor sharp tuning and appalling hand capacity effects—one would have liked to know how to deal with all this.

Finally, there has gone around a rumour of an ST100 with preceding H.F. amplifying valve. Could you let us have this for the Omni? The ST100 with increased range—what a combination!

With every appreciation of *Wireless Weekly*, particularly the more critical articles on coil types, wire, sizes, etc., etc.—Yours faithfully,

Jennings Marshall.

London, W.1.



Conducted by A. D. COWPER, M.Sc., Staff Editor.

A Microphone Relay

Messrs. Economic Electric, Ltd., have sent for test samples of their "Detectorvox" microphone attachment, for use particularly with crystal receiving sets. This is in the form of a narrow circular case, 2¼ in. in diameter, with a circular aperture on one side covered with perforated metal, behind which is the diaphragm of the microphone proper, apparently of the ordinary carbon granule type. This case is to be clamped on the ear-piece of the ordinary 'phone, a rubber ring making an effective joint between the two. The makers specify a three-volt dry battery with a telephone receiver, loud-speaker or 'phone-transformer primary of around 10 ohms resistance, to complete the equipment of the relay.

On practical trial of the microphone unit, it was found to be surprisingly sensitive when coupled up as indicated with a single 10 ohm receiver and a battery, the very faintest scratch or vibration, or speech at several feet from the microphone, being reproduced as a loud noise in the receiver, with the case either on edge or lying face downwards. It was hard, in fact, to get a support sufficiently free from vibration to give a moderately silent background. With three volts (two large dry cells) applied, and with the single microphone and a 10 ohm receiver, the resulting current appeared somewhat to overload the microphone, so that there were continuous noises of an irregular nature; with two microphones in series, or with one microphone and but 1.5 volts (one large dry cell), this effect largely vanished.

Tried as a microphone relay, with the one microphone fastened on the face of a single 2,000 or 4,000 ohm receiver connected to an efficient set tuned to the local station, and therefore already giving good signals, with three volts applied in the single microphone circuit the intensity of the relay signals in the 10 ohm receiver was considerable, so that they were audible at some distance away from the receiver, and evidently could operate to some effect a loud-speaker of suitable impedance. The familiar expedient of an improvised loud-speaker made of a deep bowl and the single receiver gave intelligible speech across the room, though, of course, a long way away from full loud-speaker strength. Using two microphones in series with the 10 ohm receiver and three-volt battery, and placing each microphone on one ear-piece of an ordinary 4,000 ohm telephone head-set, there was a considerable improvement in quality of reproduction, though the signals appeared to be no louder; but the background was much quieter. However, it will be obvious that the ordinary limitations of the carbon microphone are necessarily present in any such arrangement, so that the best effect obtainable was comparable to the reproduction obtained on an ordinary telephone trunk line distant call. Actually, in spite of the amplification attained, speech was sometimes more intelligible when fainter, but undistorted, without the use of the relay. There are obvious possibilities in this simple device, where intensity rather than flawless reproduction is required, as in "calling-up" devices, and for operating a loud-speaker to give audible warning, without requiring close attention, of the commencement or termination of some particular item in the programme, etc. The makers suggest also the possibility of connecting two microphones in cascade. Some authorities consider that future progress in domestic broadcast reception lies in the development of the efficient loud-speaking valveless relay, and this little instrument is an interesting attempt in that direction.

Dextraudion Valve

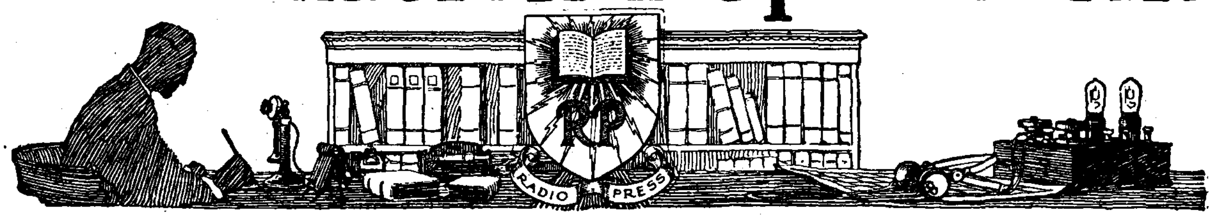
A dull-emitter valve of the .06 class, but of similar build to the well-known Extraudion bright-emitter and the 1-volt Dextraudion, has been submitted for test by Messrs. Economic Electric, Ltd., and has been given extensive trials. It is a small valve, with tubular bulb, and has the rectangular open-box-shaped anode and wire grid familiar in the Extraudion valve. The filament rating is from 2.5 to 3 volts—not to exceed 3 volts—and .06 amperes. On trial, the specimen was found to demand, when new, about .055 amperes at 3 volts; this fell off in use to about .05 amperes. The trials were made with full 3 volts on the filament, when the maximum emission obtained in use with high anode potential and positive grid bias was just under $1\frac{1}{2}$ milliamperes.

The characteristics were determined for 30, 50 and 70 volts H.T., the makers' rating being from 45 to 75 volts, or somewhat higher for L.F. amplification with grid bias; practical tests were also made with 100 volts H.T., and there were no signs of distress at this voltage. With 75 volts H.T. the optimum grid bias for good loud-speaking was around 10 volts; on 100 volts over 13 volts negative bias was demanded, with improved results on powerful signals. For detection less than 40 volts appeared best; the valve did not oscillate very freely, but microphonic effects were slight.

From the characteristics it is easy to see why heavy grid bias was advisable, as saturation (at this filament heat) set in quite early. A straight characteristic of good length was shown by the 50-volt curve, with about $4\frac{1}{2}$ volts grid bias to find the middle point for L.F. amplification; the 30-volt curve indicated favourable detection and H.F. amplification. The amplifying factor was not high, being about 5; the A.C. impedance came out at the ordinary value for a G.P. valve of 36,500 ohms.

In general, this interesting addition to the Extraudion family appears to be a useful, economical valve, very free from the microphonic effects so common in the .06 class, and able to handle a fair amount of energy with suitable grid bias and ample H.T.

Information Department



SUPPLIED BY RADIO PRESS SERVICE DEPT., LTD.

R. G. F. (BOURNEMOUTH) is constructing a set consisting of a detector and two transformer-coupled stages of low-frequency amplification for loud-speaker work on the local station, and wishes to use a system of plugs and jacks in order to obtain one, two or three valves as desired. He wishes to know what jacks to order and where useful information is available on the necessary connections.

In reply to our correspondent, we would advise that if he does not wish to switch the filament by means of the jacks, two "single-closed" and one of "single-open" type will be necessary. If, however, it is desired to switch all the filaments, so that only the valves required are lit, it will be necessary to obtain two "double-filament" jacks and one "single-filament" jack. If our correspondent consults the article by Stanley G. Rattee, M.I.R.E., in the March, 1925, issue of *The Wireless Constructor* we do not think he will find any difficulty in working out the desired connections, or alternatively a complete design is given in *Wireless Weekly* for March 4, 1925, by the same author.

R. E. (BIRCHINGTON) states that he has not used his set for a month, and now, when he switches on, signals are spoilt by crackling noises, and both signals and noises are quite strong on first switching on but fade away almost to nothing in a few minutes, the process being capable of repetition after a few minutes' rest. He asks us what is the trouble.

The trouble with our correspondent's set is diagnosed as being a case of the batteries having run down. When serious crackling is heard and this still continues when the aerial and earth are removed, the trouble is usually located in the high-tension battery, which should be renewed. When signals gradually fade away but return to normal strength after the set has been switched off for some time, the low-tension battery is usually the offender. If a dry battery is used for filament heating this should be renewed, but if an accumulator, the remedy is to have it recharged.

Even if not used, accumulators should be charged fairly regularly if they are to be kept in good condition, and we would suggest that they be charged once a month, whether used or not. When in use their voltage should never be allowed to drop below 5.4 volts for a 6-volt accumulator or 1.8 volts per single cell. This voltage should be read with a suitable voltmeter when the cells are actually delivering their normal load. Evaporation should be noted, and if the electrolyte becomes low through this cause, it should be made up with distilled water to just above the level of the top of the plates. Distilled water should always be used, and under no conditions should tap water be substituted, as the impurities which it often contains will tend to ruin the plates. Where the electrolyte itself is spilt it should be replaced with acid made up to the correct density. The accumulator should be kept in a cool but not too cold place.

An Unnecessary Society

(Concluded from page 481)

We certainly think the wireless papers should be published separately, and that the Council of the I.E.E. be strengthened by the addition of adequate radio representatives, i.e., those who are not general electrical engineers or scientists *and* wireless men, but those whose life work is connected purely with wireless. In brief, the Council of the I.E.E. should enhance the status of the wireless section.

In earlier days, most of the radio engineers were general electrical engineers, but now there are many entering the profession through other channels. Physicists, for example, have taken up the art of wireless, and many leading radio engineers, especially in the Services, have never been in the I.E.E., and many would certainly not be able to pass the A.M.I.E.E. examination because of certain of its features. The I.E.E. should therefore take a broad view without in the slightest reducing their essentially high standard.

Finally, we venture to say, that the proposal for a British I.R.E. should, if ever, come from a quarter more representative of prominent radio engineers in this country. The proposal appears to emanate largely from Mr. G. Y. P. Evans, who apparently feels left out in the cold, not being an A.M.I.E.E., and feeling that no existing institute quite fits him. It will be recalled that he launched a British radio relay league which we opposed to the full, predicting an early demise, which very shortly afterwards took place, the members being absorbed by the R.S.G.B. This zeal of his for initiating new radio societies, while bound, in our opinion, to be abortive again, is curious, but nevertheless he is doing good work in drawing attention to existing shortcomings.

We advise Mr. Nelson, M.I.E.E., and Mr. Evans to drop their scheme, which will not be supported by leading radio engineers. We have a similar parallel in the amusing action of the Radio Association in establishing a Fellowship by examination. Unless the support of those prominent in the profession is obtained, then self-confident enthusiasts will merely waste their time.

Nevertheless, the Council of the I.E.E. and its wireless section should attach due importance to the suggestion as showing to some extent the feeling in professional wireless circles. We intend to oppose to the full a separate institute, but we are equally anxious to see the wireless section show more independence and the Council of the I.E.E. more appreciation of a new profession.

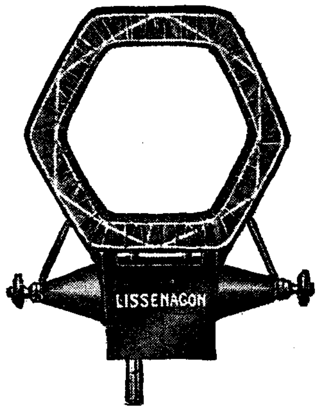
LISSENIUM

Silence-

for those distant stations!

MANY listeners would like their local station to close down so that they might search for distant stations without interference.

That is, of course, quite out of the question—and certainly most unnecessary, too.



LISSENAGON "X" COILS

No. 50 .... **6/-**
No. 60 .... **6/4**
No. 75 .... **6/4**
No. 250 .... **9/9**

LISSENAGON "X" COILS are interchangeable with the standard LISSENAGON and other standard coils and although the tappings make them suitable for special purposes, they are in other respects similar to, and can be used as, standard coils.

WITH LISSENAGON "X" COILS, distant stations can be tuned in without the slightest sign of interference, just as though the local station had actually closed down, in fact.

Readers of this magazine who wish to make their receivers highly selective should write for interesting leaflet describing the many uses of LISSENAGON "X" COILS. In many cases no alteration is necessary to a receiver, in others the alteration to wiring is a matter of a moment. Those interested in Neutrodyne and Reinartz circuits, wavetraps, etc., should also have a copy of these particulars of LISSENAGON "X" COILS.

A TEXT BOOK OF LISSEN PARTS will also be sent free on request. It contains a fund of useful information which will be of interest to all readers of this magazine.

In all cases where Standard Coils are required, Experimenters who are only satisfied with the most efficient—

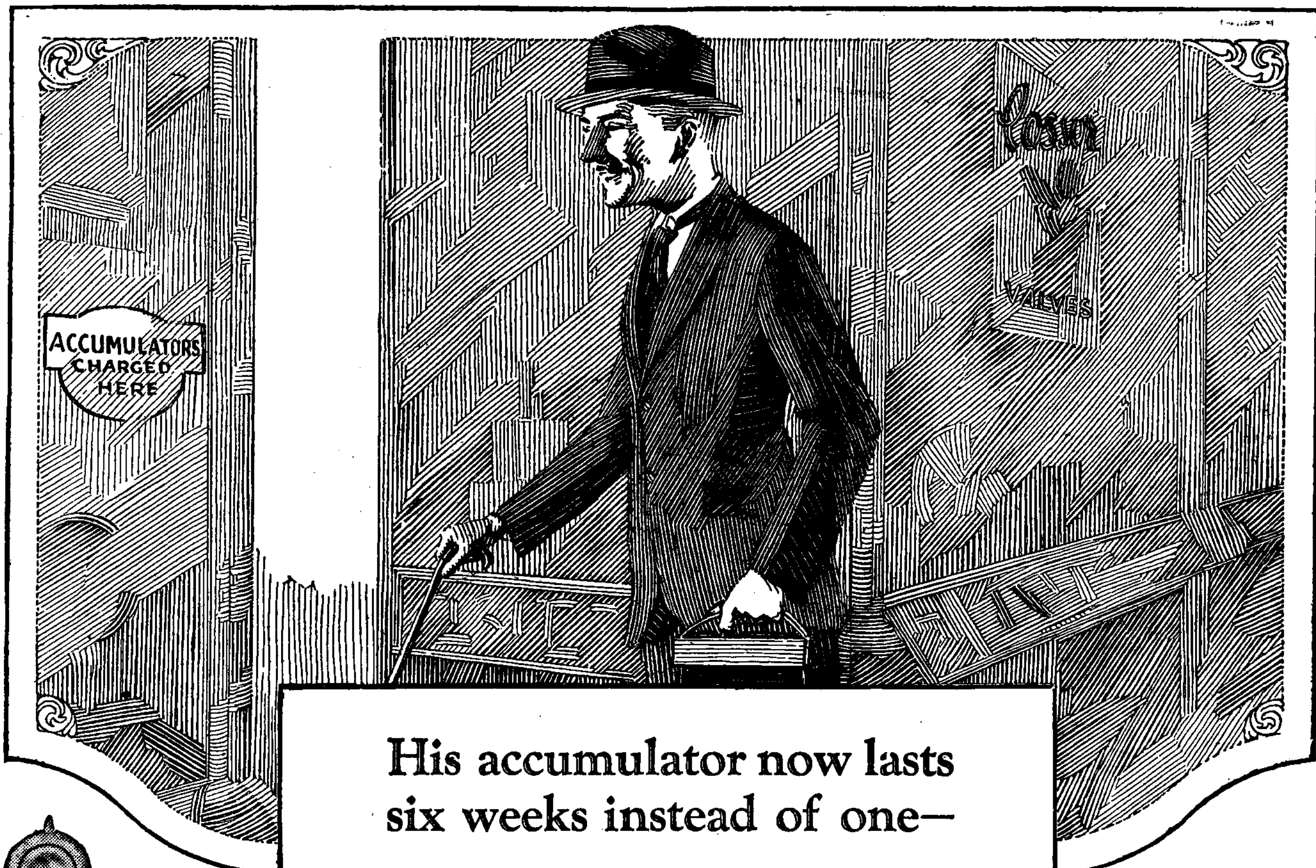
USE LISSENAGON COILS—the coils which intensify tuning.

LISSEN LIMITED,

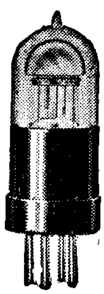
Lissenium Works, 30-32, Friars Lane, RICHMOND, SURREY.

'PHONE:—Richmond 2285 (4 lines). *'GRAMS:—"Lissenium, London."*

LISSEN PARTS—WELL THOUGHT OUT, THEN WELL MADE



His accumulator now lasts six weeks instead of one—



Wuncell Dull Emitters

Made in two series: Types W.1 and W.2 for 2-volt accumulators. Types W.R.1 and W.R.2 with additional resistance incorporated within the base so that valves can be used with either 2-, 4- or 6-volt accumulators.

W.1 and W.R.1 are for use as Detectors or L.F. Amplifiers. W.2 and W.R.2 (with red tops) are specially designed for high frequency amplification.

Technical Data:
Filament voltage, 1·6 to 1·8
Fil. consumption, ·3 amps.
Plate voltage, 20 to 80

W.1 14/- W.R.1 16/-
W.2 14/- W.R.2 16/-

THE point is just this: Can you afford *not* to use Wuncell Dull Emitters.

Or, let us put it in another way. You own, perhaps, a 3-Valve Set. Now the average bright emitter valve consumes about ·7 amp. Three of them, therefore, will consume 2·1 amps. If your accumulator is rated at 6 volts 30 amp. hours (that is a good average size) you will therefore obtain rather less than 15 hours' use from it on a charge.

The cost for this may be anything up to 2/-. Eight shillings for a month's broadcasting—practically £5 per year.

Now let us see what you would be paying if you used Wuncells. First of all you would reconnect your accumulator to give 2 volts by connecting all the cells in parallel instead of series. This will triple its capacity and give you 2 volts 90 amp. hours, but the charging cost won't be any higher.

Wunçell valves function best at 1.8 volts and consume .3 of an amp.; your 3-valve Set, therefore, will consume .9 amp. and your accumulator will last six weeks on one charge.

In other words, you get 5 weeks' broadcasting for nothing every time you get your accumulator charged if you are using Wuncells. And they will save their cost in a couple of months or so.

But in addition to economy with the Wuncell you get a greatly increased life. Owing to its special filament, quite unlike that in any other valve, it functions at an incredibly low temperature. No wonder, after extensive tests, *Amateur Wireless* reported that the filament of the Wuncell "is practically unbreakable."

So you'll readily admit that not only do you save quite a considerable amount in running costs, but you get a valve that is likely to last at least three times as long as the ordinary bright emitter.

Surely this is real economy.

Have you a Loud Speaker?

—here is the Valve you should use.

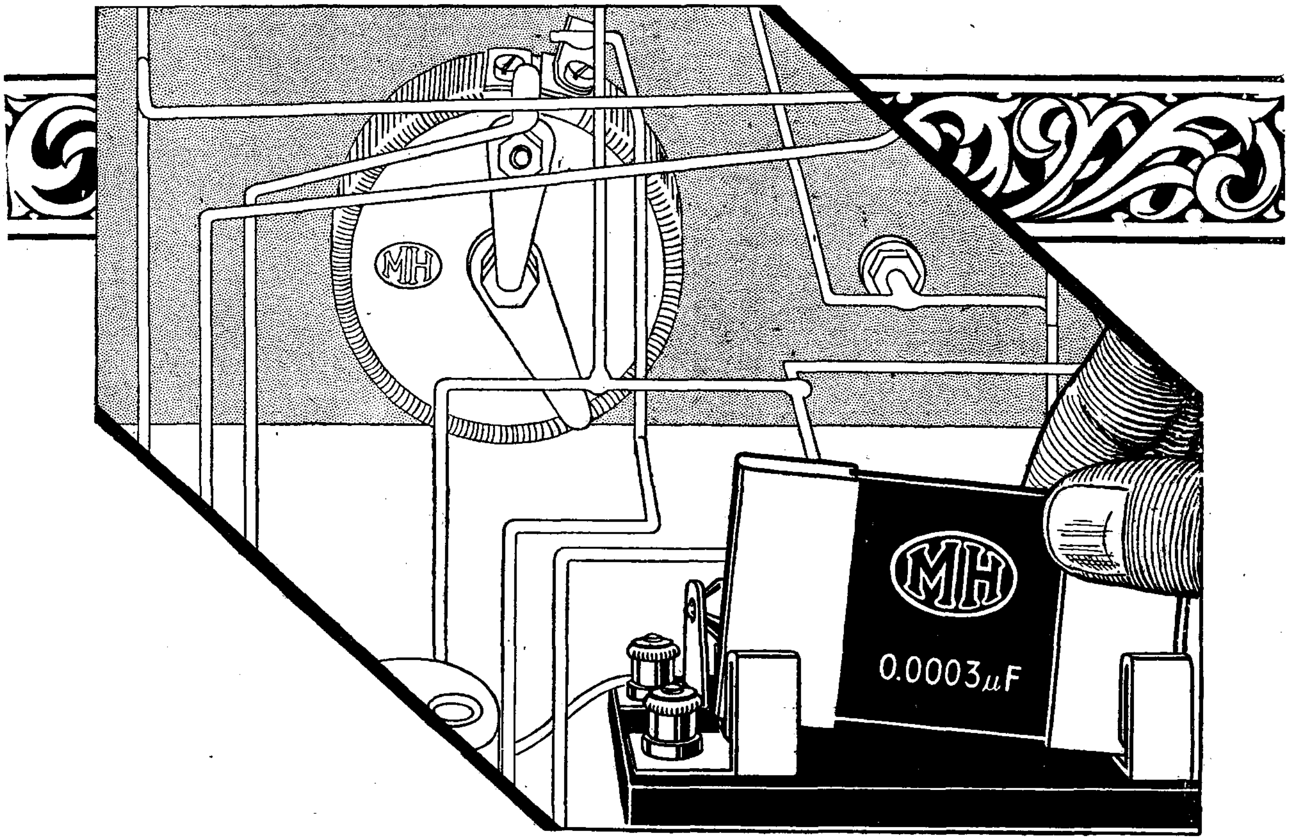
In order to get the best results from a Loud Speaker you require ample power without the necessity of working your valves to their limit. This means that you need a proper Loud Speaker Valve designed for the job. The new Cossor W3 has been specially built for power work with only a moderate high tension voltage. Use it in place of your ordinary L.F. Valve and you'll be amazed at the tremendous increase in volume.

Technical Data:
Filament voltage, 1·8 to 2
Fil. consumption, ·5 amps.
Plate voltage, 50 to 150

Cossor W3
18/6

Cossor Wuncell
— the long life Dull Emitter

Gilbert Ad 3212.



MH

FIXED CONDENSERS

ARE

1. Of the permanent capacity engraved thereon.
2. Instantly interchangeable.
3. Of everlasting and unfailing service.

GRID LEAKS AND ANODE RESISTANCES

Possess similar characteristics.

In common with all MH Components they are of original design, constructed by skilled workmen, of the best materials, with but one aim and object, i.e., **the Highest Efficiency to give you Superlative Results.**

MH FIXED CONDENSERS

0.0001 μF to 0.001 μF	1/9	each
0.002 μF to 0.01 μF	2/3	„

(Two clips are supplied with each condenser.)

Mounted on ebonite base, with terminals, any value.

0.0001 μF to 0.001 μF	2/9	each
0.002 μF to 0.01 μF	3/3	„

MH GRID LEAKS

Grid Leak, all values .. .. .. (040)	2/-	each
(Each supplied with two clips.)		
Mounted on ebonite base with terminals	3/-	each

MH ANODE RESISTANCES

Anode Resistance, all values .. .. (041)	2/6	each
(Each supplied with two clips.)		
Mounted on ebonite base with terminals	3/6	each

COMBINED GRID LEAK AND CONDENSER 4/- each

Works :—
WEXHAM ROAD, SLOUGH
Phone : SLOUGH 199

L. McMICHAEL LTD

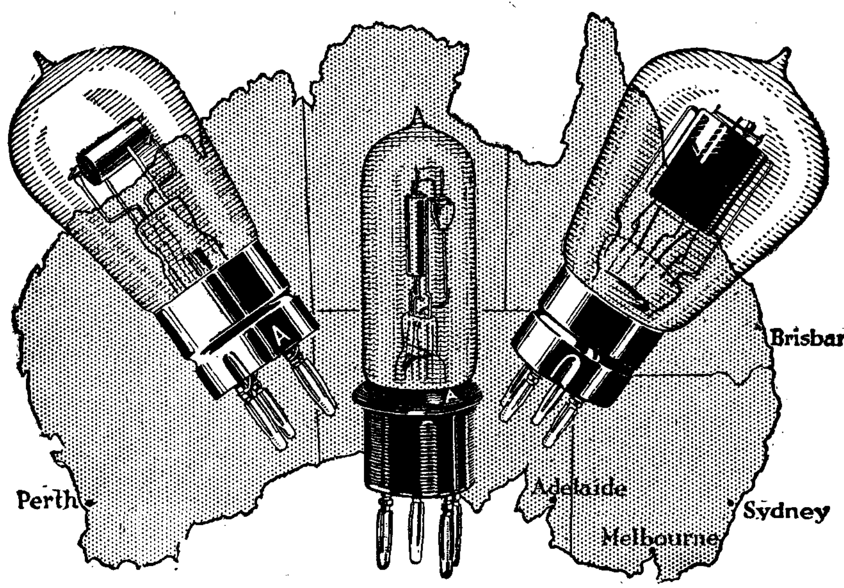
Manufacturers of Wireless and Scientific Apparatus

London Showrooms :—
179, STRAND, W.C. 2.
Phone : CENTRAL 6988

Head Office :— HASTINGS HOUSE: NORFOLK STREET: STRAND: LONDON: W.C. 2. *Phone:* CENTRAL 8272/3

TELEGRAPHIC ADDRESS: RADIETHER, ESTRAND, LONDON   CABLE ADDRESS: RADIETHER, LONDON.

Barclays Ad.



Australia on a Dull Emitter!

PROFIT BY THE EXPERIENCE OF THOSE WHO KNOW

CHOOSE YOUR DULL EMITTER VALVES FROM THIS RANGE

FOR 2-VOLT BATTERIES:		
D.E.R.	General Purpose	**14/-**
D.E.6.	L.F. Amplifier	**18/6**
FOR 4-VOLT BATTERIES:		
D.E.Q.	Detector	**27/6**
D.E.3.	General Purpose	**16/6**
D.E.3.B.	L.F. Amplifier (For resistance capacity)	**16/6**
D.E.4.	L.F. Amplifier	**22/6**
FOR 6-VOLT BATTERIES:		
D.E.5.	L.F. Amplifier	**22/6**
D.E.5.B.	L.F. Amplifier (For resistance capacity)	**22/6**

MR. W. K. ALFORD (G2.DX), the well-known radio amateur, has established a new wireless record by communicating with Sydney, N.S.W., using a ***low-power Dull Emitter valve*** for transmission.

The valve was one of the range backed by the names **MARCONI and OSRAM** and was ***the first Dull Emitter to be used for long-distance communication.***

This record again proves the efficiency and economy of this comprehensive range of Dull Emitter valves.

Buy the Valves backed by the names

MARCONI & OSRAM

Sold by Wireless and Electrical Dealers, Stores, Etc.

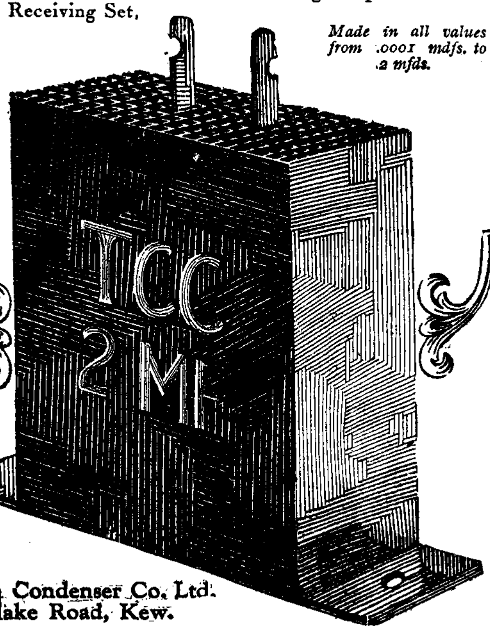
ANNOUNCEMENT OF THE M.O. VALVE CO., LTD.

20 Years ago

IT is twenty years since the first T.C.C. Condenser merited the approval of the electrical industry. When Wireless loomed ahead—we, as the largest condenser-building specialists in this country—were quick to realise its immense possibilities.
New plant was laid down—factories were extended—but still the demand for the familiar Green Condenser exceeded the available supply. Under such circumstances, any other firm might have been tempted to relax some of the restrictions which govern the quality in an effort to speed up production.

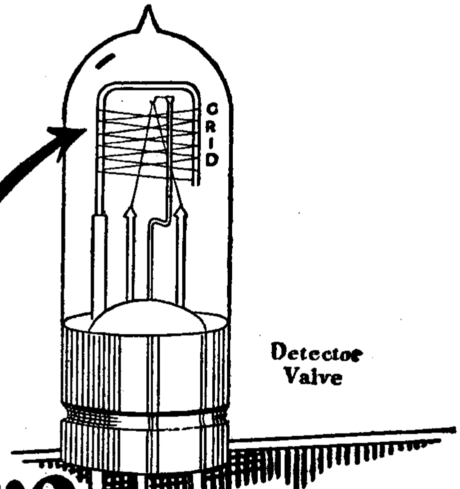
But twenty years of manufacturing experience have proved the wisdom of keeping faith with the public. A condenser for wireless use—nine times out of ten—is bought on the reputation of the maker. We are proud to think, therefore, that within three years many hundreds of thousands of T.C.C. Condensers have been chosen for the most strategical points of the Receiving Set.

Made in all values from .0001 mdfs. to 2 mfds.



Telegraph Condenser Co. Ltd.
Mortlake Road, Kew.

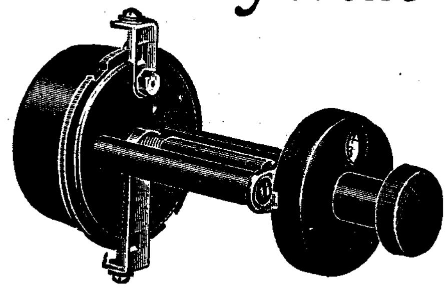
Gilbert Ad. 3230.



Detector Valve

It's here—that a lot of distortion occurs *smooth it away with this*→

IGRANIC
Variable
Grid-Leak.



A *fixed* grid-leak cannot be expected to overcome it when the set is required to work under fluctuating conditions with varying anode voltages. You must have a *variable* grid-leak and a good one too!
The Igranic Variable Grid-Leak is such. It has a resistance range of from zero to five megohms which, as you probably know, is the range most suited for obtaining good rectification with maximum signal strength.
A special feature which will readily be appreciated is that the rubbing contact is driven through an ebonite stem and all the electrical parts are well spaced from the surface of the panel. By this means the leak can be connected in any part of the circuit without risk of detrimental effects being produced when the hand is brought near the surface of the panel in the process of tuning.
The dial is of unique design, and consists of a clearly marked ivorine scale revolving behind a moulded cover.

All reputable dealers carry stocks.

IGRANIC RADIO DEVICES include Honeycomb Duolateral Coils, Variable Condensers, Fixed Condensers, Filament Rheostats, Intervalve Transformers, Variometers, Vario-Couplers, Coil Holders, Potentiometers, Vernier Tuning Devices, Switches, etc., etc. *All carry the IGRANIC guarantee.*

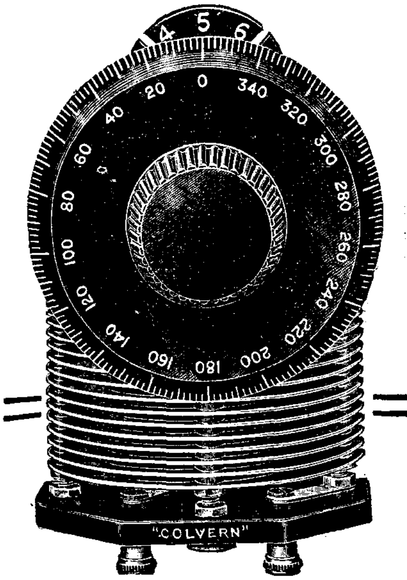
WRITE FOR LIST Y.62

Branches: Birmingham. Leeds. Cardiff.

IGRANIC ELECTRIC COMPANY LIMITED

Branches, Manchester. Glasgow. Newcastle.

149, Queen Victoria Street, London.
Works: BEDFORD.



Imagine an analytical chemist without his scientific balances or an engineer without his micrometer!

Similarly, you will never tune a receiver with a direct drive condenser once having experienced the accurate tuning of the Colvern Selector Low Loss Precision Condenser.

Obtaining Hairbreadth Tuning

THE Colvern Selector Low Loss Precision Condenser is an instrument which gives the precise adjustment so essential to obtain perfect reception, whether on loud signals, such as the local broadcast, or on transmissions from low-powered distant stations. The mechanical method employed ensures accuracy to 1/20th of a degree; and, a further consideration, the eye is not called upon to supplement imagination. **The scale interval is readily readable to that small difference in capacity—1/3,600th part of the total capacity available.**

It is when working upon weak distant transmissions that the necessity for such, critical and accurate adjustment is vital. Many excellent circuits have been discarded because they required a more critical tuning djustment than available apparatus afforded. Equally efficient circuits were condemned as uncontrollable, since, existing apparatus could not give the essential final adjustment.

Capacity reaction circuits such as the Reinartz, CR-17 Grebe, any Ultra Short Wave Receivers and the short-wave stages of Super Heterodyne Receivers, require hairbreadth tuning, obtainable only by such mechanical means as the Colvern Selector provides.

The dial of the Colvern Selector is divided over the full circle, and provides 360 degrees value for each rotation of the index. This enables 1/20th of a degree to be actually located: AND ANY PREDETERMINED CALIBRATION CAN BE RE-LOCATED TO THIS ACCURACY AT WILL.

The Colvern Selector Low Loss—
Reading to 1/3,600th of capacity

Capacity .0005 mfd.	.. ..	£1 1 0
„ .0003 mfd.	.. ..	£1 0 0

Type F, without gear attachment—

Capacity .0005 mfd.	.. ..	15 0
„ .0003 mfd.	.. ..	14 0

One hole fixing. Other capacities if required.
Descriptive Folder upon request.

The Colvern independent Vernier provides a very useful means of securing fine tuning adjustment. For balancing up H.F. Stages, taking up variations in capacity when H.F. Stages are controlled by dual or triple condensers, and for balancing up the Long Wave Intermediate Amplifier in Super Hets, when Matched Transformers are used.
Price 2/6.

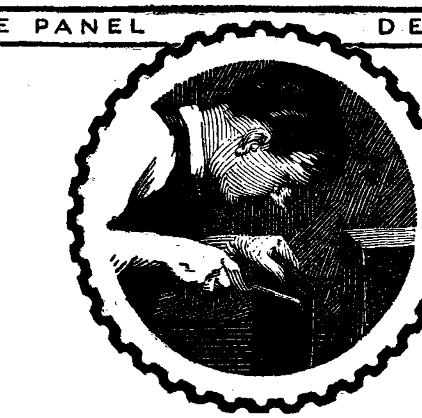
COLVERN SELECTOR LOW LOSS

From your Dealer

COLLINSON PRECISION SCREW CO. LTD.
Provost Works, Macdonald Road, Walthamstow, E.17.
Telephone: Walthamstow 532.

Barclay Ad.

THE PANEL DE LUXE



GOOD news travels apace—and it is not surprising, therefore, to find that wireless enthusiasts are gladly paying the few shillings extra for Radion Panels. Already they have realised that at a very small extra cost they can insure against surface leakage and all the deadly ills to which cheap ebonite is prone.

¶ *Radion is available in 21 different sizes in black and mahoganite. Radion can also be supplied in any special size. Black 1d. per square inch, mahoganite 1½d. per square inch.*

RADION *Trade Mark*

American Hard Rubber Company (Britain) Ltd.

Head Office: 13a Fore Street, London, E.C. 2

Depots: 120 Wellington Street, Glasgow. 116 Snow Hill, Birmingham.
Irish Agents: 8 Corporation Street, Belfast

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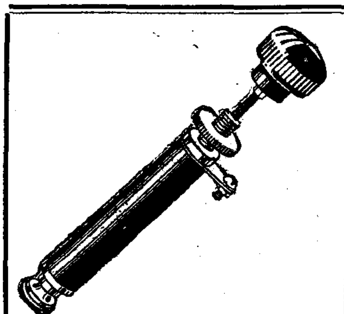


A Silent Background

is essential if long distance reception is desired.
The use of a gridleak containing carbon is bound to produce a noisy background.
In a variable grid leak, especially the resistance material used must be constant when in use.
Such a variable grid leak is the

"BRETWOOD" GRID LEAK

Successfully used and recommended everywhere.

As Changeable as the Weathercock

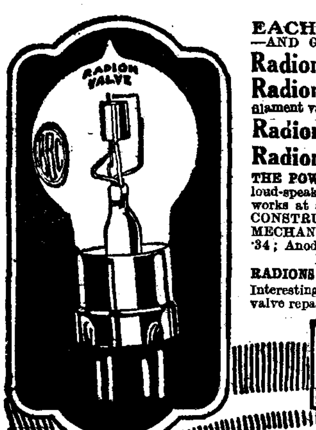
is a well-known expression. It is peculiarly applicable to the carbon compression type of variable grid leak.
A carbon leak examined under a powerful microscope shows minute arcing between adjacent particles when a test current is flowing. Thus, slowly, portions of the leak may be consumed, while its use is bound to result in noisy operation of the receiver, and atmospheric conditions change its effective resistance.
The only variable grid leak which is so constant in action as to admit of its being actually calibrated is the "Bretwood."
The substance used is silent in action and constant when in use. For better reception fit a "Bretwood."

PRICE 3/- POSTAGE 3d.

BRETWOOD LIMITED
12-18, LONDON MEWS, MAPLE ST., LONDON, W.

BRETWOOD GUARANTEED
SPECIALITIES
are obtainable from most Wireless Dealers.

Barclays Ad.

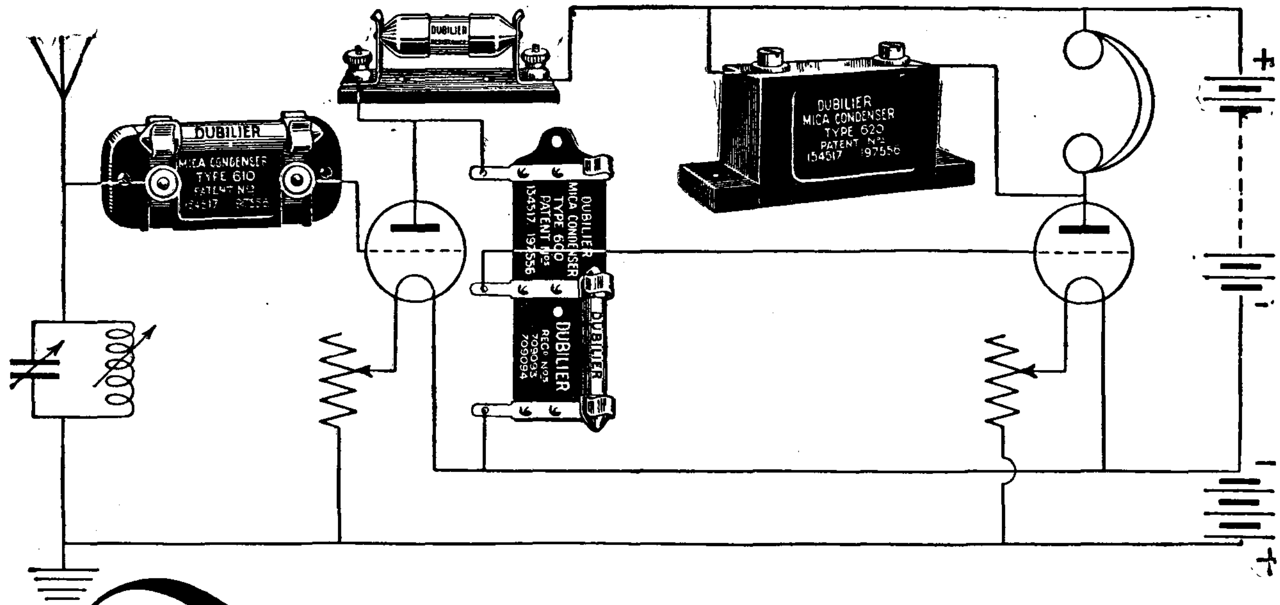


EACH A KING IN ITS CLASS
—AND GUARANTEED BRITISH MADE.

Radion G.P. A 4-volt bright valve that only consumes ·48 amp. - - } **7/-**
Radion D.E. ·06 A wonderfully efficient 3-volt "very dull" filament valve - - - - - - - } **10/6**
Radion D.E. ·34 A 2-volt dull emitter of fine performance } **10/6**
Radion Pyramid (1) Valve, 22/6

THE POWER VALVE DE LUXE. Can be used with largest loud-speaker without valve distortion. Filament robust: works at a low temperature, ensuring long life, SPECIAL CONSTRUCTION GIVES HIGHEST EFFICIENCY AND MECHANICAL STRENGTH. Fil. Volts, 5·5; Fil. Amps., ·34; Anode Volts, 50-100; Neg. Grid Bias, 3-9.
From untied Dealers or direct, Post Free.
RADIONS LTD., BOLLINGTON, nr. Macclesfield, Cheshire.
Interesting literature concerning Radion Valves and our unique valve repair service gladly sent Free on request.

RADION *Reliable Valves*



Further Small Matters~

THE components illustrated above are small but important. They are the highly specialised products of a notable firm—one which, among other things, was responsible for the introduction of Mica Condensers. Further, these components are characterised by the now well-known Dubilier standards of neatness and finish in construction and reliability in operation.

There is the Type 600 Dubilier Mica Condenser, for example :—a fixed condenser whose capacity is guaranteed by us to be accurate within close limits that are not often met with elsewhere.

A new Dubilier Grid-Leak Attachment is sold for use with it, and is illustrated above. It enables a Grid Leak to be inserted direct between the Grid and L.T. leads simply by clipping in, making use of one of the condenser clips and the clip on the attachment.

The Dubilier Anode Resistance, again, designed for extreme stability in operation, is tested during manufacture to 200 volts, and is absolutely reliable.

The new Dubilier Type 610 Mica Condenser is also shown. It was dealt with in a previous advertisement of this series—"Little Things that Matter." It is suitable for use everywhere in receiving circuits, and is provided with screw terminals and detachable Grid Leak Clips.

For specialised products such as these, it is always easier and better to specify—

TRADE DUBILIER MARK

DUBILIER CONDENSER CO LTD

Mica Condenser. Type 600
(Also Type 600A for vertical panel mounting).
0.0001—0.0009 mfd... 2/6
0.001 —0.006 mfd....3/-

Mica Condenser. Type 610
(with Grid Leak clips)
(Also Type 620 for panel mounting).
0.0001—0.0009 mfd....3/-
0.001 —0.009 mfd....3/6
0.01 mfd. 4/-
0.011—0.015 mfd. ...4/6

Grid Leak Attachment, 6d.
(for use with Type 600).

Anode Resistance
complete with holder
20,000—100,000 ohms 5/6

Grid Leak
0.5, 1, 2, 3, 4 & 5 megohms. 2/6

ADVERTISEMENT OF THE DUBILIER CONDENSER CO., LTD., DUCON WORKS, VICTORIA ROAD, NORTH ACTON, LONDON, W.3. TELEPHONE: CHISWICK 2241-2-3

The

WIRELESS DEALER

AND MANUFACTURER

EDITED BY
JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

THE First Number of this new trade periodical will be issued on September 12th and the Publishers, Messrs. Radio Press Ltd., have been pleased to appoint Messrs. Barclays Advertising, Ltd., as Advertisement Managers.

We wish to announce that the following exceptionally generous offer is made to all those firms whose advertisements appear in No. 1 issue of THE WIRELESS DEALER, viz. :—

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NOTE.—The type area of a full page advertisement is 10 in. deep by 7½ in. wide.

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Three shillings for first twelve words and threepence for every additional word.

SITUATIONS VACANT AND WANTED. *Two shillings for first twelve words and one penny for every additional word.*

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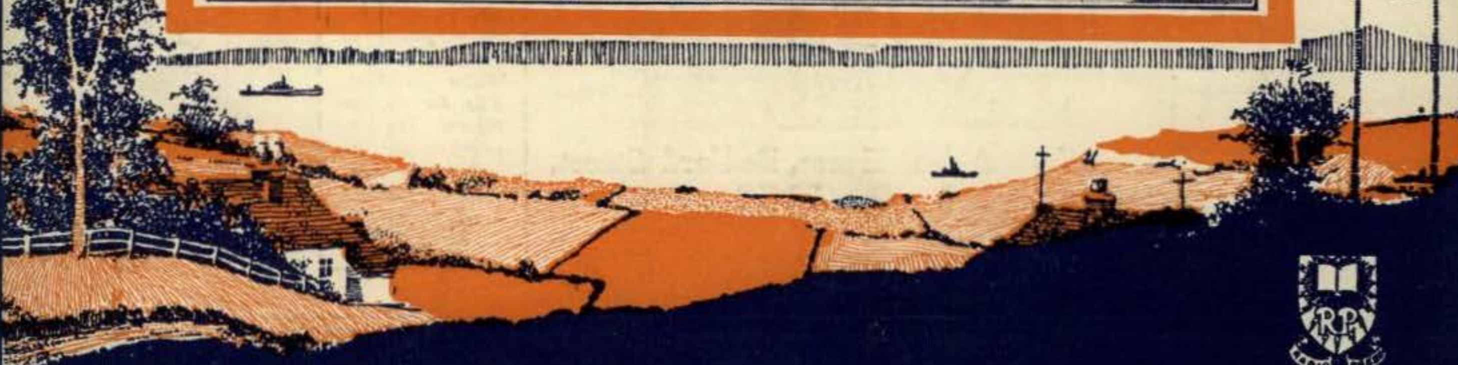
Wireless Weekly, 6d. Net. Wednesday July 29th, 1925

Wireless Weekly

Vol. 6. No. 17.



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Wireless Weekly

Phone: City, 9911.

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Radio Press Ltd Bush House, STRAND W.C.2

EDITED BY JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

Metres or Kilocycles?

UPON another page of this issue will be found an article from the pen of Mr. J. H. Reyner, which draws attention to a problem which has been gradually becoming more acute of recent months.

The increase in the number of broadcasting stations audible at any given position has necessitated the formation of an International body to regulate the allocation of wavelengths with a view to minimising interference troubles, and it will be appreciated that such a body must work in terms of kilocycles, when we remember that the separation between wavelengths of any two stations must be such that a certain definite band of frequencies is provided for their carrier waves.

In America we have seen how such a situation may develop until the final state of affairs is a wavelength band of a certain breadth completely filled with stations with a definite kilocycle separation, the one adopted in the United States being the usual figure of ten kilocycles. Such a situation compels us to think in terms of kilocycles, and indeed it is most natural to do so in this and in many other connections.

We believe that anyone who will approach the question with an open mind and will consider the points raised in the article to which we have referred, cannot fail to come to the conclusion that the time has arrived when some effort should be made to adopt to an increasing degree the more scientific system of reckoning.

We have therefore decided that in future the wavelengths given in *Wireless Weekly* will be accompanied by the kilocycle equivalent in order that our readers may accustom themselves to this method of indication, and it will be found that we are giving this week a table which shows the equivalent in kilocycles of the wavelengths of the main and relay B.B.C. stations, and also a number of the foreign stations. There will also be found a table for conversion from one system of reckoning to the other, which will be found useful in acquiring familiarity with the kilocycle method.

A considerable number of developments and modifications in our methods are likely to follow upon the increasing use of the kilocycle system. For example, we have recently seen the development of the square-law variable condenser, which is intended to give a straight line characteristic when regarded from the wavelength point of view; if stations are to be arranged upon the broadcast band with a separation worked out in kilocycles, the more recently introduced type of variable condenser which gives a straight-line frequency relation will become the more logical instrument, and is likely to be widely adopted. In such condensers the increase of capacity corresponding to a given angular rotation of the dial is very much more rapid than in the case of a straight-line wavelength condenser, and in a properly designed instrument the rate of increase is such that stations separated by an equal number of kilocycles will also be separated by an equal number of graduations upon the dial.

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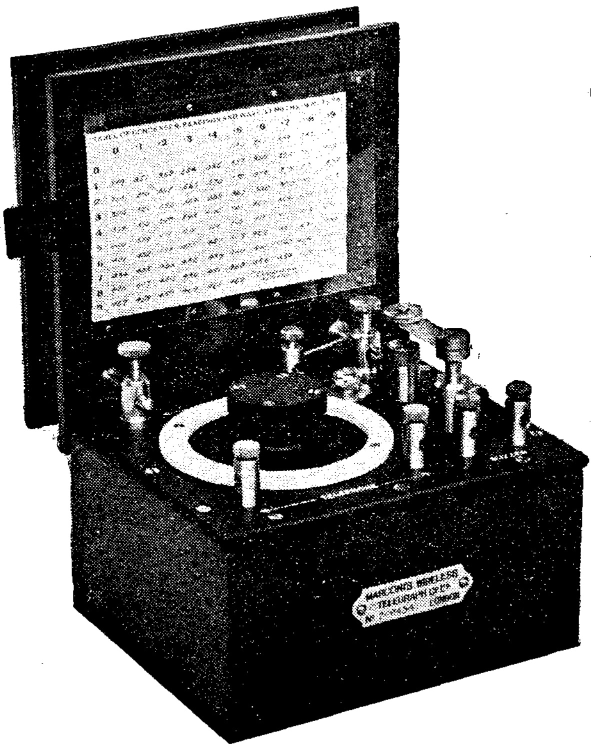
Are "Wavelengths" Played Out?

By *J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C.,*
Staff Editor.

It is fast becoming recognised that the use of frequency rather than wavelength is both more scientific and more convenient in the majority of cases. In this article the author discusses the pros and cons of the matter.



A Marconi type of wavemeter intended for use on the broadcast wavelengths for the calibration of transmitters or receivers.

IT is a curious fact that in almost every science there is a large number of terms which are accepted for everyday use, and yet are unscientific or inadequate, and the science of radio is by no means free from this defect. Such terms continue to be used by both the engineer and the "man in the street," and when the unsuitability or inaccuracy of any particular term is questioned, everyone shrugs his shoulders, either agrees or not, as the case may be, and there the matter rests.

Even when the existing practice is wholly unsuitable or even inconvenient, any change for the better is difficult to encompass. A particular instance of this point is the practice of referring to the "wavelength" of a circuit or a transmission in wireless telegraphy or telephony.

This is, in general, an unscientific and inconvenient practice, and has little except use to recommend it.

The Discovery of Ether Waves

The use of wavelength in questions of wireless technique is somewhat natural when the development of the art is reviewed.

The original ether waves, as produced by Hertz and others, were of a very short wavelength, of the order of one or two metres only.

Clerk Maxwell had predicted that such waves could be produced, and that they would be found to obey laws similar to those which governed light waves.

Now light waves, as is well known, are of an exceedingly short wavelength (red light has a wavelength of only 0.0008 mm., the other colours being shorter still). Moreover, a great deal of the properties of light such as reflection and refraction, interference, etc., are dependent upon the dimensions of the surrounding objects relative to the wavelength of the light ray under consideration.

Hence it will be seen that in the case of light, the wavelength is of considerable importance. Further, in establishing the similarity between light waves and the invisible wireless waves, Hertz carried out experiments in reflection and such-like phenomena, which, as we have seen, are dependent on the length of the wave.

Early Use of Wavelength Perhaps Justified

It was natural, therefore, that the various radiations which could be produced should be classified in terms of the wavelength of the disturbance produced in the ether, and while the waves remained short and the science was in its infancy there was no particular reason to speak in terms of frequency.

In those days it was often possible to measure the actual wave-*length* with a foot rule. Apparatus was constructed consisting of a wire which was excited by the ether waves, and the actual distance between the nodal points was measured directly.

Later Developments

As the science developed, however, the use of wavelength became more and more unsuitable. Longer and longer wavelengths were employed, until the wavelength itself ceased to have any real significance, and became merely a means of distinguishing different transmissions.

Such a process has many disadvantages. In the first place, to talk of tuning a circuit to a given "wavelength" is fundamentally unsound. If a circuit is set in oscillation the current set up therein will produce certain radiations of a definite wavelength. These disturbances will travel outwards, and will affect a second circuit placed in their path, producing in this second circuit a series of pulses of voltage following one another at a certain frequency (the same as that of the currents in the original circuit).

If this second circuit is to respond adequately, it must be tuned so that its *frequency* is the same as that of the transmitting circuit; it is thus the *frequencies* of the circuits which are brought into tune and not the wavelengths.

A Wavemeter Really a Frequency Meter

Tuning formulæ and charts have been drawn up giving the wavelength of a circuit in terms of the inductance and capacity employed. Such data, however, is only derived from the expression for the frequency of the oscillations, this being the fundamental phenomenon.

A suitable circuit may be made to oscillate at a frequency of 50 cycles or less. Such a system would not produce any appreciable radiation, and it would be ludicrous to talk of the wavelength in such a case.

Even that very common and useful instrument, the so-called "wavemeter" is in reality a frequency meter, being tuned to the frequency of the circuit which is being measured.

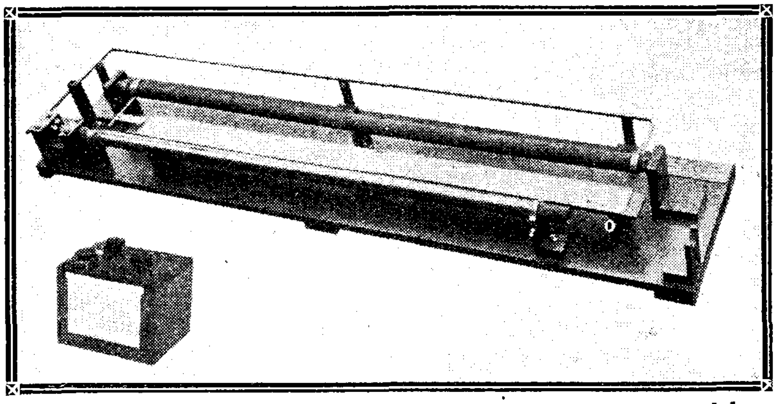
Radio an Exact Science

Electrical engineering as a whole is one of the most exact sciences in existence, it being possible to design apparatus with an accuracy not approached in many other branches of engineering, and the art of radio-communication is fast coming into line with its parent science in this respect.

With the growth of exact knowledge, the need for the use of frequency becomes even more imperative. Consider a few examples only. A modern selective receiver is designed to amplify over a certain frequency band only, and to produce a sharp "cut off" on either side of this band. What determines the width of this band? The frequency band of the particular transmission. For example, a telegraphy channel requires a frequency band of 100 to 200 cycles, depending on the speed of working, while a telephony station requires 5,000 to 10,000 cycles, according to whether speech only is required or whether music also has to be transmitted.

These bands of frequency are required irrespective of the mean frequency, which may equally well be 100,000 or 1,000,000.

But 10,000 cycles in 100,000 is 10 per cent., whereas in 1,000,000 cycles it is only 1 per cent., so that there would be a considerable difference in the selectivity required. To say, however, that a band width of 10,000 cycles is required on a wavelength of 300 metres conveys nothing.



One of the earliest types of wavemeter, the Cymometer, invented by Prof. J. A. Fleming, M.A., D.Sc., F.R.S. The small wavemeter seen in the foreground is a modern instrument.

Station.	Call Sign.	Wave-length.	Frequency. Kcy.	Station.	Call Sign.	Wave-length.	Frequency. Kcy.
Sheffield	6FL	301	996	Petit Parisien	—	345	869
Stoke-on-Trent	6ST	306	980	Madrid	EAJ7	392	765
Bradford	2LS	310	967	Rome	IRO	425	705
Liverpool	6LV	315	952	Stockholm	SASA	427	702
Nottingham	5NG	326	920	Leipzig	—	454	660
Edinburgh	2EH	328	914	Ecole Superieure	PTT	458	655
Dundee	2DE	331	906	Berlin	—	505	594
Hull	6KH	335	895	Prague	PRG	555	540
Plymouth	5PY	338	887	Lausanne	HB2	850	353
Leeds	2LS	346	867	Hilversum	HDO	1060	283
Cardiff	5WA	353	849	The Hague	PCGG	1070	280
London	2LO	365	821	Geneva	HB1	1100	273
Manchester	2ZY	378	793	Konigswusterhausen	LP	1300	231
Bournemouth	6BM	386	777	Chelmsford	5XX	1600	187
Newcastle	5NO	403	744	Radio Paris	SFR	1780	168
Glasgow	5SC	422	711	Amsterdam	PCFF	1955	153
Belfast	2BE	439	683	Eiffel Tower	FL	2200	136
Birmingham	5IT	479	626			2650	113
Swansea	5SX	482	622	East Pittsburgh	KDKA	68	4409
Aberdeen	2BD	495	606	Schenectady	WGY	309	970
Brussels	SBR	265	1131			380	789

Frequency Spacing of Adjacent Stations

Another point not unconnected with the previous one is that of the spacing of adjacent stations. With the very large increase in the number of stations desiring to work simultaneously, it is necessary to have the various transmissions as close as possible without causing interference.

In order that there shall be no heterodyning (using C.W. or telephony), the frequencies employed must be between 10,000 and 20,000 cycles apart. If we assume a 20,000 cycle spacing, to be on the safe side, then at a mean frequency of 1,000,000 the spacing is only 2 per cent. The wavelength separation would then be 6 metres (2 per cent. of 300 metres).

If, however, the mean frequency is 100,000 cycles, the spacing is 20 per cent., which gives a wavelength spacing of 600 metres. The wavelength spacing thus depends to an enormous extent on the actual value of the mean wavelength, whereas on a frequency basis the spacing is always the same, viz., 20,000 cycles, and any confusion is avoided.

The Super-Heterodyne

The Americans have arranged their stations on a frequency-spaced basis, and this constitutes the only satisfactory arrangement.

To take one more example of the convenience of the frequency basis, consider the trouble involved in designing a super-heterodyne. The frequency of the original wave and of the intermediate wavelength must be worked out. The frequency of the oscillator must then be determined to produce the desired wavelength for the intermediate amplification, and this frequency must then be reconverted back into wavelength in order to design the oscillator.

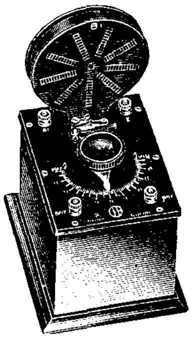
KILOCYCLES TO METRES, OR METRES TO KILOCYCLES.

Metres	Kilocycles	Metres	Kilocycles	Metres	Kilocycles	Metres	Kilocycles	Metres	Kilocycles	Metres	Kilocycles	Metres	Kilocycles
10	29982	730	410.7	1450	206.8	2170	138.2	2890	103.7	4220	71.05	6650	45.09
20	14991	740	405.2	1460	205.4	2180	137.5	2900	103.4	4240	70.71	6700	44.75
30	9994	750	399.8	1470	204.0	2190	136.9	2910	103.0	4260	70.38	6750	44.42
40	7496	760	394.5	1480	202.6	2200	136.3	2920	102.7	4280	70.05	6800	44.09
50	5996	770	389.4	1490	201.2	2210	135.7	2930	102.3	4300	69.73	6850	43.77
60	4997	780	384.4	1500	199.9	2220	135.1	2940	102.0	4320	69.40	6900	43.45
70	4283	790	379.5	1510	198.6	2230	134.4	2950	101.6	4340	69.08	6950	43.14
80	3748	800	374.8	1520	197.3	2240	133.8	2960	101.3	4360	68.77	7000	42.83
90	3331	810	370.1	1530	196.0	2250	133.3	2970	100.9	4380	68.45	7050	42.53
100	2998	820	365.6	1540	194.7	2260	132.7	2980	100.6	4400	68.14	7100	42.23
110	2726	830	361.2	1550	193.4	2270	132.1	2990	100.3	4420	67.83	7150	41.93
120	2499	840	356.9	1560	192.2	2280	131.5	3000	99.94	4440	67.53	7200	41.64
130	2306	850	352.7	1570	191.0	2290	130.9	3020	99.28	4460	67.22	7250	41.35
140	2142	860	348.6	1580	189.8	2300	130.4	3040	98.62	4480	66.92	7300	41.07
150	1999	870	344.6	1590	188.6	2310	129.8	3060	97.98	4500	66.63	7350	40.79
160	1874	880	340.7	1600	187.4	2320	129.2	3080	97.34	4520	66.33	7400	40.52
170	1764	890	336.9	1610	186.2	2330	128.7	3100	96.72	4540	66.04	7450	40.24
180	1666	900	333.1	1620	185.1	2340	128.1	3120	96.10	4560	65.75	7500	39.98
190	1578	910	329.5	1630	183.9	2350	127.6	3140	95.48	4580	65.46	7550	39.71
200	1499	920	325.9	1640	182.8	2360	127.0	3160	94.88	4600	65.18	7600	39.45
210	1428	930	322.4	1650	181.7	2370	126.5	3180	94.28	4620	64.90	7650	39.19
220	1363	940	319.0	1660	180.6	2380	126.0	3200	93.69	4640	64.62	7700	38.94
230	1304	950	315.6	1670	179.5	2390	125.4	3220	93.11	4660	64.34	7750	38.69
240	1249	960	312.3	1680	178.5	2400	124.9	3240	92.54	4680	64.06	7800	38.44
250	1199	970	309.1	1690	177.4	2410	124.4	3260	91.97	4700	63.79	7850	38.19
260	1153	980	305.9	1700	176.4	2420	123.9	3280	91.41	4720	63.52	7900	37.95
270	1110	990	302.8	1710	175.3	2430	123.4	3300	90.85	4740	63.25	7950	37.71
280	1071	1000	299.8	1720	174.3	2440	122.9	3320	90.31	4760	62.99	8000	37.48
290	1034	1010	296.9	1730	173.3	2450	122.4	3340	89.77	4780	62.72	8050	37.24
300	999.4	1020	293.9	1740	172.3	2460	121.9	3360	89.23	4800	62.46	8100	37.01
310	967.2	1030	291.1	1750	171.3	2470	121.4	3380	88.70	4820	62.20	8150	36.79
320	936.9	1040	288.3	1760	170.4	2480	120.9	3400	88.18	4840	61.95	8200	36.56
330	908.5	1050	285.5	1770	169.4	2490	120.4	3420	87.67	4860	61.69	8250	36.34
340	881.8	1060	282.8	1780	168.4	2500	119.9	3440	87.16	4880	61.44	8300	36.12
350	856.6	1070	280.2	1790	167.5	2510	119.5	3460	86.65	4900	61.19	8350	35.91
360	832.8	1080	277.6	1800	166.6	2520	119.0	3480	86.16	4920	60.94	8400	35.69
370	810.3	1090	275.1	1810	165.6	2530	118.5	3500	85.66	4940	60.69	8450	35.48
380	789.0	1100	272.6	1820	164.7	2540	118.0	3520	85.18	4960	60.45	8500	35.27
390	768.8	1110	270.1	1830	163.8	2550	117.6	3540	84.69	4980	60.20	8550	35.07
400	749.6	1120	267.7	1840	162.9	2560	117.1	3560	84.22	5000	59.96	8600	34.86
410	731.3	1130	265.3	1850	162.1	2570	116.7	3580	83.75	5050	59.37	8650	34.66
420	713.9	1140	263.0	1860	161.2	2580	116.2	3600	83.28	5100	58.79	8700	34.46
430	697.3	1150	260.7	1870	160.3	2590	115.8	3620	82.82	5150	58.22	8750	34.27
440	681.4	1160	258.5	1880	159.5	2600	115.3	3640	82.37	5200	57.66	8800	34.07
450	666.3	1170	256.3	1890	158.6	2610	114.9	3660	81.92	5250	57.11	8850	33.88
460	651.8	1180	254.1	1900	157.8	2620	114.4	3680	81.47	5300	56.57	8900	33.69
470	637.9	1190	251.9	1910	157.0	2630	114.0	3700	81.03	5350	56.04	8950	33.50
480	624.6	1200	249.9	1920	156.2	2640	113.6	3720	80.60	5400	55.52	9000	33.31
490	611.9	1210	247.8	1930	155.3	2650	113.1	3740	80.17	5450	55.01	9050	33.13
500	599.6	1220	245.8	1940	154.5	2660	112.7	3760	79.74	5500	54.51	9100	32.95
510	587.9	1230	243.8	1950	153.8	2670	112.3	3780	79.32	5550	54.02	9150	32.77
520	576.6	1240	241.8	1960	153.0	2680	111.9	3800	78.90	5600	53.54	9200	32.59
530	565.7	1250	239.9	1970	152.2	2690	111.5	3820	78.49	5650	53.07	9250	32.41
540	555.2	1260	238.0	1980	151.4	2700	111.0	3840	78.08	5700	52.60	9300	32.24
550	545.1	1270	236.1	1990	150.7	2710	110.6	3860	77.67	5750	52.14	9350	32.07
560	535.4	1280	234.2	2000	149.9	2720	110.2	3880	77.27	5800	51.69	9400	31.90
570	526.0	1290	232.4	2010	149.2	2730	109.8	3900	76.88	5850	51.25	9450	31.73
580	516.9	1300	230.6	2020	148.4	2740	109.4	3920	76.48	5900	50.82	9500	31.56
590	508.2	1310	228.9	2030	147.7	2750	109.0	3940	76.10	5950	50.39	9550	31.39
600	499.7	1320	227.1	2040	147.0	2760	108.6	3960	75.71	6000	49.97	9600	31.23
610	491.5	1330	225.4	2050	146.3	2770	108.2	3980	75.33	6050	49.56	9650	31.07
620	483.6	1340	223.7	2060	145.5	2780	107.8	4000	74.96	6100	49.15	9700	30.91
630	475.9	1350	222.1	2070	144.8	2790	107.5	4020	74.58	6150	48.75	9750	30.75
640	468.5	1360	220.5	2080	144.1	2800	107.1	4040	74.21	6200	48.36	9800	30.59
650	461.3	1370	218.8	2090	143.5	2810	106.7	4060	73.85	6250	47.97	9850	30.44
660	454.3	1380	217.3	2100	142.8	2820	106.3	4080	73.49	6300	47.59	9900	30.28
670	447.5	1390	215.7	2110	142.1	2830	105.9	4100	73.13	6350	47.22	9950	30.13
680	440.9	1400	214.2	2120	141.4	2840	105.6	4120	72.77	6400	46.85	10000	29.98
690	434.5	1410	212.6	2130	140.8	2850	105.2	4140	72.42	6450	46.48		
700	428.3	1420	211.1	2140	140.1	2860	104.8	4160	72.07	6500	46.13		
710	422.3	1430	209.7	2150	139.5	2870	104.5	4180	71.73	6550	45.77		
720	416.4	1440	208.2	2160	138.8	2880	104.1	4200	71.39	6600	45.43		

What a business, when, with a frequency basis, simple subtraction is all that is required!

High and Low Frequency

Another most important point concerns the receiver itself. From



A commercial form of wavemeter using a plug-in coil.

the aerial to the detector valve we deal in wavelengths. In the detector and subsequent stages we are concerned with frequencies!

Owing to the use of continuous waves, the design of wireless circuits has become merely a special branch of alternating current theory. The sole difference is one of frequency, and when viewed from this aspect many problems in tuner design become almost ludicrously simple.

Why then complicate matters again by turning everything upside down and working in wavelength?

If a frequency of 1,000,000 is referred to as a wavelength of 300 metres, then, to be logical, one should say, "I want a vacuum cleaner to work off my electric lighting mains. The supply is 240 volts, 6 million metres"!

Wavelength Required on Occasions

These are just a few of the many possible examples of the convenience of the frequency basis. There are, of course, occasions when it is essential to know the actual wavelength.

One such case is in connection with aerial design. The aerial should, in the majority of cases, have a natural wavelength of the order of one-half to one-third of the wavelength at which it is to be used, and, in any case, the ratio of working wavelength to natural wavelength is of importance.

Again, the wavelength must be taken into consideration in any system involving the use of "spaced" aerials, in which the aerials are spaced a definite fraction of a wavelength apart in order to obtain certain balancing effects.

This last point is particularly relevant owing to the return to short waves, where, as was seen at the beginning, reflection effects are pronounced, so that there is a certain justification for viewing the phenomena from a wavelength standpoint.

Use of Frequency More Scientific

These points, however, are minor as compared with the advantages which have been cited, and it is rapidly becoming accepted that the use of the frequency standpoint is much to be preferred.

The arrangement is quite as convenient as the existing system if the frequencies are expressed in kilo-cycles (one kilo-cycle = 1,000 cycles), and a chart has been prepared giving the frequencies, to the nearest whole number, of the principal broadcasting stations in this country and on the Continent. It will be seen that these figures are just as convenient to work with as the wavelength.

The frequency may be obtained from the inductance and capacity values from the expression

$$f = \frac{159.3}{\sqrt{LC}} \text{ kilo-cycles}$$

where L is the inductance in μH,
C ——— capacity in μF.

Conversion of Wavelength to Frequency

The conversion of wavelength to frequency is comparatively simple, and may be obtained from the expression

$$\text{Frequency} = \frac{300{,}000}{\text{Wavelength}} \text{ kilo-cycles,}$$

the wavelength being expressed in metres.

The figure 300,000 is nearly correct, but not quite so. The reason for this and the correct figure are given in the appendix at the end of this article.

A chart is also appended which gives the frequency for a variety of wavelengths from 10 up to 10,000 metres, which should prove of considerable value. It may be remarked that the important part of the chart is that from 1,000 to 10,000 cycles, and this portion may be used to interpolate values in the lower wavelength ranges.

E.g., if it is desired to obtain the frequency corresponding to 362 metres, this is not shown on the chart; 3,620 metres, however, is shown to be 82.82 kilo-cycles. Since 360 metres is 832.8 kilo-cycles, 362 metres must be 828.2 kilo-cycles.

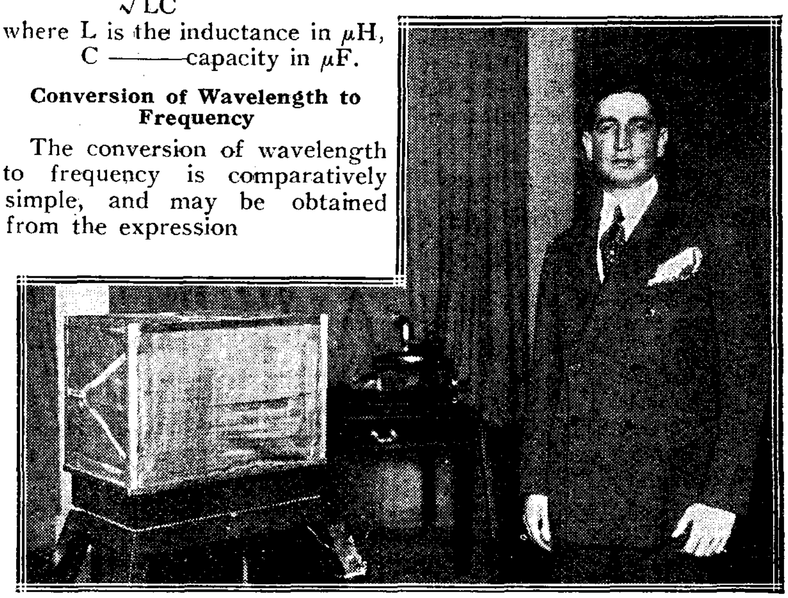
The abbreviation kc may conveniently be used for kilo-cycles, and there is little doubt that before long 2LO will be spoken of as working on 821 kc instead of 365 metres, as a matter of course.

APPENDIX

Relation Between Frequency and Wavelength

Each oscillation in the transmitting aerial circuit produces a

(*Continued on page 531.*)

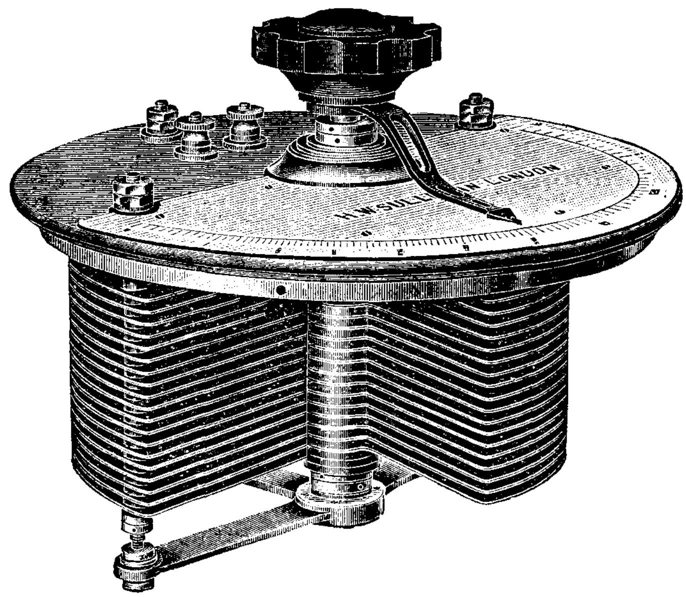


M. Ulysses Lappas, the famous Greek tenor, who scored such remarkable successes at Covent Garden, recently broadcast from the London station.

CHOOSING A CONDENSER FOR A WAVEMETER

By A. JOHNSON-RANDALL, Staff Editor.

Some notes on the selection for a wavemeter of the component on which the ultimate efficiency of the complete instrument is likely to depend to a large extent.



A laboratory standard type of variable condenser, suitable for use in wavemeters.

PERHAPS one of the most difficult problems to the experimenter is that of constructing an accurate wavemeter suitable for precision work. It is very desirable to have an instrument which will enable one to tune the receiver or transmitter to a given wavelength, but it is at the same time not very consoling to discover that, after a short period of use, the wavemeter, calibrated possibly at some trouble to its owner, has become inaccurate, and for all practical purposes useless.

Constant Calibration

The facts to be borne in mind in constructing a wavemeter, whether of the buzzer or heterodyne type, are that it must be capable of being calibrated over the required range of wavelengths, and that once calibrated it must remain constant at all times.

One of the chief factors in the construction of a good instrument is the type of variable condenser employed, and I propose to give a few hints upon the choice of this essential component.

Possible Types of Condensers

The constructor is faced with a choice of three types, viz., the straight - line capacity, the straight - line wavelength or square-law, and, to a lesser degree in this country, the straight-line frequency. In regard to the latter it may be safely said that those at present procurable are in most cases of American manufacture.

The question then arises, what are the advantages of the various types? To begin with, the straight-line capacity condenser is simply the type so popular until quite recently, the standard pattern with semi-circular vanes. Equal variations in dial setting give equal changes in capacity—in other words, the curve of capacity plotted against dial setting is very nearly a straight line. I say very nearly, because readers who studied Mr. Sylvan Harris's article in the last issue of this journal will remember that a curve was given showing that at the very bottom of the scale it was no longer linear, but over the remainder of the range a straight line was obtained. This is all very well so far, but the trouble commences directly we connect an inductance in parallel with the condenser. Our straight line is no longer straight, but becomes a curve in the more generally accepted sense, and we find that if we plot wavelength against dial readings, as we rotate the dial the wavelengths are crowded together on the lower readings and widely separated on the higher range. There is no great harm in this, except for the fact that it would be far more desirable to have the wavelengths equally spaced throughout the complete range of dial settings. Then, knowing two or three points how easy it would be by interpolation to fix the remaining points, and so determine any wavelengths within the limits of a given inductance. But, the reader will say, surely I can do all this by using a straight-line wavelength type of condenser in parallel with a suitable coil to cover the required waveband. Yes, quite true, with *a suitable coil,* but, unfortunately, *not with any coil.*

Square-Law Type

Straight-line wavelength or square-law condensers are designed to give, within limits, approximately a straight line when joined in parallel with a certain type of coil, usually a popular type, which the makers of the condenser believe to be used by the majority of amateurs.

In ninety-nine cases out of a hundred the curve will not be linear when the condenser is used in conjunction with the wavemeter inductance, but, on the other hand, there will be one advantage—the wavelengths will be *fairly* evenly distributed over the available range of dial settings, except on very short waves.

Straight-Line Frequency

Turning now to the last type of condenser, viz., the straight-line frequency, I would refer readers to Mr. Sylvan Harris's illuminating article given in the last issue of *Wireless Weekly*. While, no doubt, in the future we in this country will think in terms of frequency, at the present time we have not yet become accustomed to this method of reckoning, and in consequence the majority of amateurs will require their instruments to be calibrated on the wavelength basis.

Mechanical Efficiency

To sum up then, given condensers of equal efficiency, it would seem preferable to use the straight-line types for general use, and to have the wavemeter properly calibrated over the complete range desired.

What, then, are the desirable qualities we must look for in our wavemeter condenser. Well, the one point to keep fixed in one's mind is constancy. A condenser may be electrically efficient, but, at the same time, its mechanical construction may be poor. Look for a well-made robust instrument, preferably of the "grounded rotor" type, with metal end-plates. Ebonite and composition end-plates may warp, and by so doing alter the calibration. See that the vanes are of a hard metal, well and accurately spaced, and secured in such a manner that there is no possibility of them loosening. Reject any condenser which shows the slightest suspicion of shake in the bearings, and choose one with a straight spindle of generous cross-section. Note whether the dial is accurately engraved, and also whether the extreme divisions are really 180 deg. apart.

Is any arrangement incorporated whereby the dial can be locked on to the spindle? What method is employed for securing the condenser to the panel? Choose one with three-point suspension in preference to the type which may possibly rotate when in use. Examine the bearing surfaces and notice particularly whether wear is likely to take place, with its attendant evil "shake" and loss of accuracy developing in consequence, after a short period of use. Make sure that the contact to the moving vanes is of a reliable nature.

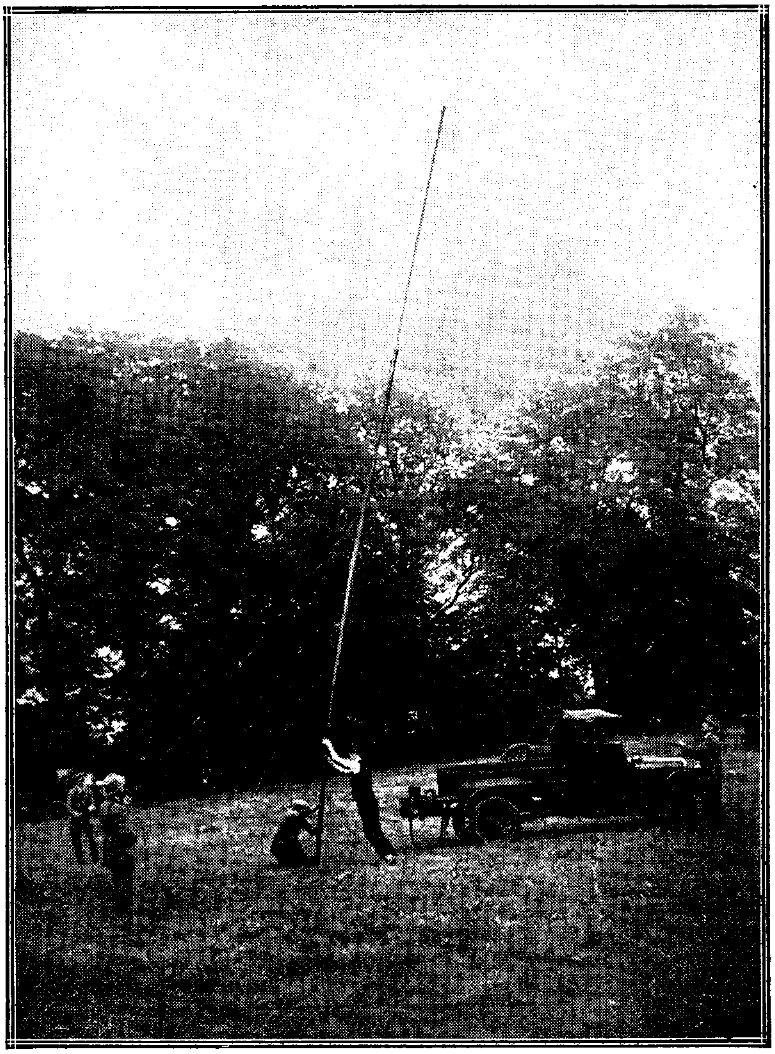
If you have the choice of a standard type condenser embodying these points, and one of the square-law type with a lower mechanical efficiency, choose the former. The square law may be preferable, but if its mechanical design is not absolutely sound it is useless.

Low Losses

The reader will now say, but what about the electrical efficiency? Are low losses essential? The answer is no; low losses are desirable, certainly, but not essential. It is always a wise plan to keep the losses as low as possible, but it should be remembered that the amount of available energy in this particular case is large, and also that in most cases the coil losses will entirely swamp those due to the condenser.

Admittedly, the smaller the total losses the less the damping and the sharper will be the tuning. Combine low losses with mechanical perfection and you have the ideal, but, failing this, put mechanical perfection first, endeavouring at the same time to secure a reasonable degree of electrical efficiency.

Do this, and you have completed the first step towards the successful construction of that indispensable instrument, the wavemeter.



Members of the Golders Green and Hendon Radio Society erecting a mast at the control station during their recent field-day.

Damping Losses in Valve Rectifying Circuits

By A. D. COWPER, M.Sc., Staff Editor.

Mr. Cowper has spent a great deal of time in studying the question of selectivity and the elimination of harmful losses, and has evolved many practical selective circuits familiar to readers of "Wireless Weekly." In this preliminary article he deals with a rather neglected source of loss, namely, that due to the grid damping of the detector valve circuit and its bearing on selectivity.

THE attention of the radio experimenter is being concentrated at the moment on various real and alleged sources of "losses" in his receiver, and various attempts are being made to minimise certain of these by improved design of components; a suggestive list of these is given by Mr. G. P. Kendall, B.Sc., in an article in *The Wireless Constructor,* Vol. 1, No. 10, p. 885. A source of what turns out to be a very heavy damping loss, but which has largely been neglected in the past—even though there does not appear to be any readily available palliative for it when brought into the lime-light—is that of the *grid-damping* of the detector-valve, operating as usual with a grid-condenser and grid-leak.

That this will produce some appreciable damping is self-evident, for positive grid-bias (as given here by the usual 1-4 megohm grid-leak to the L.T. plus) has been used extensively to damp down too exuberant multi-stage H.F. amplifiers so as to prevent self-oscillation; this positive bias is applied generally by means of a potentiometer across the L.T. battery connected directly to the lower end of the grid-inductance. But the magnitude of this effect in an ordinary detector-valve and also the varying influence of different *loads* in the anode-circuit of the detector, have rarely received mention in popular radio literature.

Measurements Needed

That a valve imposes an appreciable load on the grid circuit, when functioning as a high-frequency amplifier or detector, has long been a commonplace of electrical theory; this effect has received some mention in theoretical discussion in the past, but the magnitude of the effect is little known to wireless experimenters in general. It appeared to be of interest, therefore, to determine in an approximate experimental manner the magnitude of this damping effect of a rectifying valve, when inserted in an oscillating circuit such as the aerial, or secondary (and intervalve H.F.) circuit in a broadcast receiver, and to measure the change in the damping produced when varying loads were imposed on the anode circuit.

In this way it might be possible to determine whether there was really much room for improvement in the matter of elimination of unwanted damping effects in such tuned circuits. The relatively very small improvement observed (when once the extremely high known losses in multi-layer thin-wire compact tuning inductances have been eliminated by the adoption of modern single-layer spaced coils of a reasonable gauge of wire), when every possible effort has been made to minimise the H.F.

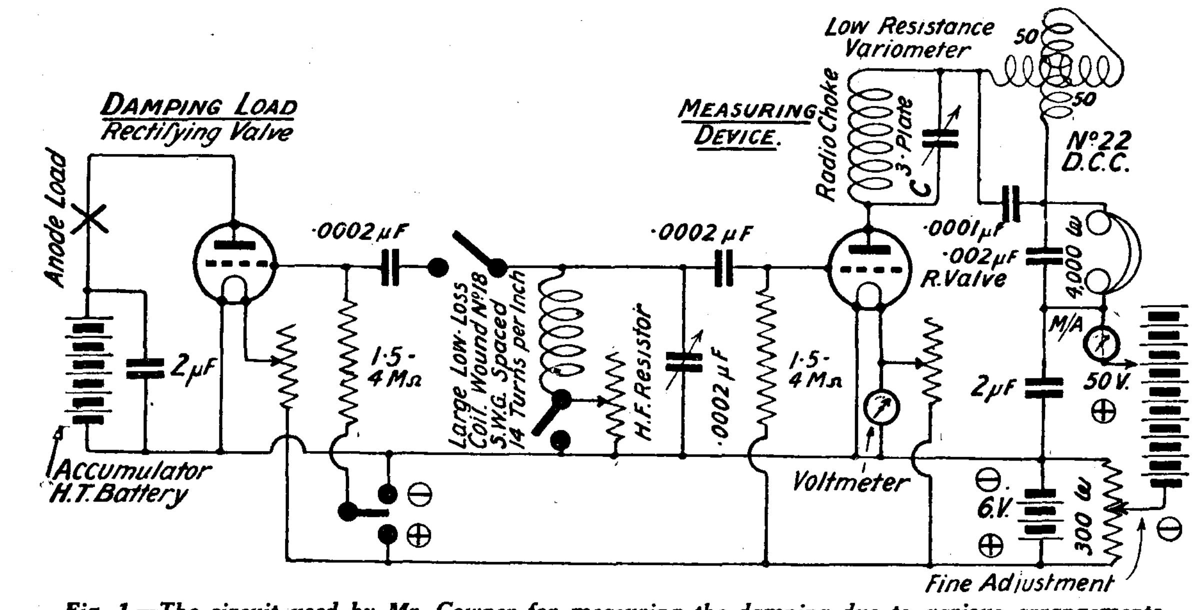


Fig. 1.—The circuit used by Mr. Cowper for measuring the damping due to various arrangements of the detector valve. The measurements are based on observations of the reaction demands of a detector valve when the load circuit is shunted across the grid circuit.

resistance by a special design of tuning-coil, over the results given by a coil of much more mediocre design, might possibly receive some explanation in this way. If there be actually present an inevitable high damping effect due to the rectifying valve itself, but little further improvement will be possible, with the best of "low-loss" coils and "low-loss" tuning-condensers (to say

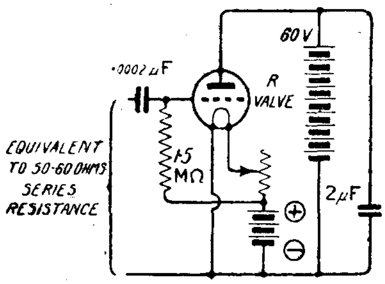


Fig. 2.—The damping effect of this detector valve circuit is equivalent to a series H.F. resistance in the grid circuit of 50 to 60 ohms.

nothing of "low-loss" valve-sockets).

Measuring Circuits Used

The method of investigation used (which is available to any serious experimenter with a fairly well-stocked apparatus cupboard) is an obvious extension of the method of relative measurement of H.F. resistances in tuning inductances given by the writer in *Wireless Weekly*, Vol. 6, No. 4, developed from a device described by him for controlling tuned anodes in Vol. 4, No. 10. The circuit used principally here corresponds more closely to Fig. 1 of the latter article: this differs from the measuring device of Fig. 2 in Vol. 6, No. 4, p. 119, by placing the reaction-control condenser C (by which the quantitative measurements are made possible) directly next to the anode, with the reaction variometer between this and H.T. plus, instead of the other way round. This gives a larger range for measurement of damping resistances, but, of course, a closer scale (Fig. 1).

With the particular R valve and conditions of experiment, the effective scale corresponded to approximately 2.7 ohms per degree of the 3-plate reaction-condenser setting, and was very closely linear; this was subsequently determined by direct calibration with an H.F. resistor-unit. The maximum capacity of the actual 3-plate reaction-condenser used (of uncertain origin) was about 33 μμF, with a low minimum. In the alternative position, with a .0001 μF J.B. standard reaction - condenser *below* the reaction-variometer, the scale was about 0.7 ohms per degree, and again closely linear. The grid-circuit of the rectifying valve, whose resistance-damping effect it was sought to determine, could be connected by means of a switch so as to load the grid-circuit of the valve in the measuring device; and the former valve could be loaded in various ways at will, by means of the requisite switches and accessories inserted in its plate circuit, etc.

Precautions to Ensure Accuracy

In order to ensure uniformity, the valve under test was operated from a separate H.T. battery, in the form of a large tapped H.T. accumulator battery (supplied by Messrs. Grafton Electric Co.), and a large 6-volt L.T. battery was used for both valves. The H.T. supply for the other (measuring) valve was from a small tapped H.T. unit, with fine control by a potentiometer (Ediswan) across the L.T. battery; a shunted Weston Galvanometer (as a milliammeter) in the plate-circuit of the latter, together with a voltmeter across its filament, insured reproducible conditions for quantitative

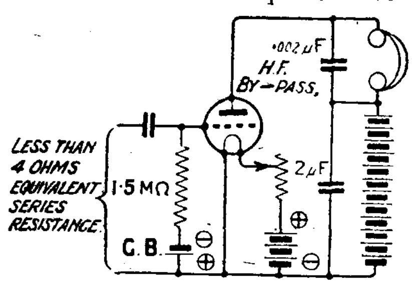


Fig. 3.—Illustrates the lowering of the damping by application of negative grid bias.

measurement of the degree of accuracy sought here.

H.F. Resistor-Unit

The latter approximately quantitative results were obtained with the aid of an H.F. resistor-unit, made up of No. 38 Eureka resistance wire (Economic Electric Co.) arranged zig-zag fashion in order to give a non-inductive effect and well-spaced on an open frame. Such fine wire has approximately the same resistance at a frequency of 3 to 4 million as for D.C., if well isolated; no sensible difference in resistance per foot could be observed, on trial, between this frame-mounted wire and a short straight isolated portion. As this wire has nearly exactly 8 ohms resistance per foot, quite accurate enough resistors can be made up

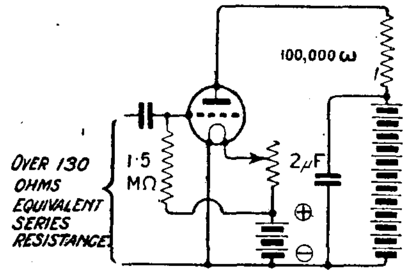


Fig. 4.—The large increase in the equivalent resistance is due here to the anode resistance.

with a frame 1 foot in length, and rated at 8 ohms per unit length; actually the resistors used here were calibrated on the usual D.C. Wheatstone bridge before use. An adjustment must always be made for the distributed capacity of such a resistor-frame unit to earth, when switched into circuit; the inductance value is negligible.

Method of Procedure

With the measuring valve and circuit adjusted to standard conditions, the reaction condenser setting which just determined self-oscillation of this valve with no added load, and with critical tuning of grid and anode on a wavelength of around 370 metres, was observed. The precise wavelength of the local station should be avoided, as the latter may produce serious errors even at a distance of a dozen miles or more with an isolated circuit such as this. The reaction condenser scale was calibrated by switching various 8-ohm resistor units into circuit in series with the grid-tuning inductance, slightly re-tuning if necessary, and re-determining the reaction condenser setting necessary for oscillation. This was repeated frequently, and a mean value obtained from the bunch of calibration curves, which lay very close.

Then the grid circuit of the detector valve, whose damping effect was to be determined, was switched in across the tuning inductance, and (after a small adjustment for the additional tuning capacity thus introduced) the absence of any appreciable load due to a *valve with cold filament* was confirmed by finding a reaction condenser setting which was identical with the first. Then the effect of a heated filament, grid-leak, H.T. connection, anode load, etc., was studied by repeating the observation of the critical reaction condenser setting in each set of circumstances, repeatedly checking up the uniformity of test conditions by re-determining the no-load setting (with switch open).

Results

In the first series of observations, the setting for the unloaded measuring valve was 54 degrees, and was the same with the bright-emitter R "damping" valve switched in, after retuning slightly—with cold filament. No change was noticed with a grid-leak to the L.T. minus when the filament was cold. With *hot* filament, and 1.5 megohm grid-leak (an average value) to L.T. minus, the reading increased to 58 or 59 degrees, showing an appreciable damping; with leak to L.T. plus, 90 degrees were required on the reaction condenser, indicating a heavy damping load, even in the absence of a plate current. With the plate connected to L.T. minus, the reaction setting rose to 108 degrees; to L.T. plus gave a

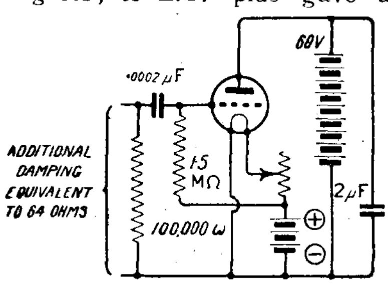


Fig. 5.—Illustrates the method used to determine the effective "impedence" of the rectifying valve.

setting of 92 degrees (i.e., rather less severe damping); with 30 volts H.T., but no impedance load in the anode circuit, 93 degrees, with 60 volts H.T., 93 degrees, and with 90 volts H.T. 100 degrees were recorded; a plate current of about 4 ma. was recorded in the last case.

Anode Resistance

With anode loading in the "damping" detector valve circuit consisting of a 100,000 ohm (Dubilier) anode resistance, and with 70,000 ohms (same make), the load produced was so heavy that the measuring valve could not be made to oscillate at all with the reaction condenser at 180 degrees. With a .002 µF by-pass condenser across this anode resistance, the load was lightened so that oscillation occurred at 94 degrees; with a .0001 µF by-pass at 112 degrees, and with .0005 µF at 98 degrees. This shows the immense relief of the H.F. load afforded by even the smallest by-pass capacity (and incidentally illustrating the fallacy of attempting H.F. amplification by resistance-capacity on the shorter waves with ordinary valves).

With the plate circuit broken, but with a .002 or .0001 µF condenser between this and earth, the setting was 102 degrees, or slightly higher than with isolated plate. Even a short flex lead connected to the anode terminal raised the damping effect by some degrees, with anode otherwise isolated.

Inductive Loads

Trying now *inductive loads* in the anode circuit: A No. 35 coil of fairly low resistance gave a setting of 93 degrees; a No. 40 of 94; No. 50, 85; No. 60, 77; No. 75, 61, and No. 100 (after slight retuning) 28 only, as against 54 for the (cold) valve alone at the start. So that the "tuned-anode" reaction effect had already made itself sufficiently felt on our "damping" valve, with a No. 75 anode coil, to wipe out most of the valve damping.

Negative Bias

In a second series, with grid-leak to L.T. *minus*, the setting for the valve alone was now 42 degrees; with grid-leak connected, the same; and with 60 volts H.T. in an unloaded anode circuit there was no detectable change; also with a No. 35 coil in this circuit. A No. 40 coil lowered the reaction reading to 40 degrees; a No. 50 to 36; a No. 60 to 34; a No. 75 to 28, and a No. 100 almost wiped out the whole of the damping load, with a setting of 9 degrees. The greatly decreased damping in

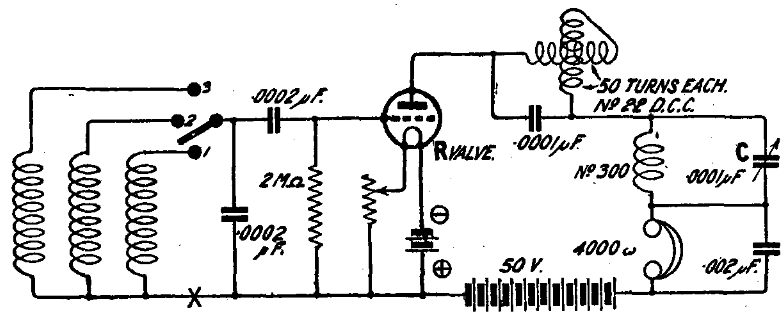


Fig. 6.—The more sensitive measuring circuit used in measurements on low-loss inductances (Vol. 6, No. 4) and referred to in this article.

this non-rectifying (or "H.F. amplifying") circuit is noticeable, and suggests the much improved possibilities for selectivity and sharp tuning in an H.F. filter or coupling circuit, non-rectifying, if other damping can be avoided without losing stability. A 70,000-ohm anode resistance loaded the circuit up to a point which called for 87 degrees of reaction; a 100,000-ohm resistance to the 88 degree point; a .0001 µF by-pass lowered this to 49, a .0004 µF to 45; and a .002 µF by-pass to 44 degrees.

Grid-Filament "Impedance"

In order to find practically what the effective "impedance" of the rectifying valve amounts to, measured in ohms as a parallel load across the tuning inductance, the damping effect of various high resistances was measured, when connected *across* the measuring device with the filament of the "damping" valve cold. Thus the cold valve alone required 45 degrees in this series of measurements; 100,000 ohms in parallel raised this to 90 degrees; 70,000 ohms to 94 degrees.

In another series, where the cold valve required 40 degrees; 70,000 ohms in parallel called for 80, and 100,000 for 75 degrees; with these two in parallel, the damping was so severe that the measuring valve would not oscillate; with the two in series (170,000 ohms total) 55 degrees was the reading; whilst a grid-leak of 2 megohms, and one of 1.5 megohms (approximate measured value) required an increase of about 2 degrees; a 1/2 megohm leak required the reaction to be raised some 4 degrees, showing the minute damping effects of such large resistances. Since the detector-valve in normal, unloaded operation calls for a reaction increase of some 40 degrees, it is evident that its effective "impedance" on a 370 metres wavelength (measuring thus by the damping effect) is actually of the order of 100,000 ohms, and far from the 1/4 megohm or so often quoted.

Valve circuit.	Effective equivalent series H.F. resistance-Ohms.
R valve, with grid-condenser, filament cold	0
Ditto, filament hot, no grid-leak or plate current	7—9
Ditto, no grid-leak, but 60 volts H.T.	11
Ditto, grid-leak 1.5 megohms to L.T. *plus* no plate current	56
Ditto, with grid-leak as before, and 60 volts H.T., no anode load	53
Detector R valve, 4,000 ohm 'phones in anode circuit	72
Ditto, .002 μF by-pass condenser	40
Ditto, 100,000 ohm anode resistance	Over 130
Ditto, ditto; .002 μF by-pass condenser	32
Ditto, with radio-choke in anode circuit	Over 130
Ditto, ditto; .002 μF by-pass condenser	40
Ditto, ditto; .0001 μF by-pass condenser	72
R valve, 1.5 megohm, grid-leak to L.T. *minus* 60 volts H.T., no anode load	8—14
Ditto, 4,000 ohm 'phones and .002 μF by-pass condenser	8
R valve, negative grid-bias of 1.4 volts through 1.5 megohm grid-leak; 60 volts H.T., no anode load	Under 4
R valve, 1.5 megohm grid-leak to L.T. *minus* 60 volts H.T.; No. 35 coil in plate circuit	Under 4
Ditto, with No. 60 coil	Nearly zero
Ditto, with No. 75 coil	0
R valve, 1.5 megohm grid-leak to potentiometer across 6V L.T. battery	8 ohms—56 ohms
DE 5 B, 90 volts H.T., 5 volts L.T.; 1.5 megohm grid-leak to L.T. *plus*; unloaded anode	48
Ditto, 'phones and .002 μF by-pass	64
P.V. 5 D.E., similar conditions; unloaded	56
Ditto, 'phones and .002 μF	64
Mullard bright-emitter L.F. valve, similar conditions, 'phones and by-pass	48
Another R valve, 60 volts H.T.	48

Effect of Radio-Chokes

In another series, with 60 volts H.T. and an R valve, with 4 megohm grid-leak to L.T. plus, the cold valve required 52 degrees; with hot filament and no anode load or current, 94 degrees; with plate current but no anode load, 102 degrees; and with a good radio-choke in the plate-circuit, 180 degrees reaction would not produce self-oscillation. A .01 μF by-pass condenser relieved this load to the point corresponding to 76 degrees; a .002 to 80; a .0005 to 90; a .0002 to 128; and a .0001 to 175 degrees. It is clear that a very moderate-sized by-pass condenser suffices to relieve the anode H.F. load.

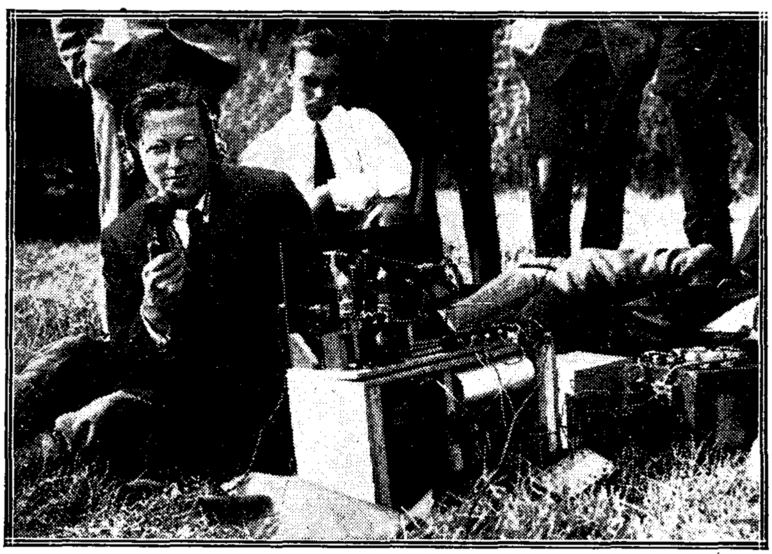
Large Inductance Load

A further series of measurements with large anode *inductance-load* confirmed the previous figures. With positive grid rectification in operation, the valve alone required 54 degrees of reaction; with the plate current corresponding to 60 volts H.T. but no anode load, 102 degrees; a No. 35 lowered this to 96; a No. 100 to 31 (i.e., reaction effect in operation); a No. 150 gave first a critical setting at 12 degrees and then a grid-leak howl; Nos. 200, 250 and upwards completely stopped self-oscillation, acting as good radio-chokes therefore; whilst the same phenomenon was observed with a No. 150 in series with, but not coupled deliberately with a coil larger than No. 100; with below No. 100 it gave a grid-leak howl. This suggests a reliable method of testing radio-choke coils.

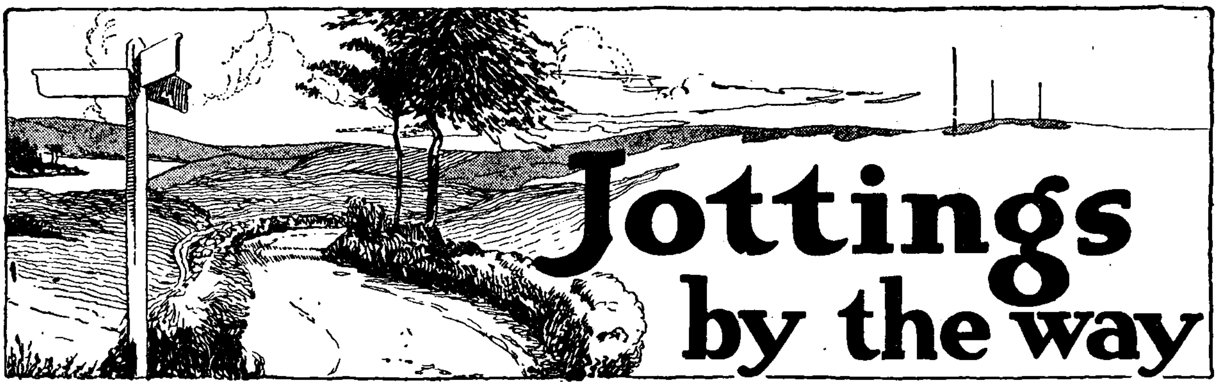
Quantitative Measurements

In order to obtain actual (approximately) quantitative figures for the magnitude of the damping resistance experienced, by the switching gear indicated in the figure tapped H.F. resistor-elements could be introduced directly into the circuit immediately after making a measurement, and the value of the resistance required to reproduce the same damping effect as indicated by the reaction-requirement determined thus directly under the particular set of conditions, as well as by rough calculation from the mean scale reading. For the smaller effects observed with grid-leaks to L.T.

(*Continued on page* 547.)



The prize-winning portable station in a competition held by the Golders Green and Hendon Radio Society on their recent field-day.



The Heroes

I TRUST that you are truly grateful to Poddleby and myself for having restored Mr. Hercy Parris safe and sound to you after our hair-raising adventures, especially at Lone Camp, in search of him. We are both of us back in Little Puddleton now, and I must admit that we have grown an inch or two, whilst each of us requires hats several sizes larger than he used to. I am sorry to say that Gubbsworthy and Bumpleby Brown, who are nasty suspicious creatures, flatly refuse to believe that we ever got further than Liverpool—Bumpleby Brown says Liverpool Street—in our quest. They merely raise their eyebrows, shrug their shoulders, and laugh rudely if they come upon us telling for the hundredth time the story of our great adventure with the gunmen at Lone Camp, who had captured Mr. Parris and were keeping him bound hand and foot in a cave until a ransom amounting to several million dollars should arrive from Bush House.

. . The gunmen were keeping him bound hand and foot . .

See for Yourself

But you, reader, are, I am sure, a more charitable person, and you know at any rate that such a man as your Wayfarer cannot lie to you. I am afraid that I cannot tell you now the whole story of our desperate time at Lone Camp. The fact is that I really forget the version of it that I gave to General Blood Thunderby, and as he makes a point of reading these notes each week it would be a catastrophe if I now wrote an entirely different account. That is the sort of thing that Gubbsworthy and Snaggsby simply love to get hold of. You see my point, do you not? I will therefore pass over this thrilling episode, though if you really want to know the kind of thing that we had to go through, you have only to visit your local picture house the next time a wild and woolly western film is being shown. Just wash out of your mind's eye the features of Mr. Douglas Fairbanks and replace them with mine; change Poddleby for Mr. Mix and there you are.

A Changed Man

Mr. Parris has altered considerably as the result of his stay in the great dry land. I told you, if you remember, that a gradual and progressive change in his raiment took place for some time before, like Columbus, he set sail to discover America. We thought when he departed that his attire was a little odd; but you should see him now. The horn-rimmed glasses which rest upon the bridge of his Apollo-like nose are so large that when the sun is shining upon them you feel as if you were meeting the most powerful kind of motor headlights upon a dark night. His hat, which is soft and round and has a narrow curling brim and a ribbon with stripes sloping like valve curves, is balanced upon the very top of his noble head. To look at his shoulders you would imagine that he measured at least seventy-five round the chest. His unmentionables are of such ample dimensions that they make Oxford trousers seem like tights, whilst so knobby are the toes of his shoes that he is continually falling over himself and over everything and everybody else. He arrives at the office chewing a green cigar, which he moves with alarming suddenness from one side of his mouth to the other. The neat attaché case which he used to

. . "Wayfarer Fairbanks" and "Poddleby Mix" . .

carry has now been discarded in favour of a genuine "grip." And as to his ties. . . . I am afraid that here words entirely fail me. I will merely say that on the first occasion upon which he crossed the Strand wearing one of them, three motor-buses fainted, whilst the hands of the Law Courts clock went backwards, and the statues on Bush House wilted. Sculptors are now engaged in removing the pained expression which remained stamped upon the faces of the statues.

A Warning

I am afraid that you will find that a great change has crept over Mr. Parris's literary style. Lest you should be taken unawares I am issuing this warning, so that you may come to it quite gradually. I happened, whilst looking over his shoulder the other day, to observe the heading and the first few lines of an article upon which he was engaged. This is what I saw:

"A THREE-TUBE FLIVVER IN A GRIP."

"Say, you wireless fans, this is sure some set. Portable? Well, I should worry. Next time you go hiking just carry this three-tuber with you, and if you don't find it a real dandy to hump just take it around to the nearest cookshop, have it made into a pie, send it to me, and I'll eat it. Understand me right now. I'm not giving you hot air; I'm telling you real rock-bottom honest-to-goodness facts about the cutest little set that ever was. The components required to make this dandy set are three tube sockets, a No. 50 coil for the primary, and a No. 75 for tickler. . . ."

Mr. Parris's Six-Shooter

This is as far as I was able to read before Mr. Parris turned round and pulled the gun which he now wears habitually strapped round his waist. I gathered, however, from his conversation that you will find in the article quite a lot about binding posts, the antenna, the ground connection, "B" batteries, pigtails, and other things of that kind. In order that readers shall be able to follow Mr. Parris's valuable articles during the next few months until he returns once more to his old self, I am engaged at the moment upon an Anglo-American dictionary which should (and I hope will) have an enormous sale. I propose also to place upon the market gramophone records of little sample speeches made by Mr. Parris in the dialect that he is at present using, together with translations into English and Esperanto. These should be of the greatest assistance to interviewers and callers.

New Sets

From the above excerpt from one of Mr. Parris's articles you will gather that we are to expect startling things in the way of new sets. Hitherto all the real novelties published by the Radio Press have been produced by Professor Goop and myself; others have merely followed where we led. The Professor and I now feel that we must look to our laurels, and we are thinking of putting our heads together to obtain inspirations. Mr. Parris, I understand, has all kinds of novelties upon the stocks. In fact, he is so busy at the present time in wielding the soldering iron that he is suffering

. . He arrives at the office chewing a green cigar . .

from a bad attack of wirelessman's-corn upon the thumb, forefinger and palm of the right hand. Every day dray after dray loaded with wire and square rod drives up to his private residence and a large staff of porters is employed to superintend the unloading and storing of this material.

Special Features

It is a peculiar characteristic of all the new sets which Mr. Parris is engaged in designing that not one of them contains a single valve; all of them employ tubes. Again, accumulators are conspicuous by their absence, being replaced by the far more efficient "A" battery. No aerial or earth is required for any of the new sets, an antenna and ground being used in their stead. This last improvement marks an enormous advance in the efficiency of wireless receiving sets. It will also effect a great improvement in the appearance of our gardens;

. . Mr. Parris pulled a gun . .

what could be more unsightly than an aerial? what more beautiful than an antenna? To dig a pit for the earth plate is sheer disgusting toil; but the expression "rigging up a ground" has a spaciousness about it that positively invites one to take off one's coat. Reaction, or rather the misuse of reaction, has been blamed with a certain amount of justice as being responsible for most of the interference from which we now suffer. In Mr. Parris's new sets the reaction coil will be discarded entirely, the tickler being used in its stead. This will mean that in future one will laugh instead of weep when one's neighbour is engaged in tuning in.

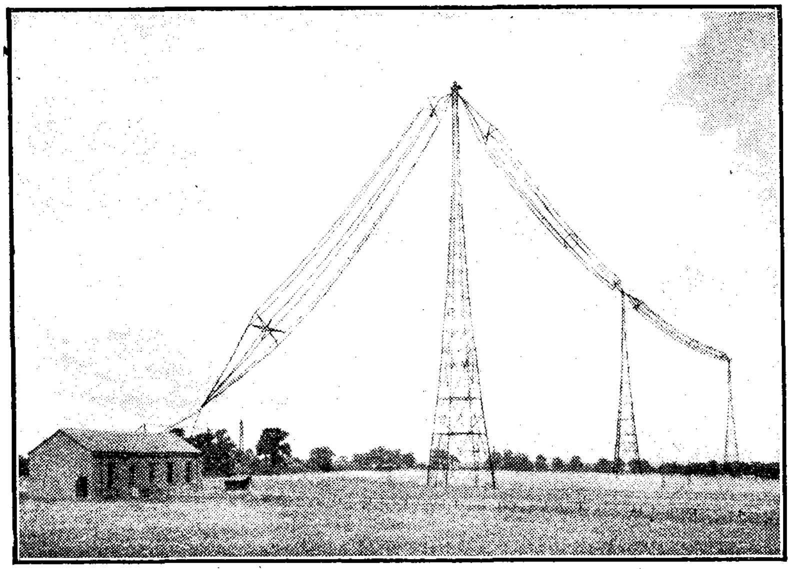
The Wonderful Future

You will see, then, that the future is distinctly rosy. We may as well begin now scrapping our old sets with the coke hammer, the hatchet and the monkey wrench, so as to be prepared for the great new developments that will shortly be with us. Scrapping sets is, I know, rather a problem to the average wireless man. In the first place he simply cannot bring himself to begin the horrid task, and, secondly, when he does, he sets about it in a fashion that I can describe only as finnicky. He actually uses a soldering iron to unstick connections that he made so carefully a few weeks ago. This in the case of most amateurs is quite unnecessary, since connections if inspected carefully will be found to have unstuck themselves without any extraneous help. If, however, any wire soldered to a terminal is discovered to be really fixed in position, there is not the least need to use the soldering iron to ungum it, which is a consideration on these hot days. Personally I always make use of a pair of Goliath Pliers, made by the Gee-Whizz Company, of Mulesear, Pa. With the help of these and the exercise of a little strength no true he-man can be defied for more than a few seconds by any soldered connection. Sometimes, of course, the terminal comes away with a portion of the panel adhering to it, but the hole so made merely goes to improve the insulation and to reduce capacity effects. Personally, I must confess that I am in favour of caveman methods when the demolition of an old set is in hand. For this reason I have installed a power hammer in my workshop which I find most useful. Its rated energy is one man-power, and it is worked by Poddleby when I can inveigle him round to do something useful.

WIRELESS WAYFARER.

THE ONGAR STATION.

A short description of the Marconi Station at Ongar to which the members of the R.S.G.B. paid a visit recently. This station is exclusively engaged in trans-ocean communication.



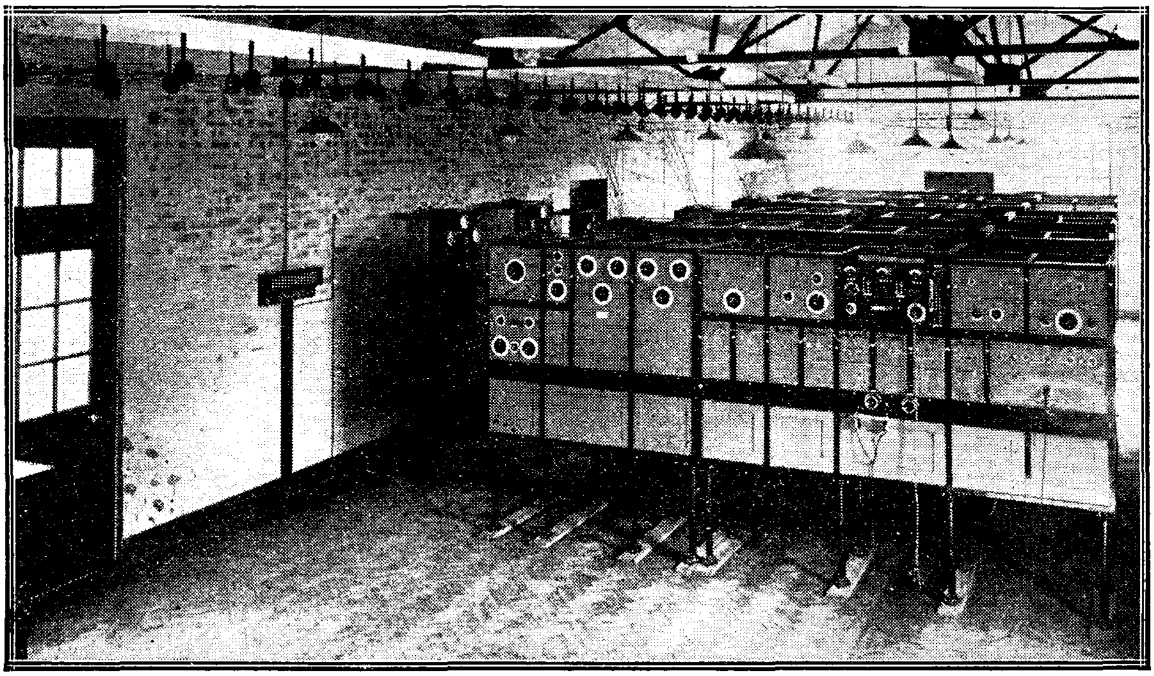
These three masts at the Marconi "B" station at Ongar are 300 feet high and carry a six-wire cage aerial.

ON the occasion of the annual outing of the Radio Society of Great Britain, which took place on Friday, July 17, the members had the pleasure of visiting and inspecting the Wireless Transmitting Centre of Marconi's Wireless Telegraph Co., Ltd., at Ongar, Essex.

The trip was made in motor-coaches, commencing from the Aldwych entrance of Bush House at 2.15 p.m., arriving at Ongar at about 3.45 p.m., where the party was met by officials of the company.

Every facility was placed at the disposal of members, who were divided into four groups, each being directed by guides supplied by the Company.

Great interest was shown in the transmitting apparatus. There are four transmitters, and these are housed in three separate buildings. Perhaps the most interesting of these was the split-wave transmitter, by means of which two separate messages, sent out on different wavelengths, can be transmitted from one aerial simultaneously.



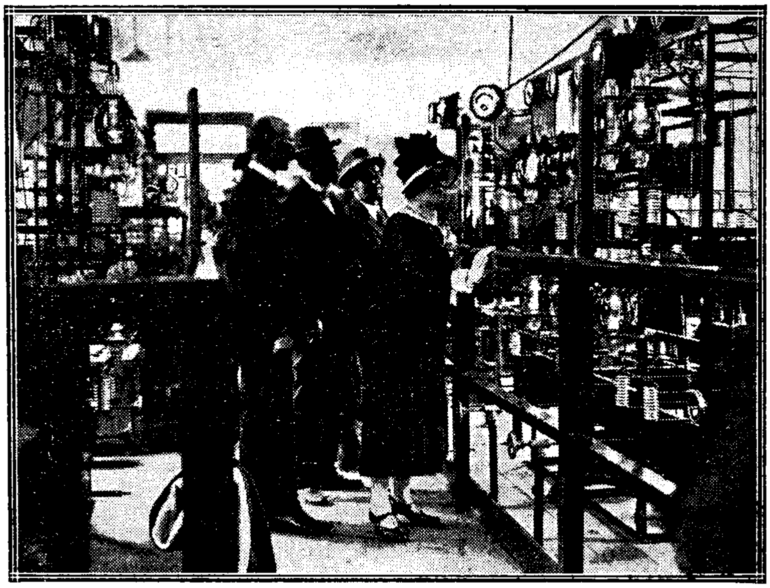
The six receivers shown here, installed at the receiving station at Brentwood, are operated simultaneously from one aerial system. From here the signals are transferred to land lines, and operate automatic receivers and printers in Marconi's central telegraph office in London.

The aerial masts appear, from a distance, to take the shape of a semi-circle, and are the supports of three separate systems. One is struck, on approaching, by the immense height of these aerial masts. On some days the wires at the top are completely invisible.

The power house, which supplies both direct and alternating current, is a separate building, which several of the party found it difficult to leave, despite the terrific noise created by the 10- and 15-kw. motor generators.

As is customary, the transmitters are operated from a distant point, in this case Radio House, London.

Sixty members of the Society attended and spent a thoroughly enjoyable day, thanks to the great courtesy of the officials of Messrs. Marconi's Wireless Telegraph Co., Ltd.



Members of the R.S.G.B. inspecting the panel of the transmitter used for working with Continental stations.

ARE "WAVELENGTHS" PLAYED OUT?

(Concluded from page 521)

disturbance or pulse in the ether, which travels outwards in all directions.

The velocity with which it travels is the distance travelled in one second. Now if there are f oscillations in the aerial in one second, there will be f pulses produced in the ether, and since they are being produced continuously they will follow one another at regular intervals.

The distance between successive pulses is called the wavelength of the disturbance. If c is the distance travelled by the first pulse in one second, and there have been f pulses produced in that second, the distance between each pulse must be c/f.

Hence we have $\lambda = c/f$ and $f = c/\lambda$

f is, of course, the number of oscillations per second in the aerial, i.e., the frequency. c is the velocity with which the disturbances travel, and is the same as the velocity of light, being approximately 300,000,000 metres per second.

The latest measured value is $\{2{\cdot}9986 \pm {\cdot}0005\} \times 10^8$ metres per sec.

The theoretical value in accordance with Maxwell's theory of electromagnetic waves is $\{2{\cdot}9979 \pm .0003\} \times 10^8$ metres per sec.

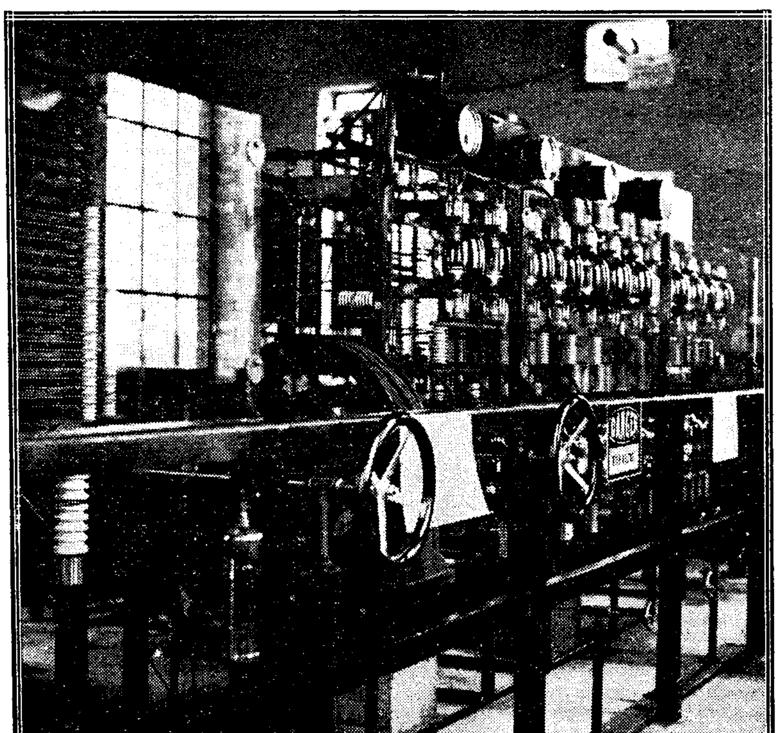
The American Bureau of Standards has taken an average figure of 2.9982×10^8 metres per second, and the conversion tables given in this article are worked out on this basis.

For all ordinary work, however, the figure of 3×10^8 is satisfactory.

Hence if λ is in metres,

$$f = \frac{3 \times 10^8}{\lambda} \text{ cycles.}$$

$$= \frac{3 \times 10^5}{\lambda} = \frac{300{,}000}{\lambda} \text{ k.c.}$$



A part of the main transmitter panel. This photograph will give the reader some indication of the size of the valves used.

WIRELESS NEWS IN BRIEF

LORD GAINFORD, Chairman of the British Broadcasting Company, in his speech at the second Ordinary General meeting of the company, said that the total receipts from the Postmaster - General for licences in 2½ years to the end of March, 1925, were £666,000. The total expenditure of the B.B.C. on programmes for the same period was £612,000. The total receipts for the financial year ending March 31, 1925, were £538,528. The excess of revenue over expenditure for the same period was approximately £79,000 after deducting dividend. Of this expenditure, 85.37 per cent. was incurred on programmes, 6.38 per cent. on administration, and 8.25 per cent. on depreciation. The dividend charge under the statutory 7½ per cent. absorbed £5,172. The whole of the profits apart from this had been invested in necessary addition to plant.

* * *

The Cunard Company has been refused permission to erect at Liverpool a short-wave wireless telegraphy station for the purpose of communicating with Cunard liners at sea.

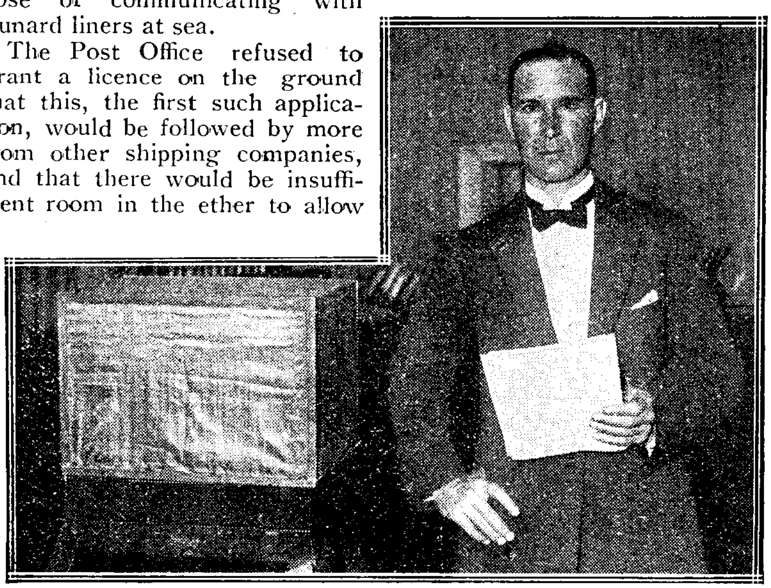
The Post Office refused to grant a licence on the ground that this, the first such application, would be followed by more from other shipping companies, and that there would be insufficient room in the ether to allow separate wavelengths to each such station.

* * *

In connection with the experiments to be carried out in September, as reported in our last issue, the British Broadcasting Company have sent a message to America through Mr. David Sarnoff, vice-president and general manager of the Radio Corporation, in which they state that, in order to explore further the possibility of an international exchange of programmes, they have made plans to establish a central receiving station, equipped with all the latest devices for receiving the world's most powerful broadcasting stations, and, by this means, it is hoped during the next winter season to be able to re-transmit transatlantic programmes with even greater success than heretofore.

* * *

The administration and control of the Wireless League has now been handed over to a committee, of which Sir Arthur Stanley is the Chairman and Sir Lawrence Weaver the Vice-Chairman.



Mr. Mitchell Hedges, who is well known to listeners, recently broadcast a talk from the London Station.

A scheme has been adopted under which England and Wales are divided into 14 areas, and branches of the League situated in those areas have been invited to form "Area Committees." These committees will elect representatives to the general council, which will be the governing body of the league.

* * *

After deliberation and consultation with the local Governments, the Government of India have taken important steps in the direction of co-ordinating and developing the use of wireless in that country as a means of entertainment and education. The existing stations belonging to the radio clubs are very small, and can do little more than serve the cities in which they are situated.

It is now announced that applications for permission to establish a wireless broadcasting company in India will be received by the Director-General of Posts and Telegraphs, Wireless Branch, Simla, up to August 31, together with applications for a separate company for Burma.

A licence will be granted for a period of 10 years, and during the first five years the company will enjoy a monopoly of broadcasting.

* * *

Under the terms of a special Act passed last month, which also confers powers in connection with wireless telephony, the name of the Marconi Wireless Telegraph Company of Canada, Limited, has been changed to that of the Canadian Marconi Company.

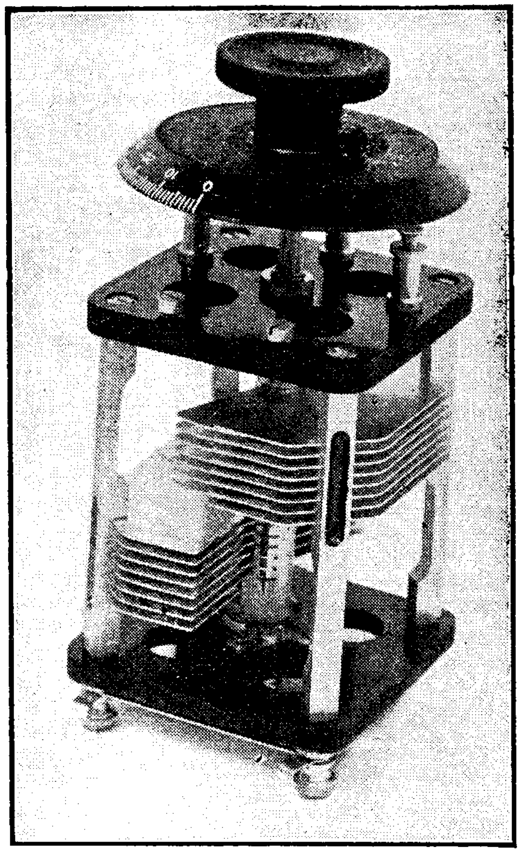
* * *

The Edinburgh station has now transferred to new and more commodious premises, and, to inaugurate the opening of the new studio, a special programme has been arranged for the evening of Friday, July 31. We understand that it will be relayed to the Glasgow and Aberdeen stations.

Selecting Components for Short-Wave Reception

By A. V. D. HORT, B.A.

A high standard of efficiency is required in components employed in short-wave reception. These notes may be of interest and assistance by indicating some of the features which merit attention in choosing components for short-wave receivers.



A typical low-loss condenser of modern design.

THE component parts of a wireless set which is designed and constructed for the reception of signals, whether telephony or morse, below about 100 metres, need to be selected with even greater care than those which are to be used in a broadcast receiver. Good material is of great importance for the satisfactory construction and operation of any receiver, but the higher the frequency of the waves which it is desired to receive, the more electrically and mechanically efficient must the components be. Apparatus which is satisfactory for a broadcast receiver may prove quite unsuitable for use on 100 metres, and absolutely useless when experiments on the ultra-short waves are attempted. At the high frequencies involved in such experiments, insulation, for instance, must receive most careful attention, and any masses of metal or other conductive material must be reduced to a minimum in order to avoid the losses occasioned by their presence.

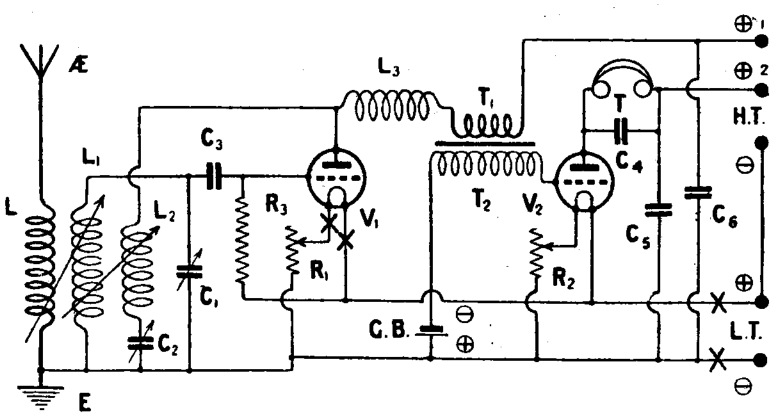


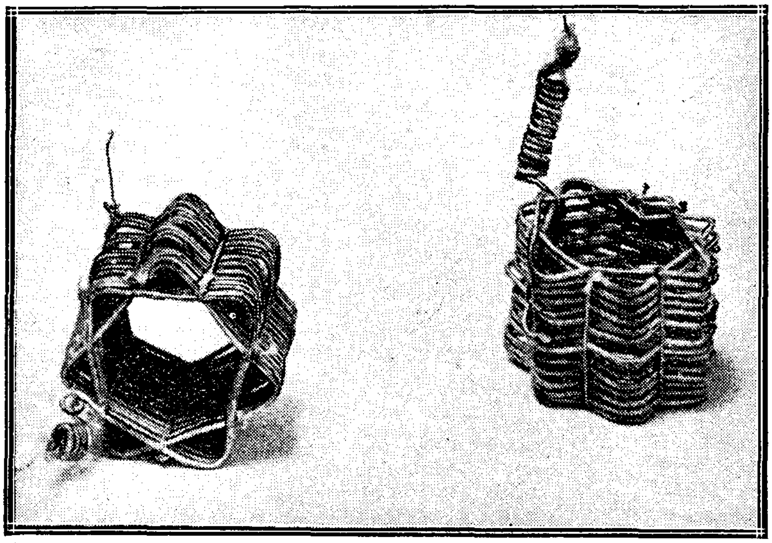
Fig. 1.—A circuit arrangement commonly used, with possible modifications, for short-wave reception. Air core choke coils may be inserted at either of the points X, X.

Variable Condensers

In these notes it is proposed to indicate the general features to study in choosing components for this class of work. On the subject of low-loss coils, however, much has already been written, and many good types have been described in these pages; the question of the best type of tuning coil to use is therefore left to be decided by the individual.

In Fig. 1 is shown a diagram of a commonly used short-wave receiving circuit. Loose coupling is provided between the aerial and grid circuit coils, and the reaction control is of the type attributed to Reinartz, the critical control over oscillation being obtained by adjustment of the condenser C2.

The first components which merit consideration here are the two variable condensers. C1 may have a maximum value of .0003 μF, while C2 may be .0002 μF, these values being suitable for use from 100 down to about 20 metres. Larger maximum capacities than these will render tuning a more difficult matter, since given changes of capacity on this wavelength band will produce bigger frequency differences than similar changes of capacity on longer wavelengths. Apart from low-loss features in the design, such as good insulation between the plates without the introduction of either large masses of non-conducting material or the use of insulating bushes of too small a size, the mechanical construction of the condensers should be carefully examined. There should be no "shake" in any of the working parts, and a smooth contact to the moving plates is essential. Any slight unevenness in this contact, apparent when the spindle is rotated, may give rise to noises in the telephones; such noises will tend to become more and more prominent as the wavelength of reception is lowered, so that what would be on 400 metres a faint hiss may become a violent crackling on 40 metres, sufficiently loud to obliterate completely any signals on this wavelength.



This type of choke coil shown is intended for inclusion in the filament battery leads, and may be found to improve the operation of a receiver on ultra-short waves.

Eliminating Noises

A silent background is one of the most important things to aim at in constructing a short-wave receiver. When no signals are coming in there should be only the very faintest hissing sound, if anything at all, audible in the telephones, when the set is just oscillating and so in its most sensitive condition; this condition should be obtainable at any setting of the grid circuit tuning condenser, and there should be no cracklings or other noises when the condenser dials are rotated.

Fixed Condensers

We next come to the grid condenser C3 and the by-pass condenser C4 across the telephones. These should preferably have a mica dielectric in each case. Experiments may be tried with a smaller value of grid condenser than the normal, a value of .0002 μF or .00015 μF being sometimes found to give better results than the customary .0003 μF. C4 may have the usual value of .002 μF, or may be omitted altogether if no improvement is brought about by its inclusion. The two condensers across the batteries may be of the Mansbridge pattern, values of at least 1 μF, or even 2 μF, being employed. It will be noted that these are shown connected between L.T. negative and the two H.T. positive tappings; it is advisable to connect them in this way, including the L.T. battery, since this gives part of the H.T. voltage in the circuit shown, and the condensers will assist in smoothing out any slight irregularities in the anode current discharge.

The grid-leak R3 may be of the usual cartridge pattern, with a value of 2 megohms; but for the reception of weak signals a higher value will usually give better results, with also a possible improvement in the smooth control of oscillation. The exact value will depend largely on the type of valve in use as the detector, so that a variable grid-leak may be of advantage. If, however, simplicity is aimed at, and it is not desired to have this type of variable control at this point, an alternative method of obtaining different values of this component is to mount a pair of clips in an accessible position in the receiver, and insert various values of fixed leaks as required; this method, however, has the obvious disadvantage that critical control of the resistance value is not so readily obtainable as by the use of a good type of continuously variable leak.

Choke Coils

The function of the air-core choke coil L3 is to choke back the H.F. currents present in the anode circuit of the detector valve, and prevent them leaking away via the transformer and the batteries back to the filament. This coil must therefore be of low self-capacity, since otherwise the H.F. currents will find a ready path across it, and the circuit will not function properly. For reception around 100 metres a No. 100 or 150 plug-in coil of good standard make may be used here.

If reception is attempted below about 20 metres, it will be prefer-

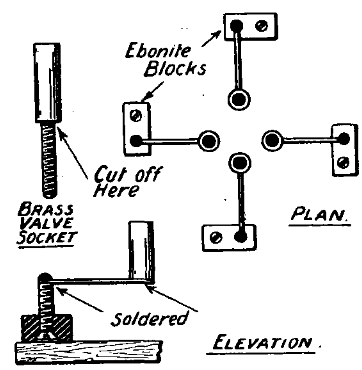


Fig. 2.—A method used by the author in constructing a low-loss valve socket. Sockets of various types resembling this can now be purchased

able to wind a low-capacity coil for the purpose; a plain 40- or 50-turn solenoid coil of 28 S.W.G. d.c.c. copper wire on a 1½ former may be found satisfactory, while a basket-weave coil of similar gauge wire and number of turns is to be preferred, as in this case no former need be used to support the coil.

Oscillation Difficulties

At these very high frequencies it will probably be found easier to induce the valve to oscillate if air-core chokes are connected in the leads to the filament battery also. These may be inserted, one in each lead, at either of the points marked X, X, on the diagram, the best position being determined by experiment.

Suitable basket-weave coils for this purpose are illustrated on a previous page, being made as described in the article, "Experimenting with 5 Metres" (*Wireless Weekly*, Vol. 5, No. 11); those shown are wound to a diameter of ¾ in. on 7 pegs in a board, with 30 turns of 28 S.W.G. d.c.c. wire each. Before the pegs are removed the coils are tied tightly with fine cotton at each point where the turns cross one another. This method of winding produces a coil which is quite rigid without the application of wax or varnish.

Valve Holders

If valves of the tubular anti-capacity type are used, the valve-holders call for no special comment, except that the ebonite used for supporting the contact clips may with advantage be reduced to the smallest dimensions consistent with mechanical rigidity. Four-pin valves can also be satisfactorily employed at high frequencies, as shown by Mr. A. D. Cowper, M.Sc., and Stanley G. Rattee, M.I.R.E., in *Wireless Weekly*, Vol. 6, No. 8, and No. 11, respectively. If the cap of the valve is removed, then ordinary holders are, of course, out of the question. But if the valve is used in the ordinary way the valve-holder should be of the low-loss type and be capable of absorbing mechanical vibration.

A Suggestion

The writer has successfully used a simple method of reducing the ill-effects of both vibration and self-capacity in the valve mounting: this is indicated in Fig. 2. From four standard brass valve sockets the threaded portion is cut off, and a 1-in. length of 16 S.W.G. bare copper wire is soldered to the base of each. The free ends of these wires are then soldered to bolts on small ebonite blocks mounted on the baseboard of the set, as shown in the diagram. The insertion of the valve aligns the sockets correctly, and the length of the connecting wires provides the right amount of springiness to insulate the valve from mechanical shocks.

Amplification

When a stage of L.F. amplification is used, as shown in Fig. 1, the L.F. transformer should be carefully chosen, silent operation of the amplifier being even more important than high amplification. If telephony is the main objective of reception, then the transformer may be of the ordinary first-stage medium ratio type. If, on the other hand, the reception of only Morse signals is desired, this transformer should be chosen for maximum amplification, and the avoidance of distortion need not be so carefully considered.

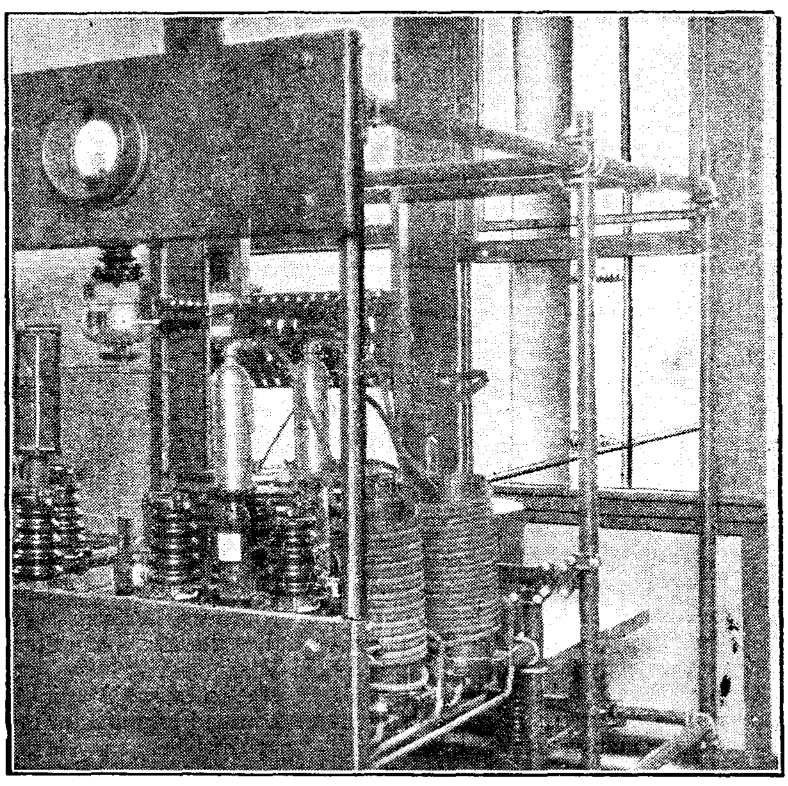
Valves

Those who use low-capacity valves will need no guidance in their choice; but if ordinary four-pin valves are used, though most bright or dull-emitter valves are likely to prove fairly satisfactory, one of the many available types of small power valves is to be preferred for use as detector, as well as for the stage of L.F. amplification. In general, such valves are likely to be more silent in operation than the standard bright emitter, while they tend to oscillate more readily and with less reaction demands at high frequencies.

Batteries

Finally, in order to ensure the essential silent background for signals, the batteries must be in good condition.

An accumulator should, if possible, be provided for the filament supply, even if dull emitters are used, as being more likely to give a steady output than dry cells, and it should not be brought into use immediately after charging, as the gassing of the plates may cause undesirable noises in the set. The H.T. battery should also be in good condition, as it, too, if partially exhausted, is capable of giving rise to annoying cracklings in the telephones, and an uneven rate of discharge which may interfere with the correct functioning of the receiver.

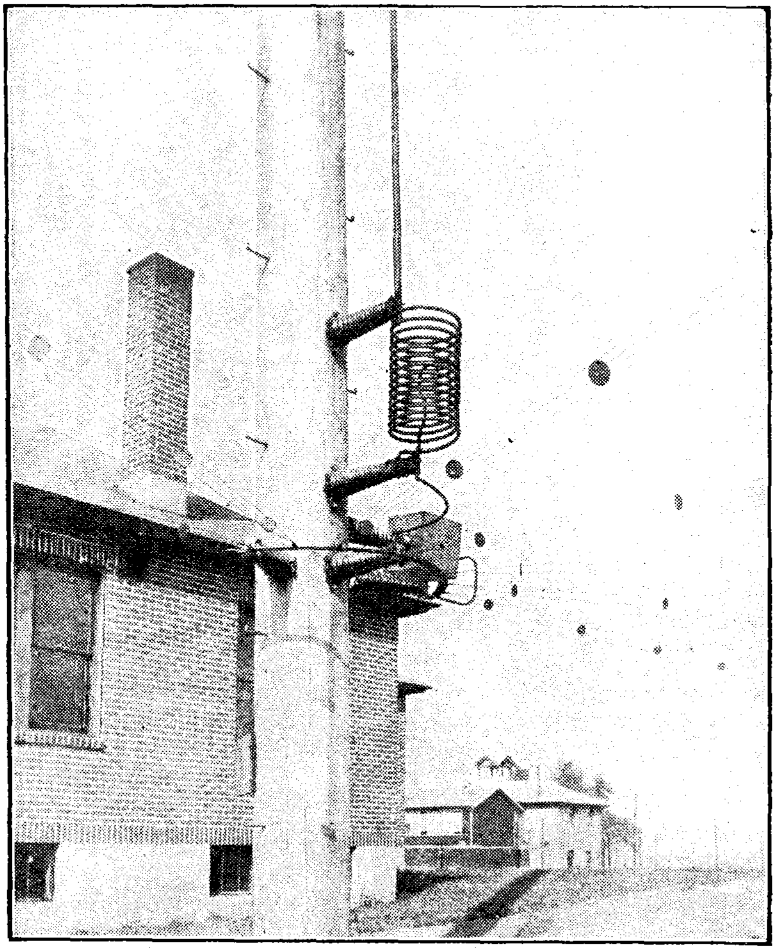


Part of the short-wave equipment in use at KDKA. Note the connection to the base of the vertical copper-rod aerial.

WHAT I SAW AT AMERICAN

By PERCY W. HARRIS, I

In this article Mr. Harris c
the latest work in some of
research laboratories in th
description of crystal o

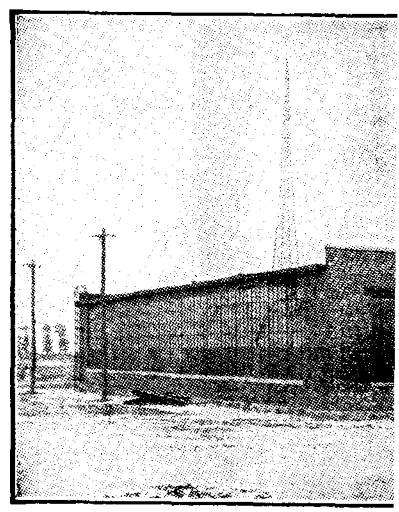


The feed-in arrangements and counterpoise support of the 309 metre transmitter at KDKA. Notice the box for the aerial ammeter, below the loading coil.

THE casual student of wireless whose contact with the art is confined to the manipulation of a finished wireless receiver is not likely to realise the immense amount of careful and expensive research work which has to be conducted in order that satisfactory instruments may be evolved. During my visit to the United States I made a particular point of visiting as many research laboratories as possible, and, by the courtesy of the various organisations concerned, I was able to visit the experimental laboratory of the Radio Corporation of America at Van Cortlandt Park (a suburb ten miles north of the business centre of New York); the radio laboratories of the United States Navy at Bellevue, Washington; the Bureau of Standards at Washington; the experimental station of the Westinghouse Electric and Manufacturing Company at Pittsburgh; Mr. J. Elliott Jenkin's laboratory in Chicago; the research laboratories of the General Electric Company at Schenectady; and several others conducted by commercial firms or private individuals.

The Buildings

The experimental building of the Radio Corporation of America, illustrated on the cover design of this issue, is an imposing-looking building, which has only been open a few months, and, indeed, is not yet operating at its full efficiency. Van Cortlandt Park is a large public park within easy reach of the city by the elevated railway. The Radio Corporation Building is thus situated in a district where there are comparatively few houses, and the surroundings are for the most part open country. The



One of the special experimental
This contains the three 100 Kw.
article l

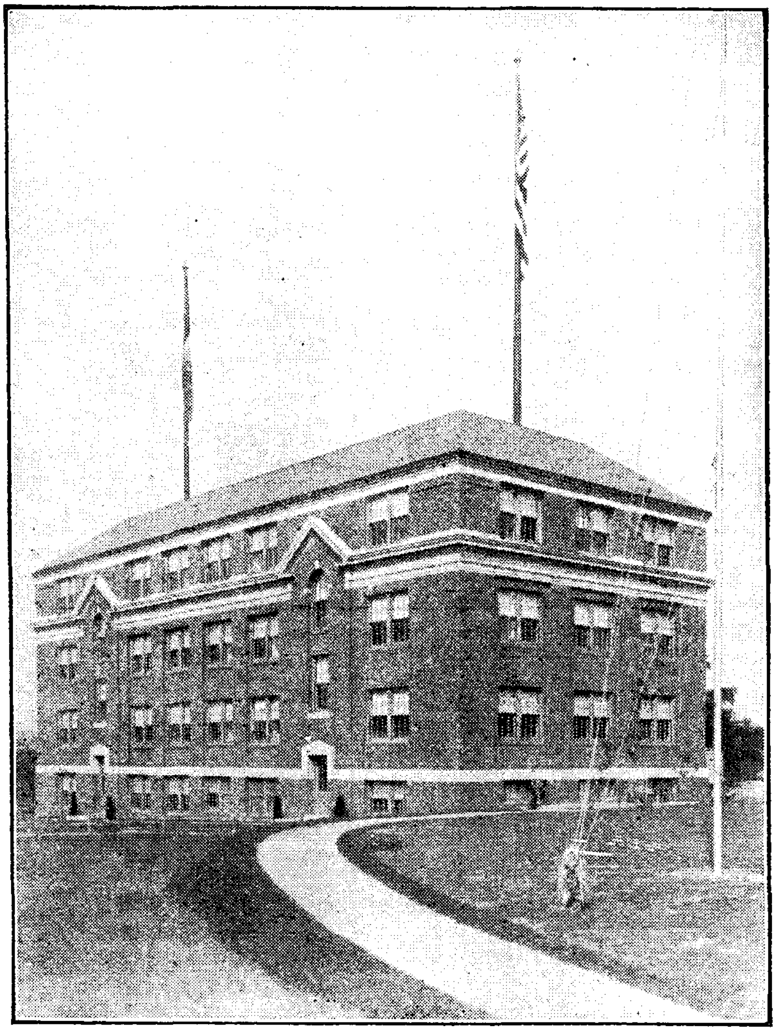
RESEARCH LABORATORIES

.I.R.E., Assistant Editor.
ntinues his description of
the best known American
United States. A brief
cillators is also given.

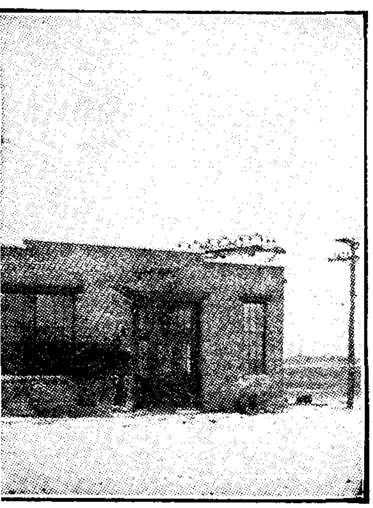
building is used exclusively for the investigation of broadcasting problems, and is under the charge of Dr. Alfred N. Goldsmith, who has made many important contributions to the art, and who is, incidentally, Editor of the "Proceedings of the Institute of Radio Engineers." Dr. Goldsmith spared no pains to make my visit a pleasant and interesting one.

The Staff

He holds the position of Chief Broadcasting Engineer of the Radio Corporation, and has working under him a staff of some fifty engineers in twenty-two separate laboratories in the main building. At present the laboratory seems almost ideally situated, but New York is growing so rapidly that I do not think it will be many years before the city has reached out beyond Van Cortlandt Park. The Radio Corporation have already been offered eleven times as much as they paid for the land!



The Radio Corporation technical building at Van Cortlandt Park, New York. The masts support a single wire aerial.



uildings at South Schenectady. ctifiers mentioned in Mr. Harris' week.

The official title is the "Radio Corporation Technical Building," and I noticed during my visit that in addition to research work there appeared to be a good deal of routine testing, such as I generally associate with factory test departments. Thus quite an appreciable portion of the building was given over to valve testing. Batches of valves from the various factories undergo "life tests" and other forms of testing necessary to preserve the output of the factories at a high level of quality. In passing, I may say that I do not consider that the American valves are so uniform in quality as our own. I mentioned this to Dr. Goldsmith, who admitted that a year or so ago the valves sold varied a good deal, but stated that at the present time the valves sold were very uniform.

Valve Tests

To prove this he showed me test charts of a number of batches of valves that had gone through the test within a few days of my visit. I must say that the charts showed a very high level of uniformity, and I trust this will be maintained, but the fact remains that in travelling I frequently came across very bad specimens of valves, both in their performance and in the placing of the elements within the bulb. Possibly these examples were survivals of last year's stock.

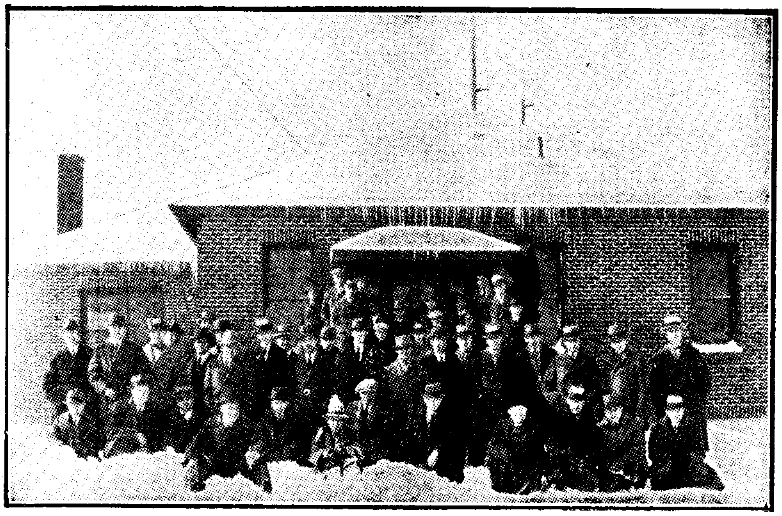
Commercial Sets

The Radio Corporation is doing a very large business in their well - known Radiola Superheterodyne. This is a six-valve instrument working on the second harmonic principle. During my trip I used two or three of these instruments, which are built up complete with loud-speaker and frame aerial for portability. They are exceedingly easy to operate, but the selectivity is not so high as that of some other super-heterodynes I have used. The quality of reproduction, however, is quite good, although I was not greatly impressed with the sensitivity.

The Radiola Super-heterodyne utilises six U.V.199 valves (the valve corresponding with our .06 ampere type). There are but four controls—two for tuning (one for the oscillator and the other for the frame aerial tuning), the remaining two being that of volume control and filament control. This last is of course essential, as the set is designed to work from dry cells, the voltage of which steadily drops during their life. The volume control is merely an additional filament resistance operating on one of the valves of the intermediate frequency amplifier.

It will thus be seen that the strength is controlled simply by varying the emission of one of the intermediate frequency valves —a scheme which is considerably different from the usual method of potentiometer control.

It appears to me that most of the energies of the laboratory were being concentrated upon developments of the super-heterodyne in forms which could be placed in gramophone cabinets.



A group of American wireless amateurs during a winter visit to KDKA, East Pittsburgh.

Loud-Speaker Research

Loud-speaker research also occupied an appreciable space, and special rooms were being equipped for acoustic experiments. In other departments attention was being given to portable amplifiers for use in connection with outside broadcasting, these amplifiers being used for connection to the telephone lines linking the microphones with the broadcasting station.

A particularly neat and efficient frame, similar in size to the small telephone switchboards used in offices, had been evolved, and was undergoing final tests. This equipment is easily portable, and can be brought into, say, a concert hall, connected up and put in operation in a very few minutes.

Reception of Chelmsford

In his private office Dr. Goldsmith showed me a combined gramophone and superheterodyne, the frame aerial for the latter being hinged on the side of the gramophone cabinet so that it could be swung through any angle. He then played to me a gramophone record which had been taken from the Chelmsford signals of the Savoy Havana Band during the last Transatlantic tests. I noticed in this the particular long-distance distortion which seems to kill the finer tones of all the music received across the Atlantic.

I had a most interesting discussion with Dr. Goldsmith on the whole question of selectivity —a question which I shall go into in detail in a subsequent article.

My impression was that it will be some time before the work at the Radio Corporation's Laboratory will be fully under way.

The Naval Laboratories

In Washington I spent a most interesting day at the Naval Research Laboratories at Bellevue. These laboratories, as mentioned in last week's issue, are under the supervision of Dr. A. Hoyt Taylor. The buildings of the laboratories are shown in one of the accompanying photographs.

In one of the buildings, which carries a pair of lattice towers, the general experimental work is done. It is particularly well equipped with power supply, for in an outer building are placed machines capable of delivering power, both D.C. and A.C., at almost any frequency, voltage and amperage. Supply lines come from this building to each of the small laboratories in the building, an ingenious distribution board in each room enabling the research engineer to obtain the supply he wants. One room is specially devoted to accumulators, both high- and low-tension. A 1,000-volt direct current supply is always available from high-tension accumulators. This accumulator room provides a training ground for naval ratings who are attached to the equipment department of the Navy, and who will specialise on accumulators and their maintenance.

Standardising of Valves

In the last twelve months or so the Navy has given considerable attention to the question of valves. For some time they have been using a valve corresponding in its electrical characteristics to the peanut valve on sale here, but recently all of the Government Services in the States have got together and agreed to standardise on a valve with similar characteristics, but an entirely new base of insulating material, about the size of our base, and with a good, sound wiping contact in the socket and the conventional American bayonet catch. The valve will operate with a 2-volt filament, taking one quarter of an ampere with 40 or 50 volts on the anode. The service tubes will thus be different in their bases from the ordinary valves sold.

The Naval Short-Wave Receiver

In my notes last week referring to the Navy short-wave receiver, I mentioned that this goes down to about 10 metres. Since writing I have been looking into my notes more fully and find that the wavelength range of the Navy receiver is from 17 to 150 metres. Hand capacity effects have been completely eliminated, and various wavelength ranges are obtainable by using interchangeable coils made of fairly heavy wire with practically no solid dielectric in the field.

All Navy coils are treated with aeroplane dope, which Dr. Taylor tells me is the best substance they have found for the purpose, being far superior to shellac or wax, and showing no appreciable losses.

Calibration Transmitter

The transmitter from which the calibrated waves are sent out is situated in the building under the lattice masts. Another large building (that on which is situated the pipe aerial for short waves) is used as the high-power research building. In this are built and tested high-power Naval transmitters of various types. Here I saw two machines, each delivering 10,000 volts direct current. One gives 10 kilowatts, and the other 15 kilowatts. Here, too, I saw the main short-wave set which can handle about 17 kilowatts on 71.35 metres. This power is not often used, and, as a matter of fact, is frequently changed. Three different wavelengths are used on this transmitter—71.35, 41.7 and 20.8 metres.

The Call Sign

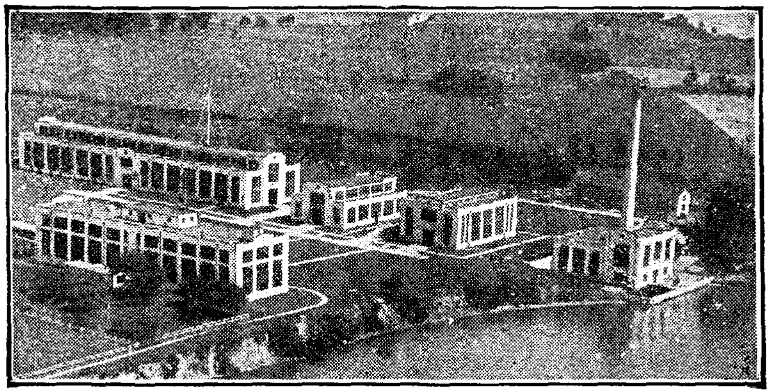
The call-sign is NKF, and when the station is working it can be heard at great strength in this country. These wavelengths are guaranteed accurate, so that any reader hearing signals can safely calibrate his receiver from them.

Frequency Control

The quartz crystal method of controlling frequency is that adopted at the Naval laboratories. It would require a whole article to explain in detail the great possibilities of this method, but at present it can be briefly described as follows :—

If from a quartz crystal we cut a section at a certain angle and grind it suitably, it can be connected (when suitably mounted) to the grid and filament of a valve. If now we place in the anode circuit of the valve an inductance and condenser forming a tuned circuit, and suitable potentials are applied to the valve, a point will be found in tuning the anode circuit when self-oscillation will be set up. A grid-leak in series with a radio-frequency choke is usually connected between the grid and the filament of the valve. A given quartz crystal connected in this way will always give the same frequency, this frequency depending upon the physical dimensions of the crystal, so that the only way to alter the frequency is to grind down the crystal, or substitute another for it. I may say that the connections I have described are not necessarily those in use at the moment, but they illustrate how a quartz crystal can be used in an oscillatory circuit. If now we use a quartz crystal, in some way similar to that described, as a master oscillator, it is possible to build a transmitter the wavelength of which can be maintained perfectly constant. Similarly in a receiver a circuit can be arranged, even with very short waves, to produce oscillations of a given frequency, which will give a definite and constant beat-note with the signals from a crystal-controlled transmitter.

[In our next issue Mr. Harris will give an account of his observations and experiences at the Bureau of Standards, Washington.]



The Naval Laboratories at Bellevue, on the Potomac river at Washington, D.C. In the left foreground is the chief radio research building.

Straight-Line Frequency Condensers

By SYLVAN HARRIS.

This concluding portion of Mr. Sylvan Harris's article, of which the first part was given in our last issue merits serious consideration in the light of Mr. Reyner's observations in an earlier article on the wavelength versus frequency question.

IT will be noted that the straight-line frequency curve in Fig. 7 increases as the dial setting becomes lower. This is in accordance with our previous statements to the effect that when the plates of this condenser are entirely *out of mesh* and the capacity is least, the frequency is highest.

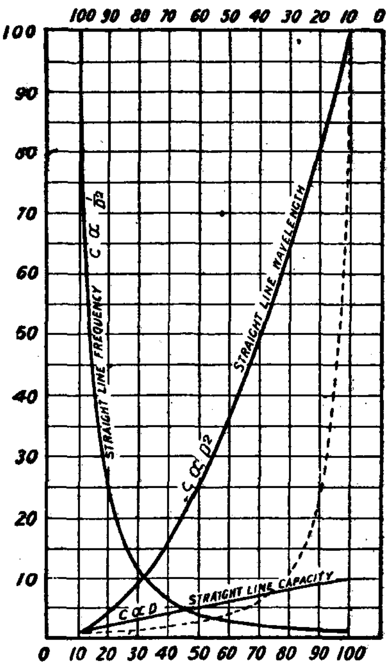


Fig. 7.—Curves showing the ratio of capacity at any dial-setting (indicated on the horizontal axis) to the capacity at 10 on the dial.

To be able to visualise more easily the difficulties which attend the design of the straight-line frequency condenser, we have reversed the reading of the latter and have made it read in the same direction as the others. The dial readings are shown at the top of Fig. 7. We have then re-plotted the curve, giving us the broken line curve of Fig. 7.

A Steep Curve

It will be noted that below about 70 on the dial the ratio of capacity of the condenser at any setting to the capacity at 10 on the dial is much less than in either the straight-line capacity or straight-line wavelength types. This means that the plates at the low dial settings (remember, we have temporarily reversed the dial) must be cut away considerably. After about 70 on the dial, however, the capacity must increase at an enormous rate. This is shown by the steepness of the curve, and the abruptness with which it turns upward. This is what makes it a difficult matter to construct straight-line frequency condensers so as to have the usual capacities and yet not to occupy too much space in the radio receiver. This will be brought out more clearly as we proceed.

Plates of Straight-Line Wavelength Condenser

Everyone is familiar with the circular shape of the straight-line capacity plates. The shape of the plates of the straight-line wavelength condenser is shown in Fig. 8. This, as is the shape of the plates of the straight-line frequency condenser, is a mathematical curve, the equation for which is

$$r = \sqrt{4aD}$$

in which r is the radius, or the distance of the plate edge from the centre, D is the dial setting, and a is a constant, which depends on the units we use in making the computations. This is just the simple plate shape, without considering the cut-out section where the rotor shaft passes through. If this is taken into account, the formula becomes

$$r = \sqrt{4aD + r_2^2}$$

where r_2 is the radius of the cut-out.

Design of Plates

To consider one of the practical problems that arise in designing these straight-line wavelength condensers, suppose we take a

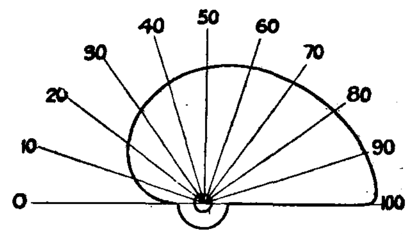


Fig. 8.—The familiar "square-law" type of plate, which gives a straight-line wavelength curve.

circular plate as in the ordinary condenser, and cut out the straight-line wavelength shape from it. We have to keep the maximum radius the same, or else we should have to build our condenser larger. This also means that the plates will be mounted eccentrically.

Obviously, it will require a greater number of plates in the

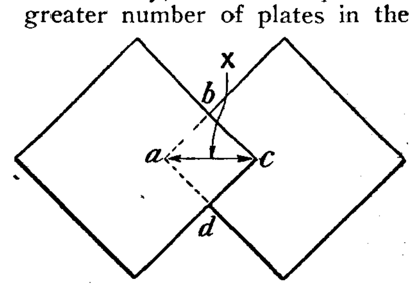


Fig. 8 (a).—Two sets of square plates arranged to interleave as above will give a straight-line wavelength curve in conjunction with a suitable inductance.

straight-line wavelength condenser to give the same capacity as we have in the circular condenser, assuming that we keep the same spacing between the plates. Otherwise, we shall have to be satisfied with condensers of smaller capacity.

Formulæ for Shapes of Plates

The straight-line wavelength law also applies to condensers of square plates, as shown in Fig. 8 (*a*). The overlapping area of the plates, and hence the capacity of the condenser, is proportional to the square of the distance x, through which the movable plates are moved. This follows from the geometric law that the area of a square (*abcd*) is proportional to the square of the diagonal (x).

The same situation is true of the straight-line frequency condenser. The formula for the shape of the plates is

$$r = \sqrt{\frac{4a}{D^3}}$$

if we neglect the cut-out section. If we take this into consideration, the formula becomes

$$r = \sqrt{\frac{4a}{D^3} + r_2^2}$$

where r_2 is the cut-out radius. This formula is very interesting for several reasons. Suppose we give a certain value to r_2, the cut-out radius, say $\frac{3}{8}$ in., and then try to calculate the radius. We shall have to start calculating from 100 on the dial, because, as we have said before, when we use zero for the dial setting, we get an indeterminate number. Furthermore, as we decrease the dial setting D, the value of r, the radius, will increase indefinitely; in fact, it increases enormously. This has been indicated in the curves of Fig. 9, which the writer has calculated.

Practical Difficulties

In all these curves a cut-out radius of $\frac{3}{8}$ in. has been assumed, and three different radii have been assumed at 100 on the dial, viz., $\frac{3}{4}$, $\frac{1}{2}$, and $\frac{7}{16}$ in. The difficulties attending the design of straight-line frequency condensers are instantly apparent. We can obtain a straight-line shape easily enough by using any portion of these curves that we fancy, as is illustrated by the heavy lines drawn in Fig. 9. But the trouble is that if we wish to keep the radius of the plates within the usual limits, we shall have to use a great many plates. For instance, in the plate shape indicated by the shading in Fig. 9, the maximum radius is $2\frac{1}{2}$ inches, which would make a pretty large condenser, and yet the area of the plate is only about one-half the area of a semi-circular plate $1\frac{1}{2}$ inches in radius.

However, if we wanted to use this plate we could do so, and it would give us a straight-line frequency curve if we had the necessary minimum capacity. We should, however, have to squeeze in our dial calibration, so that, instead of reading from 100 to 20

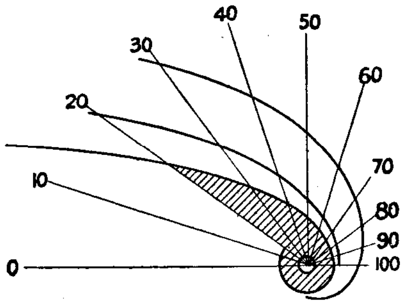


Fig. 9.—A set of curves plotted from calculations made by the author to indicate the shape of the plates for straight-line frequency condensers for various radii at a reading of 100 degrees on the dial.

on the dial, as indicated in Fig. 9, the complete rotation of the plate will be from 100 to zero on the dial. This will have no effect on the straight-line characteristic of the condenser.

Straight-Line Frequency with Square Plates

It is also possible to build a condenser of square or rectangular plates which will give a straight-line frequency calibration. The shape of the plates

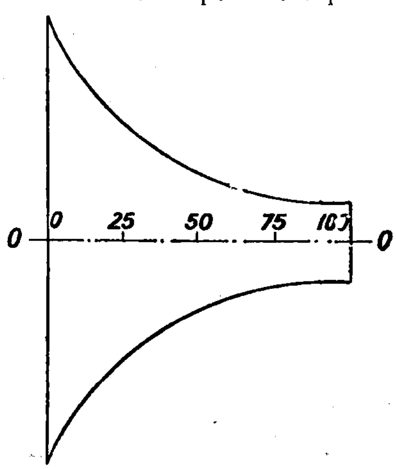


Fig. 10.—A further possible shape of the plates for a straight-line frequency condenser.

required in this type of condenser is shown in Fig. 10 and the equation of the curve with respect to the line o-o is

$$y = \frac{3a}{X^3} + y_0$$

in which y is the height of the curve from the line o-o, x is the distance along o-o and a and y_0 are constants. The curve may be duplicated on either side of o-o as has been done in Fig. 10, if we so desire, to enable us to reduce the number of plates.

But this particular shape of straight-line condenser does not solve the problem any more than does the shape shown in Fig. 9. It is open to the same objections; the plates must be so cut away at the small ends, and the area must increase at such a rapid rate toward the large end that to obtain this rapid increase, and at the same time obtain the required maximum capacity of the condenser, the dimensions of the condenser must become inordinately large.

Conclusions

Up to the present time no one has written of any way in which to overcome these inherent difficulties in the design of straight-line frequency condensers.

For the present it seems that we shall have to be content with straight-line frequency condensers of small capacity, say 0.0002 microfarad, if we wish them to have low minimum capacities. Or, if we wish maximum capacities as high as, say, 0.0005 microfarad, we shall have to be content with high minimum capacities.

The straight-line frequency condenser *has to be* designed to have a *certain minimum capacity*, in order that the inverse-square law which must apply in straight-line frequency condensers may be obtained.

Faults in Transformer-Coupled Note Magnifiers

By JOHN UNDERDOWN

A general survey of the faults which may occur in badly designed or incorrectly operated transformer-coupled amplifiers, with some helpful notes on the most effective remedies.

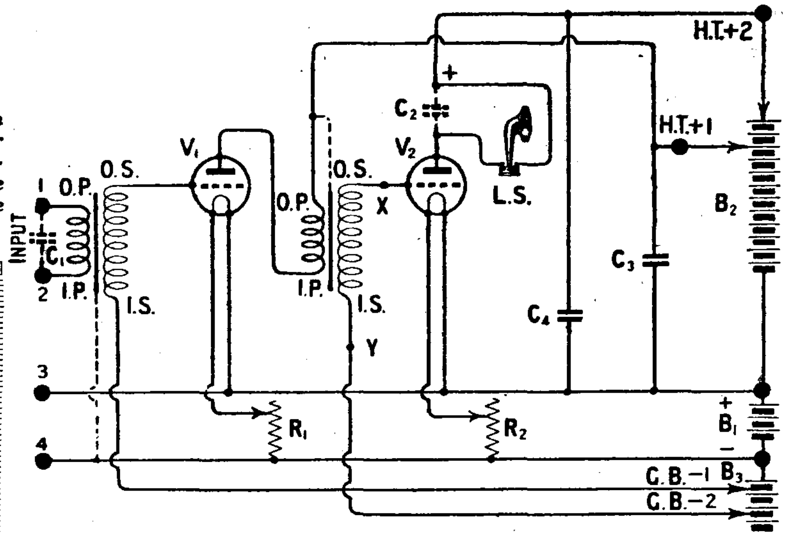


Fig. 1.—A typical two-valve transformer-coupled circuit for L.F. amplification, in which provision is made for applying suitable anode and grid voltages to the valves independently.

ALTHOUGH the low-frequency portion of most multi-valve sets is usually fairly simple in nature, it by no means follows that trouble will not be experienced with the note-magnifiers, and undoubtedly much of the very poor reproduction often heard is due to faults in the part of the circuit following the detector valve. The observed symptoms may range from a complete cessation of signals or howling and distortion down to less serious things, such as impure signals on loud passages of a received item.

It is proposed in the course of this short article to deal simply with the more usual troubles, so

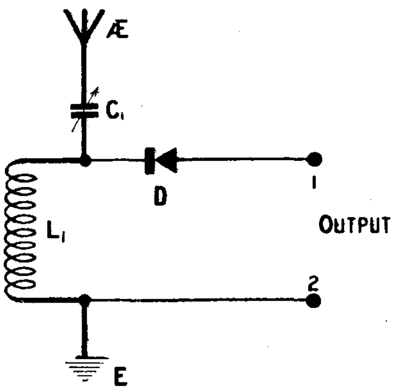


Fig. 2.—The "output" terminals of this crystal circuit are for connection to the terminals marked "input" in Fig. 1.

that the experimenter may know what to do should the note magnifiers not function correctly. Faults with the most common form of coupling, namely, transformer, will be discussed in detail this week.

Transformer Coupling

The most common system of coupling, and one that gives the highest step-up in signal strength per valve, is that in which low-frequency transformers are employed. The Fig. 1 circuit shows two valves coupled in this manner. From practical experience I would not advise the amateur to use more than two transformer-coupled stages, since when more than this number is employed trouble due to low-frequency oscillation is usually experienced. Great care in the choice of transformers is necessary when two stages are used, and if a further one is added the problem becomes much more difficult, and a considerable amount of practical experiment is required to obtain satisfactory working. This brings us at once to one of the most prevalent troubles with amplifiers of this type.

Low-Frequency Oscillation

This is low-frequency oscillation. Where the quality is good when employing one stage, and the switching into circuit of a further valve results in a loud howl, high-pitched whistle, or very poor quality, oscillation at low frequency is usually responsible.

The first remedy to try is that of reversing the primary leads to the second L.F. transformer, that is, the two leads to IP and OP respectively should be changed over. Where the howl is not particularly pronounced this procedure will often completely cure it. In other cases, more drastic treatment is called for, and a resistance should be connected in parallel with the secondary winding of the second transformer. Where a leak of ½-megohm is available, it should be placed across the points XY in Fig. 1.

In a bad case howling may still persist in spite of the ½-megohm leak, and one of lower resistance should be substituted; a variable anode resistance of 100,000 ohms maximum usually proves suitable. A ½-megohm leak connected across the secondary of the first L.F. transformer will also improve quality. A certain amount of volume is thus sacrificed, but this may be compensated by the improvement in the reproduction.

Another experiment to try is the effect of earthing the cores, that is the iron stampings of the transformers, either to L.T. negative as shown dotted in the case of the first transformer, or to H.T. positive as with the second.

With certain makes these connections may be made to a bolt passing through the laminations, whilst with some others a tag is provided for this specific purpose. In one or two types the core is appropriately connected to a winding internally for stabilising purposes.

In extreme cases it may even be necessary to replace one of the transformers with another of more suitable type.

Effect of Wiring and Layout

The way in which the wiring is carried out and the disposition of the transformers has often a very considerable bearing on the functioning of the amplifier, and rewiring, keeping the grid and plate leads short and well spaced may be well worth while where interaction effects are serious. The transformers should, if possible, be arranged with their axes at right angles.

Instability when Connected to a Crystal Set

A two - valve transformer-coupled amplifier may work perfectly satisfactory when connected to a valve set—such, for example, as is shown in Fig. 3—but loud howling results when used with a crystal set (Fig. 2). The normal connections for the amplifier to follow the crystal set are "Output" of crystal set to "Input" of the amplifier, that is 1 to 1 and 2 to 2 respectively. When, however, loud howling results, the low-tension negative of the amplifier battery should be joined to the earth terminal of the crystal set. This is effected by joining terminal 2 of the crystal set to terminal 4 of the amplifier, and practically always gives stable working.

A Peculiar Fault

A somewhat peculiar trouble is often experienced when a set of the Fig. 3 type is followed by the amplifier of Fig. 1, and switching is incorporated so that one, two, three or four valves may be used. The symptoms are generally that the set works satisfactorily when the high frequency, the detector and one low-frequency stage are used; when, however, all four valves are employed loud howling is at once experienced. The fault in this case can usually be traced to the potentiometer winding having broken in a certain manner. A simple experiment will definitely show whether this component is actually responsible. The two leads to the respective ends of the potentiometer winding should be disconnected and then that from the slider should be joined to L.T. positive, that is, to the point 3 in the diagrams. This will result in working the high-frequency valve with the full positive potential of the low-tension battery applied to the grid, so that no instability due to the high-frequency stage should be experienced. If with this arrangement the howling ceases, it is definitely established that the potentiometer is the offender. This latter component should either be replaced or the set worked with the earthed end of the aerial coil connected to either L.T. positive or negative. The latter connection will, of course, give the most sensitive working position, but on some aerials instability will be experienced and the positive connection should be made.

Distortion

Very pronounced distortion may often be obtained unaccompanied by the phenomenon of howling or whistling. This may be due to low-frequency oscillation above audible frequency or to other causes which will be discussed later. If bad quality results only when very strong signals are received, and quality is of normal purity when the set is detuned slightly, it is probably due to "amplitude distortion," for which the choice of unsuitable valves or too low a high-tension voltage is responsible. In such cases the remedies given for low-frequency oscillation troubles will not prove effective. "Amplitude distortion" is caused by the employment of valves which are unsuited, either by their design or by the fact that they are not worked with appropriate anode voltage and grid bias for the position in which they are used, and the latter points should first receive attention.

Very Loud Signals

To deal effectively with loud signals it is essential that the valves should have a long straight portion of their characteristic curve situated to the negative side of the zero grid volts axis. The high-tension voltage should, therefore, be increased to the maximum permissible, as given by the makers, and a suitable value of grid bias should be employed. Where even this does not permit the valve to handle the signal input, it should be replaced by one with a greater permissible grid swing.

Valves to Use

For ordinary loud-speaker work in rooms in the average house a general purpose 'R'-type valve will prove perfectly satisfactory for V1 (Fig. 1), with an anode voltage of 80 or 90 and $1\frac{1}{2}$ volts grid bias. V2 should preferably be a small power valve of the B4 type, and have an applied anode voltage of 100 to 120, and grid bias of $4\frac{1}{2}$ or 6 volts. Where very great volume

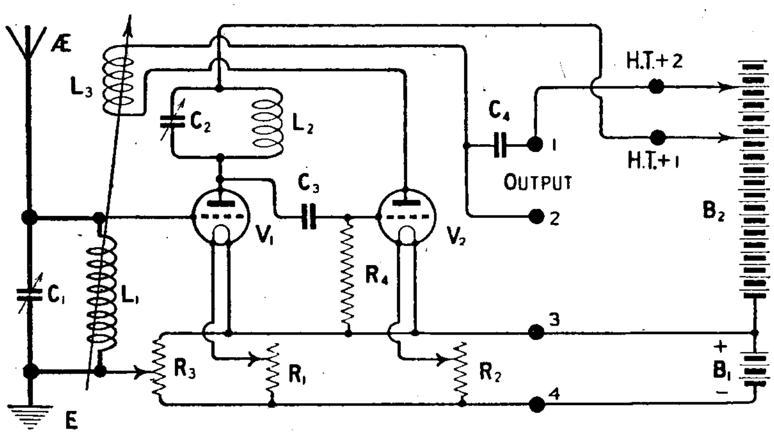


Fig. 3.—A circuit consisting of an H.F. valve, with tuned-anode coupling to the detector valve, in which the four terminals on the right correspond with the input terminals of Fig. 1.

is required the reader is advised to use valves capable of dealing with a greater input, and should refer to *Wireless Weekly*, Vol. 6, No. 15, in which issue Mr. Johnson-Randall has dealt with circuits capable of giving very loud signals without distortion.

Breakdown in Transformer Windings

A by no means uncommon fault in a circuit employing L.F. transformers is the occurrence of a complete break in a winding. This is often erroneously referred to as a "burn out." In actual use no ordinary L.F. transformer will ever have to carry sufficient current to cause the wire actually to fuse. Failures of this type are due to the fluctuating current in the primary winding giving rise to corresponding fluctuation in the magnetic field round the windings, which, reacting upon the turns themselves, may cause sufficient mechanical vibration to break the wire. Where this occurs in the primary winding the result may be complete absence of signals or only very faint ones. In the secondary the effect of a break will be either weaker signals, distortion, or, in some cases, very little difference may be noticed, depending entirely on where the break is located.

The Telephones and Dry Cell Test

A very simple test will definitely show whether a transformer winding is continuous. One tag of a pair of telephones should be connected to one side of a small dry battery, such as is used in a pocket flash lamp, and the free side of the battery to one terminal of a winding, for example OP, whilst IP should be tapped with the free telephone tag. If the winding is unbroken, loud "plonks" will be heard in the telephones. Before carrying out such a test it is advisable that some preliminary idea of the loudness of the plonks should be obtained by experimenting with a transformer which is known to be working effectively. The secondary winding should be similarly tested, and in this case the plonks should not be quite so loud as those obtained across the primary winding. Where the winding is broken in a certain position it is possible that slight clicks may be heard in the telephones, but if an effective transformer has already been tested no difficulty should be experienced in determining whether the transformer windings are continuous or not.

Insulation Tests

When crackling noises are heard and the high-tension battery does not last as long as it should do, faulty insulation between transformer windings may be responsible. The 'phones and dry cell test should be applied between the two windings where trouble of this type is suspected. A slight click does not indicate that the transformer is defective, but if a strong one is obtained between a terminal of the primary and one of the secondary winding, the insulation is most certainly defective, and the instrument should be changed. The loudness of the click may vary according to the position of the leak and the primary and secondary terminals between which the test is carried out.

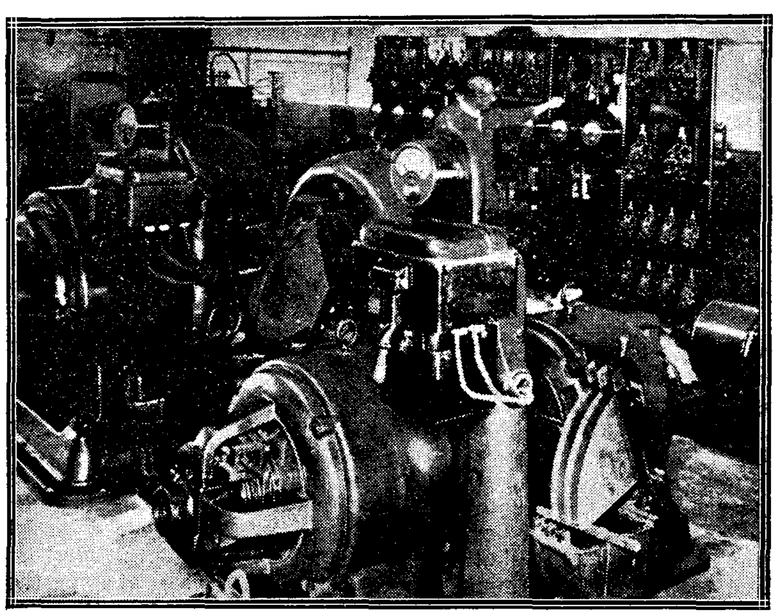
Tests between the various terminals will, however, soon confirm whether the insulation is poor.

Windings and Iron Core

Except in one or two special cases, such as previously mentioned, it is intended that the insulation between windings and frame should be of a very high order, and if this is poor it may account for an actual fault. Tests should, therefore, be made between each winding and the core of the transformer, which should be cleaned in order to make satisfactory contact. Except in the case of the few transformers in which definite internal connections are made with a view to increasing stability, a loud "plonk" indicates that the insulation is unsatisfactory, and the component should be changed.

Broken Connections

Breaks in the transformer windings are not necessarily located in the actual wire forming the two coils, but often are found where the stout wire which makes connections to the terminals externally is soldered to the finer wire with which the transformer is wound. If the insulating cloth or other material placed outside the winding can be readily removed a break of this kind can generally be seen and easily repaired with a hot soldering iron, but corrosive flux should on no account be used if the joint is to be permanent. It is difficult, if not impracticable, to repair internal disconnections, and transformers with faults of this type should be returned to the makers.



The motor generator room in the high-power station at Pennant Hills, Sydney, in Australia, which will form one of the links in the Imperial wireless chain.

Correspondence

AN ATTEMPT TO SOLVE A GRAVE PROBLEM

From Lieut.-Col. C. L'Estrange Malone, F.R.Ae.S., Chairman of the Radio Association.

Sir,—I shall be greatly obliged if you will correct an error which appears in your May 27, 1925, issue.

In referring to the anti-oscillation campaign which is now being carried on by the Radio Association, you state that the Association has asked for names and addresses of oscillators. This is not the case. The Association has merely requested persons who suffer from oscillation to inform them, so that we may be in a position to help them to discover the offender. Naturally the Association would not countenance anything which savours of encouraging espionage.—Yours faithfully,

Cecil L'Estrange Malone.

Sentinel House, W.1.

[While we appreciate the spirit prompting the last sentence of the above letter, we cannot see that the letter itself helps the position of the Radio Association. If it merely requires the names of people who suffer from oscillation, the Radio Association should make use of Post Office or Kelly's Directories; the number is in the neighbourhood of two million.

The statement that the Radio Association asked for names of suspected oscillators was widely notified to the public by the general Press, but we confirmed the facts from a responsible officer of the Radio Association. Moreover, we saw no contradictions by the Radio Association of the published statement. The following note appeared in the *Daily Mail* of May 13, 1925:—

"RADIO HOWLERS.

"To be Hunted Down and Prosecuted.

"At a meeting of the Radio Association at the House of Commons yesterday it was stated that owing to the increase of oscillation the Post Office had under view drastic steps with regard to the use of reaction in wireless sets.

"Motor cars, fitted up with direction-finding sets, would shortly travel about London in order to locate houses where sets are being badly handled and causing oscillation and interference with the enjoyment of other listeners, and as soon as definite evidence is obtained the Association intended bringing test prosecutions against the offenders.

"The Secretary of the Association, Sentinel House, Southampton Row, W.C.1, would be glad to receive confidential information about oscillation offenders."

We might have emphasised in our original leader our view that the Executive of the Radio Association should avoid schemes of the wild cat variety, which, while gaining the Association momentary publicity, merely bring it into ridicule.—Editor.]

THE GOLDERS GREEN AND HENDON RADIO SOCIETY

Sir,—The following report of a field day held by the above Society may be of interest to your readers. Members of the Society spent a very instructive and most enjoyable field day on Sunday, July 19, at Mill Hill. Four small portable transmitting sets with receivers combined, wired up to different circuits, were situated at each corner of a field and controlled by a main station. The transmitting circuits employed were: (1) Colpitts; (2) Hartley with choke control; (3) ordinary feed-back; (4) master oscillator, and the sets were constructed by the following members respectively: Messrs. L. A. Richardson, Frost, Donaldson and C. L. Thompson.

Intercommunication between the stations was established, and the

A field day was held recently by the Golders Green and Hendon Radio Society, for which portable transmitters and receivers were taken out. Members of the society are seen here at the main control station.

sets worked admirably on a short aerial 25 ft. long on a wavelength of 175 metres, both on speech and C.W.

The valves used on the transmitters were of the L.S.5 type, kindly lent by the Marconi Osram Valve Co., Ltd., while the H.T. supply consisted of accumulators loaned by C. A. Vandervell & Co., Ltd.

Prizes of wireless apparatus were kindly presented by various manufacturers, including L. McMichael, Ltd.; Peranne & Co., Ltd.; The Dubilier Condenser Co., Ltd.; H. Clarke & Co., Ltd., and Portable Utilities Co., Ltd.

The prizes will be presented to the various winners at the next general meeting of the Society on September 23, while the remaining prizes not yet awarded will be competed for at a future date.—Yours faithfully,

CYRIL L. THOMPSON,
Assistant Secretary.

Golders Green, N.W.11.

Members of the Hounslow and District Wireless Society on the occasion of their recent " River Day " outing.

THE ANGLO-AMERICAN SIX

SIR,—I think it would be of interest to you and your readers to know of results I have had from the " Anglo-American Six " described by Percy W. Harris, M.I.R.E., in the January and February issues of *The Wireless Constructor*.

I followed out instructions practically to the letter, and also added an extra stage of resistance-coupled L.F. amplification.

My aerial is 85ft. of 7/22 S.W.G. 35ft. high, valves are three Marconi D.E.R's., one B.T.H. B3, one Ediswan A.R.D.E., one B.T.H. B4 and one L.S.5. The H.T. supply is obtained from 220-volt D.C. mains, with a tapped wire resistance and smoothing unit, and the loud-speaker is an Amplion A.R.27.

Daylight reception at full loud-speaker strength has been obtained from the following stations during the past six weeks: 5IT, 2ZY, 2LO, 6BM, 5NO, 2BD, 5SC, 2BE, 2LS, 6LV, 6KH, 5NG, 6FL, 6ST, 5XX, FL, FPTT, SFR, and Brussels.

Night-time reception at full loud-speaker strength includes the following: 2DE, 5WA, 2EH, 5PY, 5SX, Petit Parisien, Radio Toulouse, Radio Lyon, Cassel, Dresden, Nuremburg, Breslau, Vox Haus, Munster, Bremen, Hamburg, Munich, Frankfort, Leipzig, Konigsberg, Stuttgart, LP, Radio Wien, Rome IRO, Oslo, EAJ6, Radio Catalana, SASC.

I have logged 78 amateurs, British and French, also CNRA and WGY.

I received my " baptism " in wireless in March, 1924, when I constructed the ST100 from the Radio Press Envelope No. 1, by John Scott-Taggart, F.Inst.P., A.M.I.E.E., since then the " Three-Valve Dual " (*Modern Wireless*, April, 1924, by J. Scott-Taggart, F.Inst.P., A.M.I.E.E.), All-Concert (*Modern Wireless*, September, 1923, by Percy W. Harris), Transatlantic Five (June, 1924, *Modern Wireless*, by Percy W. Harris) have all been tried. I find that the " Anglo-American Six " is the best, but the Transatlantic Five is an exceedingly good second to it. Last winter I successfully received 11 American broadcasting stations.

Wishing Radio Press publications every success.—Yours faithfully,

J. K. JOHNSON.

Heywood, Lancs.

THE HOUNSLOW AND DISTRICT WIRELESS SOCIETY

SIR,—The enclosed photograph was taken on the occasion of the " River Day " held by the above Society on Sunday, July 19. I sincerely believe that it will be of great interest to many of your readers, as this is the first River Day ever held by a Radio Society.—Yours faithfully,

JOHN C. READ, Hon. Sec.

Hounslow.

A " CHOKE-COUPLED THREE-VALVE RECEIVER "

SIR,—I have constructed the " Choke-coupled Three-valve Receiver " described by John W. Barber in *Wireless Weekly* for May 27 (Vol. 6, No. 8), and have found it excellent as a means of musical reproduction. I have constructed many Radio Press sets and have not yet found one where its possibilities have been overrated. I am very keen on the Puriflex, and have constructed one, using a choke-coupling for the last stage, and this has improved the volume without any detriment to the musical reproduction.—Yours faithfully,

ARTHUR VICKERS.

Blackheath, S.E.3.

AN UNNECESSARY SOCIETY.

SIR,—Your Editorial in Vol. 6, No. 16, has been brought to my notice, and I am very sorry that it has been necessary to take up so much of your valuable space in order to advertise the proposed B.I.R.E., and to give your personal views of myself in such derogatory terms.

Your suggestions regarding how the Wireless Section of the I.E.E. should cater for the radio engineer (a term which you do not define) are very interesting, and I hope the I.E.E. will soon modify their existing standards.

You state that physicists *and others* are taking up wireless, but that many would certainly not be able to pass the A.M.I.E.E. Examination. How perfectly true this is should be fully realised by a few who are already enjoying an Associate Membership.

Your final paragraph I prefer not to comment upon, as I am reminded that incivility may not be a vice, but is often the result of other vices such as vanity, and contempt for others.

To sum up your Editorial, one may assume that " Success is sold in the open market if one can bid high enough, and woe betide the individual without funds and a University education who dares to look at the palatial building of the Institute of Electrical Engineers with the idea of becoming associated."

Fortunately, this is not my view, and I hope it never will be, and that the day is not far distant when the I.E.E. will hold out a helping hand to those who wish to take up its interests seriously.—Yours faithfully,

Y. W. Evans.

Manchester.

[We have pleasure in publishing this letter, though we feel that it was written in both heat and haste immediately after reading our Editorial. We are taking identically the same stand that we took on the occasion when Mr. Evans launched his British Wireless Relay League —namely, that a strongly supported existing society should be improved rather than that a rival organisation should be formed.

We have no knowledge whatever about the technical abilities of Mr. Evans except his own admission that he fits nowhere, which in itself means nothing, because we agree there are many very able wireless men who could not readily become members of the I.E.E. He has no reason for supposing our remarks are in any way derogatory to himself, although, without offence to him, we cannot help feeling that the proposals might have carried more weight if left in the hands of Mr. Nelson, M.I.E.E., who is essentially a reasonable advocate of some good proposals. A professional society cannot however be launched in the same way as an amateur one, and the precipitate way in which matters have been dealt with has, to say the least, been unfortunate.

Mr. Evans is, in our opinion, an enthusiastic worker who has done a great deal for the amateur, and in our former criticisms of his activities we have made it quite clear that while many of his ideas are thoroughly sound his final objective is wrong. He is an extremist, and as such is invaluable, because he helps to put things right even though his proposed extreme measures are ill-advised.

We are, ourselves, concerned simply with the principles involved, and Mr. Evans flatters himself if he imagines anything else. Many of our views as expressed in our leader are identical with his own, but we oppose and intend to continue to oppose a separate society provided the Wireless Section of the I.E.E. is fully representative of the profession. The profession at present is very small, as regards really qualified radio engineers. If, in the future, the number of radio engineers increases greatly, the whole subject may come under review again, but at present we have no doubts as to which is the right attitude to take.—Editor.]

Damping Losses in Valve-Rectifying Circuits

(Concluded from page 527)

minus, etc., the more sensitive arrangement of Fig. 2 in *Wireless Weekly*, Vol. 6, No. 4, was used, with similar direct calibration. The table gives the results obtained. It will be observed that with the ordinary value of grid-leak, and with adequate by-pass condensers in the anode circuit across any large H.F. impedances present therein, a detector valve in normal operation offers an average damping effect in the grid circuit equivalent to a series H.F. resistance of some 50-60 ohms in the same circuit, which does not vary much even with high-ratio valves such as the D.E. 5B (M=20); or with small power-valves of low impedance. Either a good radio choke or a high anode resistance in the plate circuit raises this damping effect to a figure corresponding to over 130 ohms series resistance; this is almost completely relieved by a small by-pass condenser, which is already present (in the form of distributed capacity in the double flex leads) in ordinary telephones. A negative grid bias reduces the damping effect to an insignificant figure, whilst the regenerative effect of a *small* inductive load in the plate circuit is apparent.

Bearing on Selectivity

The significance of this extremely large and yet inevitable damping load of the detector valve in connection with the design of grid tuning circuits, and particularly in relation to selectivity, scarcely needs emphasising here. The order of the effect is well substantiated by an experiment in which H.F. resistor units were introduced (*a*) into the aerial circuit, (*b*) into the secondary grid circuit of a detector valve operating as a Moullin voltmeter, without reaction, in broadcast reception on a large, high, carefully-erected aerial with excellent earth connection. The primary consisted of 31 turns of No. 20 d.c.c. on a 3 in. dry cardboard former; the secondary was one of the author's ultra-low-loss coils of spaced No. 18 on a large skeleton former.

In order to halve the signal voltage registered (with optimum tuning and coupling), no less than 122 ohms had to be introduced into the *primary* circuit, corresponding roughly to a total effective aerial-earth resistance of this order; whilst 60 ohms introduced into the *secondary*, with unloaded primary, halved the signal strength. The last figure agrees in a most convincing and satisfactory manner with the order of the damping effects recorded previously.

Reducing the Damping

An obvious suggestion to reduce to some extent the evil effects of this damping is to follow the analogous case of the crystal detector, the output from which can often be improved by putting it across only *part* of the tuning inductance. Simple trial showed, however, that this did not hold in practice with the much lower degree of damping offered by the detector valve; the available signal voltage, as determined by a carefully-calibrated Moullin voltmeter arrangement tuned to the local broadcast wave, fell off almost proportionally to the turns included in the secondary grid circuit, other things being kept as constant as possible; whilst tapping the *tuning condenser* across only part of the grid inductance, unlike the corresponding case of a crystal receiver, neither decreased nor increased the signal voltage appreciably for some 15 turns in a 55-turns inductance.

A combination of valve with negatively-biased grid and a crystal rectifier in the anode circuit would appear to be indicated for a really selective rectifying circuit, though this immediately introduces complications through the (largely uncontrollable) reaction or negative damping effect produced by the inductive anode load. Of course, in normal valve rectification the damping is largely eliminated by the judicious use of reaction in some form, but this effect is not so beneficial as a pure sharpening of the resonance peak by lowering the inherent H.F. resistance in the circuit.

Apparatus we have tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

"Stradio" High-Frequency Transformers

Messrs. Stirlings, Ltd., have submitted a series of barrel-type plug-in H.F. transformers, in matched pairs, and also some provided with a variable core, for our inspection and test. These are of familiar type and dimensions, wound in alternate slots in an ebonite barrel on the usual four-pin base; the makers' instructions should be carefully followed as to the direction of connections here. The pair of nominally 300 to 600-metre wavelength range gave this with adequate overlap with a .0003 μF tuning condenser across the primary. They proved to be very closely matched and operated satisfactorily in a two-stage H.F. amplifier with simultaneous tuning by a double condenser, with potentiometer control, giving about the expected amount of amplification under these circumstances, but not a very noticeable degree of selectivity. The (nominal) 1,100-3,000-metre pair showed a range of approximately 1,150-2,500 metres with a .0003 μF (actual) tuning condenser, and gave similar satisfactory service on trial. The instruments with variable core were provided with a split bush which slipped into the open end of the barrel, and through which worked a screwed brass rod fitted with an insulating handle. As this conducting rod was lowered into the coil, eddy-current effects were introduced, affecting the tuning by progressively lowering the inductance value and simultaneously bringing into play an increasing damping effect. On trial, it was found possible to match the two transformers of the same nominal range so closely that a heterodyne note could be reproduced without change in pitch when the transformers were changed, and on trial in a two-stage simultaneously tuned H.F. amplification circuit excellent matching was obtained, the effect on the short-wave instruments (300-600-metre) being more marked than with the longer-wave pair. The latter showed a range of 1,200-2,500 metres under these circumstances (.0003 μF tuning condenser). The damping effect when two stages of H.F. amplification are in use assists in their control; with one stage a fine control over reaction is obtained when the aerial coupling is light by manipulating this variable core. For use in a simultaneously-tuned many-stage H.F. amplifier this device offers decided advantages.

The instruments are sturdily made, though some tendency was noticed towards working loose of the pins, with resulting bad contacts; the insulation resistance between windings was adequate.

"Polar" Micrometer Condenser

Messrs. Radio Communication Co., Ltd., have sent for our trial and comment a sample of their "N" type micrometer condenser. This is adapted for single-hole panel mounting by the customary screwed bush device, and has a long insulated handle to avoid hand-capacity effects. The condenser has two small semi-cylindrical plates, with narrow clearance, and both longitudinal adjustment (controlling the overlap of the plates) and rotational adjustment are possible, whilst a locking-ring is provided by means of which any adjustment can be retained, as, for example, that of a permanently neutrodyned H.F. amplifier. The instrument occupies very little space on the panel, and a depth of about $2\frac{3}{4}$ in. when fully extended. On measurement, the minimum capacity came out at a little under $1\frac{1}{2}$ $\mu\mu$F, the maximum being 12.5 $\mu\mu$F, a very convenient range both for fine adjustments of tuning and for neutrodyne work. On practical trial, in each of these services the device gave excellent results. The insulation - resistance proved excellent, and the finish and workmanship offered a favourable impression. The instrument can be recommended for the purposes indicated.

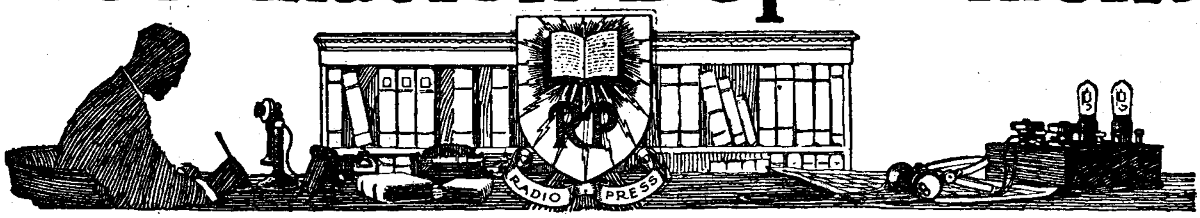
"Guiterphone" Anti-Capacity Valve Holder

A four-pin valve holder of unusually low capacity between sockets has been sent for our test by Messrs. S. Guiterman & Co., Ltd. In this the sockets (two of which are made shorter than the others as a measure of precaution against accidental short circuits) are mounted on a comparatively thin disc of ebonite, and small terminal screws are arranged round the outer rim of this disc for alternative connections. The holder can be mounted on the panel or underneath with the sockets projecting through. A central hole and two alternative holes near the periphery are provided for fixing screws, but the latter should be avoided, of course, for high-frequency work. The connecting wires can be passed into the ends of the sockets and held by the side screws acting as set-screws, can be soldered in position, or can be secured under the washers on the side screws outside the disc, giving in the last case an arrangement of exceedingly low casual capacity. On measurement, the capacity between grid and filament sockets, and between plate and grid sockets, after eliminating the capacity effects of the leads, came out at below one-half micro-microfarad in each case; the insulation resistance was excellent.

"B.E.N." Midget Spanner

A very neat little adjustable spanner suitable for use in radio work, the "B.E.N." Midget, has been sent for our comment by Messrs. The B.E.N. Patents, Ltd. This measures only $2\frac{3}{4}$in. overall; the jaws are $\frac{3}{8}$in. deep and open to a maximum of 9/16in. Since the jaws are just under $\frac{1}{8}$in. thick, it is evident that this tiny spanner will be of use in many positions where a larger tool would be useless, as, for example, in tightening lock-nuts on control spindles or on an inaccessible No. 4 B.A. back-stud. The spanner is made of blued steel, and appeared to be of good quality and finish. It should be a useful addition to the tool chest or for the waistcoat pocket of the experimenter.

Information Department



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J. O. H. (NAAS) is at present using a 4-valve receiver—constructed from Radio Press Simplex Radio Chart No. 3. He wishes to use a power valve in the last stage, and asks our advice as to how this may be done whilst still retaining the simple switching arrangement at present incorporated.

Owing to the simple switching arrangement incorporated in the Four-Valve Receiver of Simplex Chart No. 3, it is necessary that a separate extra high-tension battery be used when a power valve is placed in the last socket of this set and it is desired to apply a special value of H.T. to this valve. The value of this extra high-tension battery is such that, added to the value previously employed, the resultant voltage on the last valve is that advised by the makers, usually from 100 to 120 volts. If at present 60 volts are used on all four valves and 120 are required for the power valve, it will be necessary that the value of the extra high-tension battery be 60 volts. A slight alteration in the wiring must be carried out, and the procedure to follow is to remove the lead between the plate of the last valve, namely, 8, and stud 48; 8 should be connected to a further terminal which becomes the extra high-tension plus terminal, whilst 48 is joined to a further terminal which becomes H.T. minus for the same battery. The extra high-tension battery is connected between these two terminals. When a high value of H.T. is used it is advisable to provide for grid bias so that the valve may be worked on the best part of its curve for pure reproduction and minimum current taken from the high-tension battery. To insert a grid-biasing battery the lead from the point 43 to 38, that is, L.T. negative, should be removed; 43 should be brought out to a further terminal which becomes grid-bias negative. Grid-bias positive will be coincident with L.T. negative; 56 should still be left joined to 38. An appropriate grid-bias battery, the voltage of which must be determined by the type of power valve and the value of H.T. applied to it, should be connected to the two G.B. terminals. This arrangement allows of the extra high tension being applied to the last valve only, whilst the simplicity of switching is retained.

T.W. (PENZANCE) has constructed a Transatlantic 5-valve receiver, but up to now has been unable to get the H.F. side to work properly. He states that using matched transformers, which have been tested in another set of the same type and found to work correctly, the set has a very pronounced tendency towards self-oscillation, and the least movement of the potentiometer causes howling. A station on a wavelength of the order of 400 metres can be received only when the dual condenser vanes are full out and no station below this can be obtained. If, however, the filament of the second H.F. valve is turned out, stations lower in wavelength come through fairly well and the dual condenser seems to tune. Turning on the second valve, however, reduces signal strength to about one half, and in some cases, completely eliminates the signals. The general symptoms are that the set seems to work fairly well with either H.F. valve alone, but they will not work well together. The wiring has been carefully checked and agrees in every detail with that in the blue prints and photographs shown in "Modern Wireless." Our correspondent asks us whether we can suggest a cause of the trouble.

It has been the experience of this Department that troubles of this type are usually due to a wrongly designed dual condenser in which the two sets of plates are placed too near each other. No mention of the type of dual condenser used was made in our correspondent's letter, and if this is not of the type used in the original design, we would suggest that the first step to be taken is to change this for one such as those used in various 2H.F. designs in any of our publications, when we think the trouble will probably disappear.

N. O. (IPSWICH) is desirous of building a Supersonic-heterodyne Receiver and asks us what is the essential difference between a Tropadyne arrangement of which he has heard, and the more usual circuit used in this country which has a separate oscillator.

The essential difference between the Tropadyne arrangement and the ordinary separate oscillator type of Supersonic-heterodyne receiver, such as that described in the May issue of *Modern Wireless*, is that in the former, one valve is made to act both as the "oscillation generator" and as the "first detector," whilst in the latter separate valves are used for these two functions. Which is to be preferred is largely to be decided by individual requirements, but if our correspondent has had no previous experience with sets of this type we would advise him first to build a set using a separate oscillator before proceeding with the other arrangement mentioned.

J. H. A. (ST. LEONARDS-ON-SEA) has constructed a single-valve Flewelling Receiver, from which he obtains excellent results on a large number of British and Continental stations. He asks our advice on adding stages of low-frequency amplification in order to work a loud-speaker.

The Flewelling circuit, which our correspondent is using, is essentially a one-valve super circuit, and we do not advise the addition of stages of low-frequency amplification to such a set. In certain cases the addition may be made, but generally speaking, results are not satisfactory unless much experimental work is done, and we therefore do not advise this proceeding.

Printed for the Proprietors, RADIO PRESS, LTD., of Bush House, Strand, W.C.2. by THE AVENUE PRESS (L. Upcott Gill & Son, Ltd.), 55-57, Drury Lane W.C.2. and Published by the Proprietors, RADIO PRESS, LTD., at Bush House Strand, W.C.2, on Wednesday of each week. Address for Subscriptions and Editorial Communications :—Bush House Strand, London, W.C. Advertisement Managers :—BARCLAYS ADVERTISING, LTD., Bush House Strand, London, W.C.2. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates :—32/6 per annum, 16/3 for six months, post free. Sole Agents for Australasia :—GORDON & GOTCH (Australasia), LTD. For Canada :—IMPERIAL NEWS, LTD For South Africa :—CENTRAL NEWS AGENCY, LTD For Japan :—SALE & FRAZAR, LTD